Westway Expansion Project

Draft Environmental Impact Statement – Volume 3

CITY OF HOQUIAM

DEPARTMENT OF ECOLOGY
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Local Policies Governing Land and Shoreline Use

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Local Policies Governing Land and Shoreline Use

Aberdeen

The City of Aberdeen's 2001 *Comprehensive Land Use Plan* is available at:
http://aberdeenwa.gov/pdf/2001_comp_plan.pdf.

Land Use Element

Description

The City of Aberdeen, over the last two decades, has been subject to unplanned economic restructuring created by an erosion of the underlying economic base of timber processing and commercial fishing. Land use issues, as a result, became intertwined with economic issues. The economy needed to diversify, with an emphasis placed during this transition period on the retention of existing businesses, relocate existing businesses into the area, and encouraging the start-up of new business. The economy will continue to transition from resource-based activities to those of a regional service and retail provider. Aberdeen's needs for various land uses are substantial, and result in significant changes that reflect this transition period.

Groupings of similar or compatible industrial uses can improve the flow of shipping and employment traffic, as well as allowing firms to share facilities and services. Groupings also help reduce land use conflicts with less-intensive uses.

Heavy industries, such as wood processing, machinery manufacturing, mining operations, and port facilities, may have multiple impacts that are more complicated to mitigate, such as heavy truck traffic, noise, vibration, light, glare, and odors. These impacts can best be controlled when heavy industries are separated from residential and commercial uses.

The Industrial area should provide the opportunity for intensive heavy industrial uses or large-scale manufacturing uses in appropriate locations, and reserve the limited amount of industrial lands within Aberdeen for industrial uses.

Industrial Development Policies

L-300 Industrial development should be grouped with similar or compatible use to in areas that limit land use conflicts, improve traffic flow and safety, and allow businesses to share public facilities and services.

L-301 Uses that generate significant non-industrial auto and pedestrian traffic during industrial working hours should be discouraged from locating in industrial areas, if such traffic would be incompatible with the industrial uses.

L-500 Industrial development should be designed to be compatible with adjoining uses. Off-site impacts, such as noise, odor, light and glare, and vibration should be mitigated through the pollution control measures, setbacks, landscaping, and other best management practices.

Unsightly views of parking areas, loading areas, and storage areas should be screened from adjacent office, retail and residential uses.

L-501 Areas where the allowed uses could have a major adverse effect which cannot be lessened are unsuitable for the Industrial area designation.

L-502 Industrial development should have direct access from principal arterials or state routes. Access points should be combined and limited in number to allow for adequate levels of service on arterials. Access through residential areas should be discouraged.

Economic Development Element

Description

As mentioned previously, the City of Aberdeen, over the last two decades, has been subject to unplanned economic restructuring and, as a result, land uses became intertwined with economic issues. The economy will continue to transition from resource-based activities to those of a regional service and retail provider. Aberdeen's needs for various land uses are substantial, and result in significant changes that reflect this transition period.

The City's economic diversification strategy is based on the retention of existing businesses while working to provide a reliable level of public services, which encourages private sector development.

Industrial Development Policies

E-090 New industrial firms should be encouraged to locate within the City of Aberdeen and in the Grays Harbor area.

E-091 The expansion of existing industrial uses is encouraged in appropriate areas.

E-092 A full range of industrial uses should be allowed and encouraged to increase economic diversity.

E-093 The prime industrial land within Aberdeen and the region should be designated and reserved for industrial uses in a manner consistent with the directives provided by the 1990 Overall Economic Development Program and the 1989 Industrial Lands Study for the Grays Harbor region.

Housing and Community Development Element

Description

Employment in Aberdeen is more dependent on forestry, fisheries, personal services, and manufacturing than the state as a whole. While employment in agriculture, forestry, fisheries, social services, personal services, and producer services increased, jobs in manufacturing, construction, and distributive services declined.

Unemployment in Aberdeen and Grays Harbor County consistently exceeds the state average and has remained high throughout the 1990's. Taxable retail sales also indicate poor economic performance. Aberdeen has experienced a loss in taxable retail sales for the past two years.

According to Aberdeen residents, the major barriers to economic development in their community are:

1. Community attitudes about change and growth.
2. City government.
3. The lack of employment and family wage jobs.
4. Low educational levels among workers and inadequate educational and training programs.
5. The need to recruit more businesses to the area.
6. Environmental issues.

Community Development Policies

H-409 The City should support programs that are designed to attract new businesses and industries to the City by increasing or emphasizing:

a. Local worker skill levels;
b. Suitably zoned lands for a wide range of business types;
c. State of the art telecommunications services;
d. Access to state and federal development assistance resources; and
e. Availability of adequate transportation, sewer, water, and electrical infrastructure.

Transportation Element

Description

A majority of the transportation corridors that provide access from industrial properties to the State transportation system are located within areas that were historically designed to provide service for a mix of commercial and residential properties. It is essential that the transportation system continue to be improved to decrease the transport time from these industrial sites to their markets. The City of Aberdeen, the Washington State Department of Transportation, Grays Harbor County, and the adjacent municipalities must continue to improve the industrial transportation system as an essential component of our economic development policies.

The deep-water port of Grays Harbor affords the City of Aberdeen a substantial degree of economic opportunity associated with international trade.

Rail service in the City of Aberdeen is an essential component of the regional transportation system, as it provides reliable access for the Port of Grays Harbor and local manufacturing facilities to regional, national, and international markets.

Industrial Transportation System Policies

T-081 Development approval processes, such as rezones, subdivisions, and building permit processes, should be used to obtain rights-of-way and the construction of transportation improvements required by the policies of this Plan.

T-083 The truck route system should be designed to ensure that ample truck access is provided to industrial areas while minimizing transportation impacts on residential and commercial areas.

T-084 Private industrial haul roads are encouraged in appropriate areas to provide an increased level of access to industrial areas and minimize impacts on other uses.

T-085 Truck routes and industrial haul roads should be within industrial areas whenever possible, and designed and constructed to minimize impacts on nearby uses and natural resources.

Port and Moorage Facility Policies

T-090 The City of Aberdeen and the Port of Grays Harbor should coordinate land use, economic development, and public facility policies, decisions, and actions which impact both jurisdictions.

T-091 The City should support the continued maintenance and improvement of the Grays Harbor Navigation Channel.

T-092 The City should support the ongoing maintenance of the Grays Harbor Navigation Channel.

T-093 The development and maintenance of deep-water marine shipping terminals is encouraged in the industrial and waterfront development zoning districts.

T-095 The City and the Port of Grays Harbor should consider the preparation of a coordinated interagency multi-year service and location analysis of port capital facilities. The analysis should include rail and truck freight movement for use in assessing transportation system adequacy and land use compatibility and availability for current and future port needs.

T-096 The City and the Port of Grays Harbor should coordinate development and transportation programs for consistency with both the City's Comprehensive Plan and the Port's Industrial Properties Master Plan.

Railroad Transportation System Policies

T-100 Automobile and pedestrian railroad crossings should be limited to maintain rail safety and efficiency. Rail crossings which are not necessary for automobile or pedestrian circulation should be closed. Rail crossings should be signalized and improved to facilitate pedestrian and vehicle safety.

T-101 The railroad should be encouraged to maintain, upgrade and extend rail service within Aberdeen and Grays Harbor County. Alternatives to any proposed rail abandonment for spurs which serve existing industries or planned industrial areas should be thoroughly explored.

T-102 Regional freight terminals should provide screening and buffering to reduce their visual impact on surrounding land uses. Off-site impacts, such as increased traffic congestion or air and noise pollution, should be mitigated.

Natural Resource Element

Description

This Chapter establishes policies to guide planning and the conservation of valuable forest lands, farmlands, mineral resources and waterways, and to encourage and promote their productive management by resource industries. The City recognizes that healthy resource industries are essential to the conservation of resource lands and waters.

The Grays Harbor Estuary, the Chehalis River, the Wishkah River, the Wynoochee River, Alder Creek, Devonshire Slough, Division Creek, Fry Creek, Mill Creek, Miller Slough, Shannon Slough, Stewart Creek, and Union Slough combine to provide the City of Aberdeen with a unique habitat for resource industries. Aquaculture resource waters are water and the underlying aquatic lands primarily devoted to shellfish harvesting and commercial fishing and which have a long-term commercial significance for harvesting and fish production.

The waterfront development policies outline and describe directions for governmental action and decision making to implement the waterfront development goals. The policies are also applied to specific projects through zoning conditional use reviews, special use permit reviews, rezone ordinances, State Environmental Policy Act reviews, discretionary administrative reviews, long and short subdivision reviews, and reviews of shoreline permit applications.

Aqua-Culture Resource Water Policies

N-601 The City should use the commercial and recreational shellfish growing classification of the Washington State Department of Health, the kelp and eelgrass identification system of the Washington State Department of Natural Resources, and the important habitat and species classification and designation of the Washington State Department of Fish and Wildlife, in the process for determining and mapping aqua-culture resource lands.

N-602 Development adjacent to all waters of the state should be consistent with the policies of the City's Shoreline Master Program and the Grays Harbor Estuary Management Plan.

N-603 The City should participate in Chehalis River basin-wide planning efforts to coordinate private and public sector development activities to facilitate increased awareness of the resource and to actively address issues related to water quality, habitat value and function, and flooding.

N-604 The City should work with Washington State, Grays Harbor County, the Quinault Indian Nation, the City of Hoquiam, the City of Cosmopolis, the Port of Grays Harbor, special purpose districts, and the private sector to coordinate those land use actions which would impact the ability of the Chehalis River watershed and the Grays Harbor estuary to function as a resource water.

Downtown and Waterfront Development Element

Description

One of Aberdeen's most important economic and natural resources is the City's waterfront. The waterfront is used for fishing, recreation, commercial uses, and industrial uses. Grays Harbor is the

only deep water port on the Washington Coast. Aberdeen has many different types of waterfront areas, including the habitat areas of the Chehalis River, the Wishkah River, and Grays Harbor. Lake Aberdeen, a freshwater lake, is also with the City's corporate limits. Aberdeen also has several creeks and sloughs, including Alder Creek, Devonshire Slough, Division Creek, Fry Creek, Shannon Slough, Mill Creek, Miller Slough, Stewart Creek, Union Slough, and Wilson Creek.

Waterfront Development Policies

W-010 Waterfront development within the City should be consistent with the findings, conclusions and recommendations contained in the City of Aberdeen's Shoreline Master Program, the Grays Harbor Estuary Management Plan, the 1991 East Aberdeen Waterfront Walkway Plan, the Port of Grays Harbor's 1996 Aberdeen Landing Master Development Plan, the Port of Grays Harbor's 1996 Industrial Properties Master Plan, the City's Report 13: The Local Economy study document, the Washington State Department of Transportation's 1997 Washington Coastal Corridor Master Plan, the 1987 East Aberdeen Waterfront Redevelopment Plan and Market Study, and the 1981 Revitalization Potentials on the Grays Harbor Waterfront report.

W-011 New developments fronting upon the water should provide appropriate levels of public access. The access should be provided as condition of any discretionary land use approvals granted for the property where an access is identified, or where appropriate through a combination of private and public funding.

W-012 Public access is necessary to continue the public use of the public shorelines of the City of Aberdeen. The protection and development of this access is found to be in the public interest of the City of Aberdeen.

W-013 Waterfront access should be provided as condition of any discretionary land use approval granted for a property where a proposed development would:

a. Generate increased demand for waterfront access; or

b. Reduce public access to the waterfront.

Open Space and Critical Areas Element

Description

The City of Aberdeen's wide variety of natural features include lands that can accommodate extensive development, as well as lands where development must be carefully planned or sized to maintain environmental quality. This section describes the natural features requiring special consideration in land use decisions to reduce hazards and prevent adverse environmental impacts.

Critical Area Policies

O-200 Land use actions should consider natural constraints, such as wetland areas, aquifer recharge areas, frequently-flooded areas, geologically hazardous areas, and fish and wildlife habitat conservation areas as part of any decision-making process.

O-201 The City should prepare detailed mapping, to scale, which identifies known critical areas. The mapping should be for informational or illustrative purposes only, and should require additional field verification prior to any regulatory action.

O-202 The need to protect sensitive features should be incorporated into site planning when environmentally sensitive areas are discovered through the technical review process of a development proposal. Development plans should ensure that structures locate on unconstrained portions of the site whenever feasible, and that clustering, if approved, is compatible with surrounding uses. These considerations may result in a reduction of density from that otherwise allowed by the underlying zoning district.

Wetland Areas Policies

O-210 Wetlands important for flood control, drainage, water quality, aquifer recharge, visual or cultural values or habitat functions should be preserved or enhanced.

O-211 The City should utilize both the United States Federal Manual for Identifying and Delineating Jurisdictional Wetlands and the United States National Wetlands Inventory Map as baseline information sources for regulatory actions involving wetland areas.

Aquifer Recharge Areas Policies

O-220 Groundwater recharge areas should be identified and protected to ensure that groundwater resources are protected from potential pollution.

O-221 The City should utilize both the United States Safe Drinking Water Act and the Washington State Groundwater Management Program as baseline information sources for regulatory actions involving aquifer recharge areas.

Frequently Flooded Areas Policies

O-230 The natural flood storage function of floodplains should be preserved. Non-structural methods should be emphasized in planning for flood prevention and damage reduction. New development or land modification in 100-year floodplains should be designed to maintain natural flood storage functions and minimize hazards.

O-231 The City should utilize both the United States Federal Emergency Management Agency policies and the United States National Flood Insurance Rate Map as baseline information sources for regulatory actions involving floodplain areas.

Geologically Hazardous Areas Policies

O-240 Geologically hazardous areas should be classified as those susceptible to one or more of the following types of hazards:

a. erosion hazard;

b. landslide hazard;

c. seismic hazard;

d. other geologic events, such as coal mine hazards.

O-241 The City should utilize both the United States Soil Conservation Service policies and the United States Department of Agriculture's Soil Survey of Grays Harbor Area, Pacific County, and Wahkaikum County, Washington as baseline information for regulatory actions involving geologically hazardous areas.

O-242 Land uses on steep slopes should be designed to prevent property damage and environmental degradation, provide open space, and enhance wildlife habitat values.

O-243 Development intensity, site coverage and vegetation removal should decrease as slope increases to mitigate for problems of drainage, erosion, siltation and landslides.

O-244 Severe landslide hazard areas should be free of development and roads unless proven to be engineered to reduce adverse impacts.

O-245 Native ground cover should be retained or replaced after construction in areas subject to erosion hazards, with special construction practices used and allowable site coverage reduced to prevent erosion and sedimentation. Limitations on the time site work may be undertaken may also be appropriate.

O-246 Special building design and construction should be used in areas with severe seismic hazards to minimize the risk of structural damage, fire and injury to occupants, and to prevent post-seismic collapse.

O-247 Builders should conduct special studies, prior to development in severe seismic hazard areas, to evaluate seismic risks and should use appropriate mitigation measures to reduce identified risks.

Fish and Wildlife Habitat Conservation Areas Policies

O-250 The City should utilize both the Washington State 1994 Water Quality Assessment report and the Washington State Forest Practice Base Maps as baseline information for regulatory actions governing fish and wildlife habitat areas.

O-251 Private development and public actions should maintain adequate flows in rivers, streams, and sloughs to protect fisheries and recreation resources.

O-252 Development within designated shoreline jurisdictions should:

a. Preserve the value and function of the water and shoreline;

b. Avoid natural hazards;

c. Promote visual and physical access to the water; and

d. Preserve navigation rights.

O-253 Water quality, natural drainage, fish and wildlife habitat, and aesthetic functions of rivers, streams, sloughs, and the harbor should be protected.

O-254 New development adjacent to rivers, streams, sloughs, and the harbor should preserve an undisturbed corridor wide enough to maintain natural bankline and wetland functions.

O-255 Natural stream and slough channels should be preserved, protected and enhanced for their hydraulic, ecological and aesthetic functions through development regulations, land dedications, easements, tax incentives, or acquisition.

O-256 River, stream and slough channels should not be placed in culverts unless absolutely necessary for property access. Bridges are preferred for these crossings, and such crossings should serve several properties to reduce the disruption to these waters and their banklines. Oversized culverts, designed to facilitate fish passage, which maintain channel width and grade should be used when culvert installation is necessary.

O-257 Degraded river, stream and slough channels and banklines should be rehabilitated by public programs and by new development to maintainwater quality and prevent further erosion problems. The channels and associated bankline areas should be restored to their natural state where conditions permit.

O-258 Water quality should be protected and enhanced. Land development should preserve the amenity and ecological functions of water features.

O-259 Water resources should be managed for multiple uses, including recreation, fish and wildlife habitat, flood protection, erosion control, water supply, energy production, and open space. Use of water resources for one purpose should, to the fullest extent possible, preserve opportunities for other uses.

Utilities Element

Description

The City of Aberdeen is one of only two Washington State municipal utilities that provides industrial-grade water. The Wynoochee River watershed serves as the source of supply for industrial sites located both within the City and the adjacent municipalities of Cosmopolis and Hoquiam. This supply system, which has a 100 million-gallon per-day capacity, provides the City with a water resource opportunity to create increased industrial development opportunities within the City and in areas immediately adjacent to the City.

Industrial Water Service Policies

U-301 The City of Aberdeen should establish, with the cooperation of the utility users, an equitable rate structure that allows for ongoing maintenance and improvements to deteriorated sections of the conveyance system.

U-302 The City should explore state and federal funding sources for system extensions to serve new utility customers.

U-303 The City should explore interlocal agreements with special purpose districts and the county concerning opportunities for the operation of the utility as a regional industrial water purveyor.

Hoquiam

The City of Hoquiam's 2009 *Comprehensive Land Use Plan* is available at http://cityofhoquiam.com/pdf/lup.pdf.

Future Land Use Element

Development Strategy, Industrial District

Ensure a diverse manufacturing and manufacturing-related base for Hoquiam by designating lands appropriate for intensive industrial activities.

The communities of Hoquiam, Aberdeen, and Cosmopolis collectively create "The Harbor," the historic manufacturing center of Grays Harbor County. Today, that role continues in Hoquiam, despite the exodus of several large manufacturing businesses over past 20 years. Although the wood products industry remains as a major contributor to the local economy, there have been recent major strides in industrial diversification. The greatest opportunities for industrial growth in Hoquiam remain facing the Grays Harbor Estuary.

Land Use Action Steps

3.1.A Create an Industrial District for land uses associated with extraction, processing, transportation, distribution, and wholesale activities.

3.1.B Industrial District lands have access to maritime, rail, aeronautical, and/or truck transportation systems.

3.1.C The district allows a mix of support activities as accessory uses in the district, such as offices, transshipment facilities, warehousing, and uses that benefit employees.

3.1.D Maintain the separation of industrial activities from residential and commercial uses with the use of buffers or transitional uses, such as heavy commercial/light industrial uses, parks, and community facilities.

3.1.E The location of industrial activities serving regional needs and requiring access to rail and marine links are most appropriate along the Grays Harbor Estuary shoreline south of the Simpson Avenue Bridge.

Development Strategy, Industrial Development and Infrastructure

Maintain existing and promote future industrial development through infrastructure planning.

The availability of public facilities and services is essential for retaining existing industrial uses and attracting new ones. The city should manage its infrastructure to reserve capacity for future industrial growth or build facilities capable of expansion if needed.

Land Use Action Steps

3.3.A Plan for reserves within the city's sewer and water systems for serving future industrial growth as demand occurs.

Environmental Management Element

Development Strategy, Wetlands

Protect wetlands to preserve their value for flood and stormwater control, improving ground and surface water resources, and fish and wildlife habitat.

Land Use Action Steps

6.1.A The 1997 City of Hoquiam Wetland Inventory delineates the general location of wetlands within the city. The Washington State Wetlands Identification and Delineation Manual (Ecology Publication #96-94) is the guiding document to determine the extent of wetland boundaries. The Washington State Wetlands Rating System for Western Washington (Ecology Publication #04-06-025) is the guiding document for determining the resource value of wetlands.

6.1.B The city requires development activities to mitigate impacts to wetlands by implementing buffer requirements appropriate to their value. The city relies on the best available science to determine buffer widths. Currently, the Washington State Wetlands Rating System for Western Washington will serve as a guiding document for determining buffer widths.

6.1.C The city encourages flexibility in determining wetland buffer widths. Assessments conducted by qualified experts may show the need for greater or lesser distances provided in the Washington State Wetlands Rating System for Western Washington to protect wetland values.

6.1.D The city maintains a goal of no-net loss of wetlands. However, limited development of wetlands is possible if no practical alternative exists for locating a project elsewhere or if protection precludes any reasonable use of the property. Loss or alteration of wetlands requires replacement mitigation of equal or greater value.

6.1.E The city supports efforts for restoring degraded wetlands to increase their value for flood control and habitat for fish and wildlife. This includes restoring connectivity to rivers and streams cut-off by past development.

6.1.G Encourage the preservation of wetlands on private property by allowing density and dimensional bonuses.

Development Strategy, Geologically Hazardous Areas

Regulate development activities in geologically hazardous areas to protect the public health, safety, and welfare.

Most geologically hazardous areas are not suitable for residential, commercial, or industrial development and may impact adjacent properties as well. It is in the community's interest to manage development in and around these areas carefully to minimize risk to life and property.

Land Use Action Steps

6.2.A Require development proposals on soils with moderate or severe slopes to undergo geo-technical analysis to ensure the safety of on-site and area property owners. Prohibit development on slopes 40% or more in grade.

6.2.B Limit development on soils with slopes greater than 15% or severe erosion hazard by encouraging the preservation of open space. Use cluster development or density and dimensional bonuses as incentives to developers to avoid geologically hazardous areas.

6.2.C Minimize and control soil erosion during and after construction by using best management practices and retaining native vegetation to the greatest extent practical.

6.2.D Preserve natural topographic, geologic, and hydrological features to the greatest extent possible to prevent erosion and slope instability.

6.2.E Encourage the retention of open space in geologically hazardous areas by allowing density and dimensional bonuses.

6.2.F Preserve natural vegetation along the top, toe, and sides of steep slopes in excess of 40% in grade.

6.2.G The city will coordinate with the Department of Natural Resources all Forest Practices Application Permits to ensure that harvest and road building activities do not create unstable slopes or severe erosion within geologically hazardous areas.

6.2.H Encourage essential public facilities to either locate outside of geologically hazardous areas or upgrade structures to withstand potential loss in the event of earthquake.

Development Strategy, Fish and Wildlife Conservation Areas

Protect Fish and Wildlife Habitat Conservation Areas through incentives, restoration efforts, and development regulations.

Land Use Action Steps

6.3.A Coordinate development review with state and federal fish and wildlife agencies and organizations to protect critical habitat.

6.3.B Protect the function of fish and wildlife conservation areas by requiring appropriate buffers.

6.3.C Prepare a study that identifies and delineates fish and wildlife conservation areas in Hoquiam that includes migration corridors that prevent the isolation of habitats. Maintain the accuracy of this information through regular updates.

6.3.D Allow density and dimensional bonuses for private property owners as incentives for protecting fish and wildlife habitat conservation areas and corridors.

6.3.E Encourage and facilitate programs and projects leading to restoration of fish and wildlife habitat areas in the city. The city adopts by reference the Chehalis Basin Salmon Habitat Restoration and Protection Plan for WRIAs 22 and 23 to assess the needs of salmon within the Hoquiam River and its tributaries.

6.3.F Integrate the protection of fish and wildlife habitat conservation areas with other city, state, and federal regulations to ensure a comprehensive approach.

Development Strategy, Frequently Flooded Areas

Protect the health, safety, and welfare of Hoquiam by minimizing the threat of flooding and flood-related damage.

Land Use Action Steps

6.4.A Maintain the city's participation and rating in the National Flood Insurance Program by requiring development to meet minimum program requirements.

6.4.B Continue to work with the National Flood Insurance Program to update the Flood Hazard Map of the city.

6.4.C Prohibit any development within the floodway that would reduce the capacity of the floodway.

6.4.D The city may require studies as part of the state environmental review process and require mitigation measures for new development within frequently-flooded areas. Mitigation may include flood storage improvements, flood-proofing of structures, and elevating structures.

6.4.E Use the most recent Stormwater Management Manual for Western Washington to set stormwater management requirements for new and expanded developments.

6.4.F When practical, require the use of natural systems over the installation of engineered structures, impoundments, or other engineered alterations for protecting development in frequently flooded areas.

6.4.G Integrate flood control measures with projects that benefit fish and wildlife conservation areas and wetlands.

Development Strategy, Surface Waters

Protect and manage surface water quality within the city.

Land Use Action Steps

6.5.A Manage future development within the city to maintain historic stormwater discharge rates and volumes into surface waters. Use the most recent Stormwater Management Manual for Western Washington to set stormwater management requirements for new and expanded developments.

6.5.B Mitigate impacts to surface waters created by stormwater runoff through the development of regulations and incentives that maintain water quality and quantity.

6.5.C Increase the number of opportunities along Hoquiam's fresh and marine waterfronts for public access. The city, in partnership with community groups, should facilitate the development of a public access plan that would identify potential access points, trails, and strategies for making them possible.

6.5.D Promote restoring degraded riparian areas that benefit fish and wildlife by encouraging projects and providing incentives to property owners.

Transportation Element

Development Strategy, Balanced Transportation Systems

Design a balanced and integrated transportation system consistent with the needs of residential, commercial, and industrial land uses.

Land Use Action Steps

8.1.D Retain and promote commercial and industrial development by maintaining and improving access to an integrated system of highway, rail, marine, and aviation links.

8.1.F Support the Port of Grays Harbor and other private property owners in maintaining and improving marine-related transportation links.

Development Strategy, Transportation Improvements

Design and implement safe and efficient transportation improvements.

Land Use Action Steps

8.2.A Prepare a study examining the possibility of constructing a bridge over the Hoquiam River to connect North Hoquiam at or near the current railroad bridge. The eventual completion of the bridge is critical for ensuring emergency access to and encouraging future development in the Woodlawn area.

8.2.B The city adopts a Level of Service standard of C or better for designing city locals, collectors, or arterials and evaluating development impacts to traffic.

8.2.L Upgrade railroad crossings and tracks within rights-of-way to improve traffic safety and street conditions. Work with the Puget Sound and Pacific Railway to reduce and minimize traffic delays created by trains.

Public Facilities and Services Element

Development Strategy, Meeting Future Demands

Provide effective and efficient public facilities and services that meet current and future population demands.

Land Use Action Steps

9.1.D Provide public facilities and services for new development in a timely manner so adequate facilities are available when development occurs.

9.1.E The city shall not approve any development that creates future conditions that will reduce the capacity of existing public facilities and services from meeting adopted minimum level of service standards.

9.1.F Schedule and phase utility extensions to occur concurrently with expected new development.

Development Strategy, New Development

Establish public facilities and services requirements for new development within the city.

Land Use Action Steps

9.2.A All new development shall connect to the city water system.

9.2.B All new development shall connect to the city sewer system.

9.2.C Future development shall provide water, sewer, and storm drainage service as outlined in respective system plans.

9.2.D Create incentives that encourage alternative green development standards that reduce impacts to water, sewer, and stormwater systems and promotes their conservation.

Development Strategy, Emergency Planning

Ensure the long-term function and safety of providing public facilities and services during times of emergency.

Land Use Action Steps

9.4.A Prepare a City of Hoquiam element to the Grays Harbor County All-Hazards Mitigation Plan that examines potential impacts to public facilities and services and makes recommendations for protecting critical city assets.

9.4.B Construction of future public facilities and services should avoid critical areas if practical.

9.4.C Plan for and coordinate with other local, state, and federal jurisdictions in providing public utilities and services during emergencies.

Parks and Open Space Element

Development Strategy, Managing Open Spaces

Manage Hoquiam's land base to assure an adequate supply of diverse open space for recreation and protection of critical areas.

Land Use Action Steps

11.2.A Encourage the retention of open space critical areas within the city, particularly in relation to wetlands, geologically hazardous areas, and fish and wildlife conservation areas.

11.2.B Use critical area ordinances and development incentives as tools to preserve open space on private property within the city limits.

Economic Development Element

The City of Hoquiam is undergoing an economic transition that is seeing new types of industrial activities come to the waterfront, growing opportunities for tourism, and significant challenges to the retail sector. Currently, there is steady progress happening that eventually will return Hoquiam to its former economic position in the county. Therefore, it is essential that the Comprehensive Land Use Plan support, sustain, and nurture the community's economic rebirth.

Development Strategy, Framework for Economic Development Planning

Provide a comprehensive framework that will encourage the creation of a diverse and strong local economy.

Hoquiam has been undergoing a comprehensive community and economic development planning process since 2005 and has identified a series of strategies and action steps for change.

Land Use Action Steps

12.1.A The Comprehensive Land Use Plan adopts by reference the Hometown Hoquiam Phase 2 Economic Development Strategic Action Plan: 2008-2012.

Development Strategy, Managing the Development Review Process

Ensure that the Comprehensive Land Use Plan furthers the city's economic development efforts.

To be effective as an economic development tool, the Comprehensive Land Use Plan needs to undergo continual review, analyzed with current events in the city, and adjusted accordingly to continue to meet the vision of this plan and the other plans adopted by reference.

Land Use Action Steps

12.2.B Development review through the plan and its implementing regulations should be as streamlined as possible without sacrificing thoroughness.

12.2.C The city should explore using performance standards rather than standard specifications within its development regulations to encourage innovation and flexibility.

12.2.D Annually review land development applications to evaluate the effectiveness and efficiency the Comprehensive Land Use Plan at addressing the development review process.

Appendix I

Local Policies Governing Aesthetics, Light, and Glare

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Local Policies Governing Aesthetics, Light, and Glare

Grays Harbor County

Shorelines Management Master Program

The Grays Harbor County 2015 Shoreline Master Program Update is available here: http://www.ghcsmp.org/index.html.

Development Policies

Policy 1. Ports and Water Related Industry.

Ports are centers of water-borne traffic particularly inter-coastal or transoceanic vessels including facilities for docking, loading, and unloading of cargo and raw materials and supplies and services for the vessels.

b. Port facilities should be designed to permit viewing of harbor areas from viewpoints, waterfront restaurants and similar public facilities which would not interfere with port operations or endanger public health and safety.

Policy 4. Recreation.

Recreation is the refreshment of body and mind through forms of play, amusement, or relaxation. The recreational experience may be either an active one involving boating, swimming, fishing, or hunting, or the experience may be passive such as enjoying the natural beauty of a vista or a lake, river, or saltwater area.

c. The linkage of shoreline parks and public access points through the use of linear access should be encouraged. Many types of connections can be used such as hiking paths, bicycle trails and/or scenic drives.

d. Whenever practical, scenic views and vistas should be preserved.

Amenity Policies

Policy 1. Visual Enhancement.

a. Unappealing operation which must have a waterfront site should be located where visual appearance, or emissions can be best screened and should be grouped together if possible to avoid spreading visual blight along the waterfront and to facilitate screening.

b. Urban, rural, and sparsely developed shorelines should be evaluated as to their visual amenity and where amenity is generally high, operations which are prone to release smoke

or gases that would reduce visibility, release visible particulate fallout, discolor the sky or stimulate fog formation should not be allowed.

c. The natural shoreline configuration should be preserved to protect scenic beauty and to prevent inappropriate eye-catchers. In prime scenic areas buildings should not rise above the skyline and where possible should be set behind an existing topographic or vegetation barrier to protect the vista. The leveling of hills or dunes, the filling of troughs or the terracing of slopes are other activities which can have the effect of creating an unnatural and visually unappealing shoreland configuration.

d. Outdoor advertising, above ground utilities, parking lots, and structures which are not architecturally related to the site and topography should not be allowed within identified scenic corridors or vista areas.

Environment Policies

Policy 1. Urban Environment.

i. The Urban Environment allows the highest density of development and the most intense types of shoreline uses. While some control of these factors is necessary, the main management focus should be on quality of development centering on such matters as pollution prevention and abatement, visual amenities, public access, site layout and design.

Policy 3. Conservancy Environment.

d. Conservancy areas are often attractive recreational areas and low intensity recreation can be permitted if it does not adversely affect the management of the resources and other values such as wildlife habitat and scenic amenity.

Administration Policies

Policy 2. Shorelines of Statewide Significance:

When considering the appropriateness of development on shorelines of statewide significance, local government and the developer should:

b. Preserve the natural character of the shorelines. This can be accomplished by:

1) Minimizing man-made intrusion on the shorelines.

2) Where intensive development already occurs, upgrade and redevelop those areas, before extending high intensity uses to low intensity use or undeveloped areas.

c. Prefer the long-term over short-term benefit. This can be accomplished by:

1) Preserving the shorelines for future generations and severely limiting anything that will detrimentally alter the natural conditions.

2) Evaluating developments for short-term economic gain or convenience in light of long-term and potentially costly impairments to the environment.

3) Actively promoting aesthetic considerations in a new development, redevelopment of existing facilities, or simply for the enhancement of the shoreline area.

Shorelines Designations

The shorelines which are designed as shorelines of statewide significance are:

2. Those portions of the Grays Harbor Estuary and its associated wetlands within Grays Harbor County under the jurisdiction of the Act, exclusive of those areas within the city limits of Ocean Shores, Westport, Hoquiam, and Aberdeen.

3. Those portions of the Chehalis River and its associated wetlands under the jurisdiction of the Act, exclusive of those areas within the city limits of Aberdeen, Cosmopolis, Montesano, Elma, and Oakville.

Public Access Regulations

Regulation 1. Shorelines of Statewide Significance.

b. Heavy commercial and industrial uses fronting on shorelines of statewide significance shall provide an easement or dedication for one or more vista points located as near to the outer harbor line as is reasonable, considering the nature and siting of the use. The vista points shall have a length parallel to the shoreline equivalent to 10% of the first 500 feet of the site frontage on the shoreline and an additional 5% of any additional frontage on the shoreline. The access and vista point area shall be capable of handling passenger vehicles safely and conveniently, unless topography or other limitations preclude this, in which case safe and convenient pedestrian access shall be sufficient.

c. The property owner shall not be required to install or maintain improvements for such public access and vista facilities unless a subdivision is required, in which case improvement may be required as a condition of plat approval. Public use shall not be allowed until reasonable improvements and provisions have been made by the appropriate public agency so that trespassing on adjacent private property, littering, and environment abuse will be minimized.

Scenic View and Vista Regulations

All applications for Substantial Development Permits must be evaluated for possible detrimental effects on scenic views and vistas. The possible blocking of residential views will be examined. Disruption of scenic vistas will be examined. If some detrimental effects on views or vistas are determined to be the case, the Administrator shall make record of the case and place conditions on the permit so as to minimize said detrimental effect. Such conditions may include but are not limited to:

1. Limitations of height of structures, as per RCW 90.58.320.

2. Requirements for screening.

3. Requirements for underground utilities.
4. Requirements for screening.
5. Restoration requirements.
6. Requirements for retention of appropriate vegetation.

Should the Administrator determine that there will be no adverse effect on scenic views or vistas, such determination will be noted. Should a particular project be so disruptive of scenic views and vistas that no amount of special requirements will ease the disruption, then the application may be denied if the project could reasonably be located elsewhere.

City of Aberdeen

The City of Aberdeen's 2001 *Comprehensive Land Use Plan* is available here: http://aberdeenwa.gov/pdf/2001_comp_plan.pdf.

Comprehensive Plan

Land Use Element

L-001 Encourage and provide for growth in economic activity and population while maintaining a balanced and orderly pattern of development and protecting the desirable attributes of the City and its environs.

L-002 Encourage appropriate land uses within suitable areas.

L-003 Provide sufficient space, protected from conflicts, for all land uses.

L-005 Provide for the expansion of uses which require additional area while minimizing potential adverse impacts on nearby uses.

L-006 Minimize land use conflicts and encourage compatibility between land uses through careful and attractive design.

L-008 Provide support for private sector developers to produce infill development, while encouraging infill development which is attractive to potential residents and both beneficial and acceptable to existing residents.

L-300 Industrial development should be grouped with similar or compatible use to in areas that limit land use conflicts, improve traffic flow and safety, and allow businesses to share public facilities and services.

L-500 Industrial development should be designed to be compatible with adjoining uses. Off-site impacts, such as noise, odor, light and glare, and vibration should be mitigated through the pollution control measures, setbacks, landscaping, and other best management practices. Unsightly views of parking areas, loading areas, and storage areas should be screened from adjacent office, retail and residential uses.

L-501 Areas where the allowed uses could have a major adverse effect which cannot be lessened are unsuitable for the Industrial area designation.

Transportation Element

T-006 The City, the Port of Grays Harbor, and private sector water-dependent uses should encourage the maintenance and continued development of both the Grays Harbor Navigation Channel and water-borne shipping terminals.

T-093 The development and maintenance of deep-water marine shipping terminals is encouraged in the industrial and waterfront development zoning districts.

Natural Resource Element

N-102 Retain the desirable elements of Aberdeen's character and setting.

N-103 Minimize the potential undesirable impacts of development.

N-203 Resource industries should use management practices that protect the environment and adjacent uses, and maintain the long-term productivity of the resource base.

Downtown and Waterfront Development Element

W-004 Increase appropriate public and private use of the waterfront areas of the City.

W-005 Protect important waterfront areas and resources.

Open Space and Critical Areas Element

O-252 Development within designated shoreline jurisdictions should:

b. Preserve the value and function of the water and shoreline;

c. Avoid natural hazards;

d. Promote visual and physical access to the water; and

e. Preserve navigation rights.

O-253 Water quality, natural drainage, fish and wildlife habitat, and aesthetic functions of rivers, streams, sloughs, and the harbor should be protected.

O-259 Water resources should be managed for multiple uses, including recreation, fish and wildlife habitat, flood protection, erosion control, water supply, energy production, and open space. Use of water resources for one purpose should, to the fullest extent possible, preserve opportunities for other uses.

Municipal Code

The project site is located in an area zoned Industrial (I). There are no specified height restrictions for this land use based on Chapter 17.48, *I Industrial District*, of the City of Aberdeen Municipal Code, Aberdeen's municipal code contains the following ordinances pertaining to aesthetic resources:

Section 17.48.050 Signs and lighting. In the I district, signs shall comply with the requirements of Chapter 17.84. (Prior code § 11.014.045)

Section 17.48.070. Landscaping. In the I district, landscaping shall comply with the requirements of Chapter 17.88. (Prior code § 11.014.060)

Section 17.84.120. Lighting. All lighting for required parking facilities or signage shall be designed to reflect light away from adjacent residential areas and streets. (Prior code § 11.026.120)

Section 17.88.030. Description of landscaping. The following are types of landscaping as required in Section 17.88.040; all proposed plant material, sizes and characteristics shall be in accordance with current American Association of Nurserymen Standards:

C. Type III—See Through Buffer. Type III landscaping shall consist of a mix of evergreen and deciduous plantings including living trees, shrubs and ground covers. Plantings of shrubs and ground covers shall be chosen and spaced to result in a covering of the landscape strip within three years. Shrubs shall be of a type that do not exceed a height at maturity of approximately three to four feet. Deciduous trees shall have a minimum trunk diameter of one and three-quarter inches at time of planting, and be spaced so as to result in touching of branches after ten years of normal growth. Evergreen trees shall be a minimum of four feet tall at time of planting and spaced so as to result in a space between trees approximately equal to the mature spread of the trees used. See Figure L-1.

Section 17.88.040. Type of landscaping required. Landscaping shall be provided in all developments subject to this title as set forth below, except for single-family residences and duplexes:

B. Five feet of Type III landscaping is required adjacent to all streets, except where permitted structures and driveways are proposed.

D. Landscaping is not required adjacent to alleys.

E. The buffer requirement between uses not specifically mentioned in this chapter shall be the same as the most similar above circumstance. (Prior code § 11.028.040)

Section 17.88.050. Landscaping plan requirements. The plan shall be accurately drawn, using an appropriate engineering or architect scale, and show the following:

A. Boundaries and dimensions of the site;

B. Location and identification of all streets, alleys and easements on the site;

C. Proposed location and dimensions of all on-site buildings;

D. Proposed landscaping including species, and size at the time of planting;

E. Existing vegetation;

F. Details of any proposed architectural barriers;

G. Locating of existing and proposed driveways and parking surfaces, curbs and sidewalks. (Prior code § 11.028.050)

Section 17.88.070. Maintenance and enforcement. All landscaped areas required by this chapter shall be planted according to accepted practice in good soil with a water source within seventy-five (75) feet, and maintained with respect to pruning, trimming, watering and other methods to create an attractive appearance and a healthy growing condition. Dead, diseased, stolen or vandalized plantings shall be replaced within three months. Property owners shall keep the planting area free of weeds and trash; lack of maintenance shall constitute a violation of this code. The department shall have the authority to enforce the standards set forth in this chapter and the conditions attached to all permits for development pursuant to application of this chapter, in accordance with the provisions of Chapter 17.96. (Prior code § 11.028.070)

City of Hoquiam

The City of Hoquiam's 2009 *Comprehensive Land Use Plan* is available here: http://cityofhoquiam.com/pdf/lup.pdf.

Comprehensive Plan

Environmental Management

Development Strategy 6.5: Surface Waters. Protect and manage surface water quality within the city. This development strategy addresses that

> Hoquiam's fresh and marine surface waters are important community and regional resources. The waters and shorelines provide significant economic benefits through marine commerce, recreation, tourism, and aquaculture. They serve as essential fish and wildlife habitats and migration corridors. The creeks, rivers, and the estuary create a natural stormwater conveyance system. Finally, Hoquiam's surface waters create a distinctive and aesthetically pleasing backdrop that visually defines the essence of the community's past, present, and future. Thus, protecting these assets is important.

While there are no actions that pertain to visual resources, the actions under this development strategy protect water quality that, in turn, affect visual resources.

Transportation

Land Use Action 8.1.E. Work closely with the Washington State Department of Transportation to ensure State Routes 101 and 109 remain consistent with the vision, development strategies, and land use action steps in the Comprehensive Land Use Plan and other city plans and policies.

Municipal Code

The City of Hoquiam Municipal Code (HMC) contains the following ordinances pertaining to aesthetic resources:

10.03.100. Density and dimensional requirements. Limits heights for industrial (I) land uses to 55 feet. Heights greater than 55 feet require a conditional use permit.

10.05.065. Landscaping and Screening. A. The purpose of this section is to carry out the objectives and policies of the Comprehensive Plan; to maintain and enhance the urban forest as an important asset to the community as expressed in the Comprehensive Plan; to provide landscaping and screening regulations which will promote a well-balanced, healthy, aesthetically pleasing environment for city residents and visitors. Specifically, the regulations contained in this section are intended to accomplish the following:

3. Provide adequate buffers between differing land uses;
4. Mitigate the effects of noise, light, glare, heat, wind and other adverse impacts;
5. Improve the character and appearance of the City;
8. Promote public health, safety and comfort through the retention and planting of trees;
9. Soften the visual impacts of paved surfaces.

B. The provisions of this Chapter shall apply to all new developments within the City of Hoquiam as specified in this Section "Table of Minimum Planting Standards for New Development."

1) Landscaping development standards.

a) The landscape development standards contained in this Chapter shall be administered by the Director. The City Planner shall be responsible for reviewing and approving planting specifications in the implementation of this Chapter. The Director, with the concurrence of the City Planner, is authorized to make modifications when reviewing site plans based on topographical conditions or other factors unique to the site.

b) Credit may be given against the requirements of this Section "Table of Minimum Planting Standards for New Development" for certain existing trees that are preserved in accordance with this Section "Preservation and Protection of Existing Trees."

c) Ornamental trees at least 6 feet in height may be substituted for no more than 30% of the required deciduous trees.

d) All required plant materials shall be compatible with the USDA Hardiness Zone for Hoquiam and shall not have characteristics detrimental to the public welfare such as susceptibility to disease and wind damage or a tendency to interfere with utilities or public right-of-ways.

e) No tree shall be planted where the soil is too poor to ensure growth. An adequate sized hole shall be excavated with the unsuitable soil removed and replaced with suitable soil.

f) Irrigation systems, root barriers and other mechanical devices may be required to assure planting viability.

g) Existing trees which will be saved and which meet the minimum specification herein specified, shall count toward meeting the requirements herein, provided they are an acceptable species as to their location.

2) Table of minimum planting standards for new development. 10.05.065 - Table of Minimum Planting Standards for New Development, establishes the following for industrial development:

- Deciduous Trees Min. 2 in. caliper DBH (at 4.5 ft. above ground): 18 in. total caliper per gross acre.
- Evergreen Trees Min. 3 ft. Height: 18 ft. total height per gross acre.
- Street Trees (1 per every 50" of frontage) Min. 1 in. caliper: Required.

3) Landscape plans/approval.

a) A plan of the proposed landscaping and screening shall be provided, which may be incorporated into plans submitted for preliminary plat, site plan or building permit review.

b) At a minimum, landscaping plans shall identify:

i. The common name and variety ("Bradford Flowering Pear" for example), the quantity and the location of proposed plant material. Both the common name and the scientific name may be required for larger projects as determined by the Director.

ii. The location, species and size of all existing trees 6 inches or more in diameter (measured at 41/2 feet above ground level) and any such trees proposed to be removed.

iii. The location, type, size and height of existing or proposed fencing.

iv. The location of outdoor storage areas and trash receptacles and the type and size of screening.

v. The location and type of irrigation system.

vi. In addition to basic site information and tree identification, the City Planner may require the applicant to specify the methods used to preserve existing trees including the means of providing water to and protection of the root system during the construction period. A survey of relevant elevations, before and after,

may also be required if development will result in a change of elevation within 10 feet of the drip line of such trees.

c) No permits are required for normal maintenance or the replacement of dead or diseased plants.

4) Performance surety.

a) No Certificate of Occupancy shall be issued until the required landscaping is in place. If, however, landscaping installation is incomplete at the time of formal application for occupancy due to weather related reasons or other unforeseeable circumstance, the City may authorize a Certificate of Occupancy subject to submitting a bond or other surety acceptable to the City at a value of 150% of the estimated cost of installation.

b) Upon completion of the landscape installation, the City shall promptly release the performance surety. If the required landscaping improvements are not made within six months of occupancy of the building, the City will use the surety to install the landscaping.

5) Maintenance requirements.

a) All shrubs, trees and vegetative material used in the screening or landscaping shall be perpetually maintained in a healthy, growing condition. Irrigation systems shall be kept operational. Dead, diseased or dying plant material shall be replaced immediately, and planting areas shall be maintained reasonably free of trash and weeds.

b) Fences used in screening and landscaping shall be perpetually maintained in an attractive and structurally sound condition.

c) A maintenance surety in the form of a bond, cash deposit, or other security acceptable to the City covering 20% of the cost of the original plant materials in place may be required for one year following installation to insure compliance with this Code.

i. If a maintenance surety is required under this Section, the property owner shall provide the City with a non-revocable notarized agreement granting the City and its agents the right to enter the property and perform any necessary work.

ii. The maintenance surety may be used by the City to perform any maintenance, and to reimburse the City for documented administrative costs associated with the maintenance activity.

iii. Upon completion of the one year maintenance period, the City shall promptly release the maintenance surety or any remaining portion thereof.

Appendix J

Cultural Resources Technical Report

Text containing sensitive information was removed

WESTWAY AND IMPERIUM EXPANSION PROJECTS

CULTURAL RESOURCES TECHNICAL REPORT

[*NOTE: SENSITIVE INFORMATION HAS BEEN REDACTED WHERE INDICATED*]

PREPARED FOR:

City of Hoquiam, Washington
609 8th Street
Hoquiam, WA 98550
Contact: Brian Shay
(360) 538-3983

Washington State Department of Ecology
300 Desmond Drive SE
Lacey, WA 98503
Contact: Sally Toteff
(360) 407-0271

PREPARED BY:

ICF International
710 Second Avenue, Suite 550
Seattle, WA 98104
Contact: Christopher Hetzel
(206) 801-2817

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Christopher Hetzel, J. Tait Elder, and Melissa Cascella. 2015. Westway and Imperium Expansion Projects, Cultural Resources Technical Report. August. (ICF 00138.14). ICF International, Seattle, WA. Prepared for City of Hoquiam, WA, and Washington State Department of Ecology, Lacey, WA.

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Acronyms and Abbreviations

BP	before present
Cascadia	Cascadia Archaeology, LLC
CFR	Code of Federal Regulations
DAHP	Washington State Department of Archaeology and Historic Preservation
Ecology	Washington State Department of Ecology
EIS	environmental impact statement
GPS	global positioning system
HOV	high-occupancy vehicle
ICF	ICF International
Imperium	Imperium Terminal Services
MLLW	mean lower low water
NRHP	National Register of Historic Places
Port	Port of Grays Harbor
PS&P rail line	Puget Sound & Pacific Railroad
RCW	Revised Code of Washington
SEPA	Washington State Environmental Policy Act
SR	State Route
USACE	U. S. Army Corps of Engineers
WAC	Washington Administrative Code
Westway	Westway Terminals LLC
WHR	Washington Heritage Register
WISAARD	Washington Information System for Architectural and Archaeological Records Database
YMCA	Young Men's Christian Association

Chapter 1
Introduction

The City of Hoquiam and Washington State Department of Ecology (Ecology) engaged ICF International (ICF) to conduct cultural resources studies for two proposed expansion projects at the Port of Grays Harbor (Port) in Aberdeen and Hoquiam, Washington. These proposed actions are being separately undertaken by Westway Terminals LLC (Westway) and Imperium Terminal Services (Imperium) on two adjacent project sites. Both companies are proposing to expand their existing bulk liquid storage and distribution facilities at the Port's Marine Terminal No. 1.

Westway has operated a methanol distribution facility at the Port since 2009. Operations involve storing, handling, and transporting methanol by vehicle, rail, and tanker vessel. Similarly, Imperium has operated a biodiesel processing and distribution facility at the Port since 2006. The facility currently produces biodiesel on the property and receives, stores, and loads (for transport) various other materials, such as vegetable oil, methanol, diesel, glycerin, and biodiesel. Both facilities contain multiple, large liquid storage tanks; rail, tanker truck, and tank vessel loading/unloading areas; and associated pipelines for transferring the products. In addition, they both use existing railroad spurs that connect to the Puget Sound and Pacific Railroad (PS&P) rail line and vessel-loading facilities located at the Port's Marine Terminal No. 1 berth. The existing facilities employ many of the same logistical and operational considerations that would be required by the proposed actions.

The proposed actions require permits from the City of Hoquiam and Ecology. Therefore, the proposed actions are subject to the requirements of the Washington State Environmental Policy Act (SEPA). This cultural resources technical report was prepared to support environmental impact statements (EISs) under SEPA for each proposed action. The EISs are being prepared under SEPA Chapter 43.21C Revised Code of Washington [RCW]), the SEPA Rules (Chapter 197-11 Washington Administrative Code [WAC]), and the City of Hoquiam Municipal Code (11-10).

The following are descriptions of each proposed action, including the project sites, the proposed facilities and operations, and a summary of the no-action alternative.

Westway Project

Westway is proposing to develop an additional 7 acres of its existing 16-acre site to expand its bulk liquids storage facility. This expansion would provide additional facilities necessary for receiving, storing, and loading crude oil for transport. Crude oil would arrive at the project site by rail and be shipped from the project site by tank vessel. The Westway project site is located between Marine Terminals No. 1 and No. 2 of the Port (Figures 1-1 and 1-2).[1]

[1] Tax Assessor's Parcel Information: City of Hoquiam in Section 18, Township 17, Range 9 West, North of the Willamette Meridian, Tax Parcel Number #056402300000; and City of Aberdeen in Section 7, Township 17, Range 9 West, North of the Willamette Meridian, Tax Parcel Number #029902000200.
Latitude: 46.968253, longitude: -123.855871.

Proposed Action

The Westway proposed action, would be constructed in two phases. Phase 1 would include constructing two new storage tanks, expanding the existing onsite rail facilities, constructing related pipelines, upgrading dock capabilities, and installing a marine vapor combustion unit. Phase 2 would include constructing three additional storage tanks. Depending on market conditions, Phases 1 and 2 may be constructed at the same time.

Storage Tanks

The Westway proposed action would construct five new storage tanks on the Westway project site, south of the facility's existing storage tanks (Figure 1-2). Each tank would be approximately 150 feet wide and 64 feet tall and would have the capacity to hold approximately 200,000 barrels (8.4 million gallons) of crude oil, for a total crude oil storage capacity of 1 million barrels (42 million gallons).

The area where the new tanks would be built is currently paved with asphalt. Construction of the proposed tanks would require removing the existing pavement, amounting to approximately 14,000 cubic yards of paved material, and grading the project site. An impervious geotechnical (clay) lining, approved by a registered Washington State Professional Engineer, would be installed over the graded area to prevent any spills or leaks from contacting soil in the area. The lining would then be covered by soil and crushed rock and a containment area constructed on top of the clay liner to house the storage tanks.

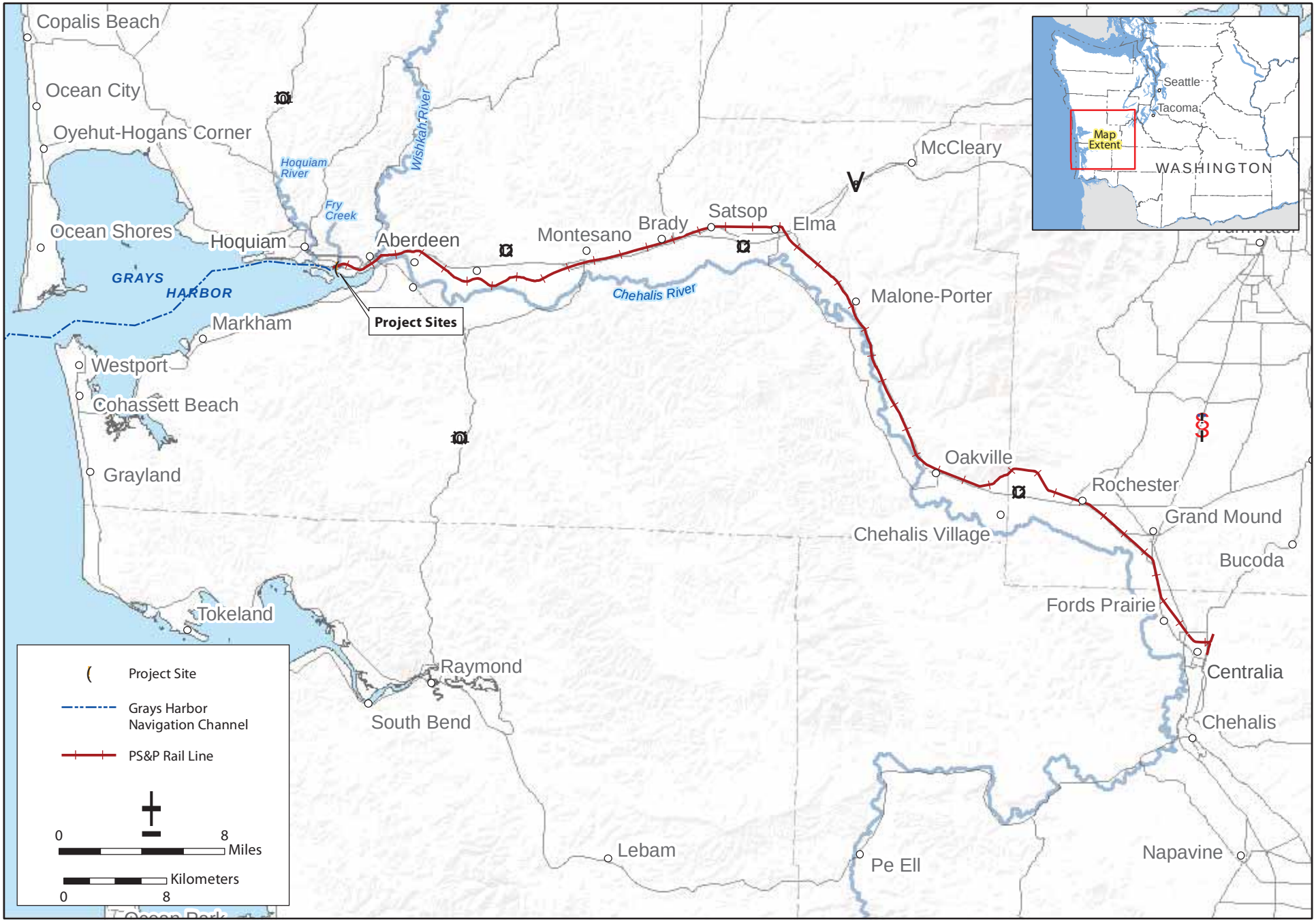
The containment area would consist of underlying concrete slabs surrounded by a 5-foot-tall concrete wall with the capacity to contain the total volume of a single tank plus an allowance for precipitation. The concrete slabs would be supported by approximately 200 piles driven 150 feet into the ground. The piles would be 18-inch-diameter steel pipe. Once all piles are driven for a tank, the concrete slabs would be formed and poured over the piles, creating a solid 3-inch-thick slab upon which a storage tank would be placed. Rebar in the slab would extend approximately 20 to 30 feet into the steel pipe piles, which would be filled with concrete.

Loading and Unloading Areas

The Westway proposed action would expand and improve Westway's existing rail and vessel loading and unloading areas, as described below. No changes would be proposed for the facility's existing truck loading and unloading areas.

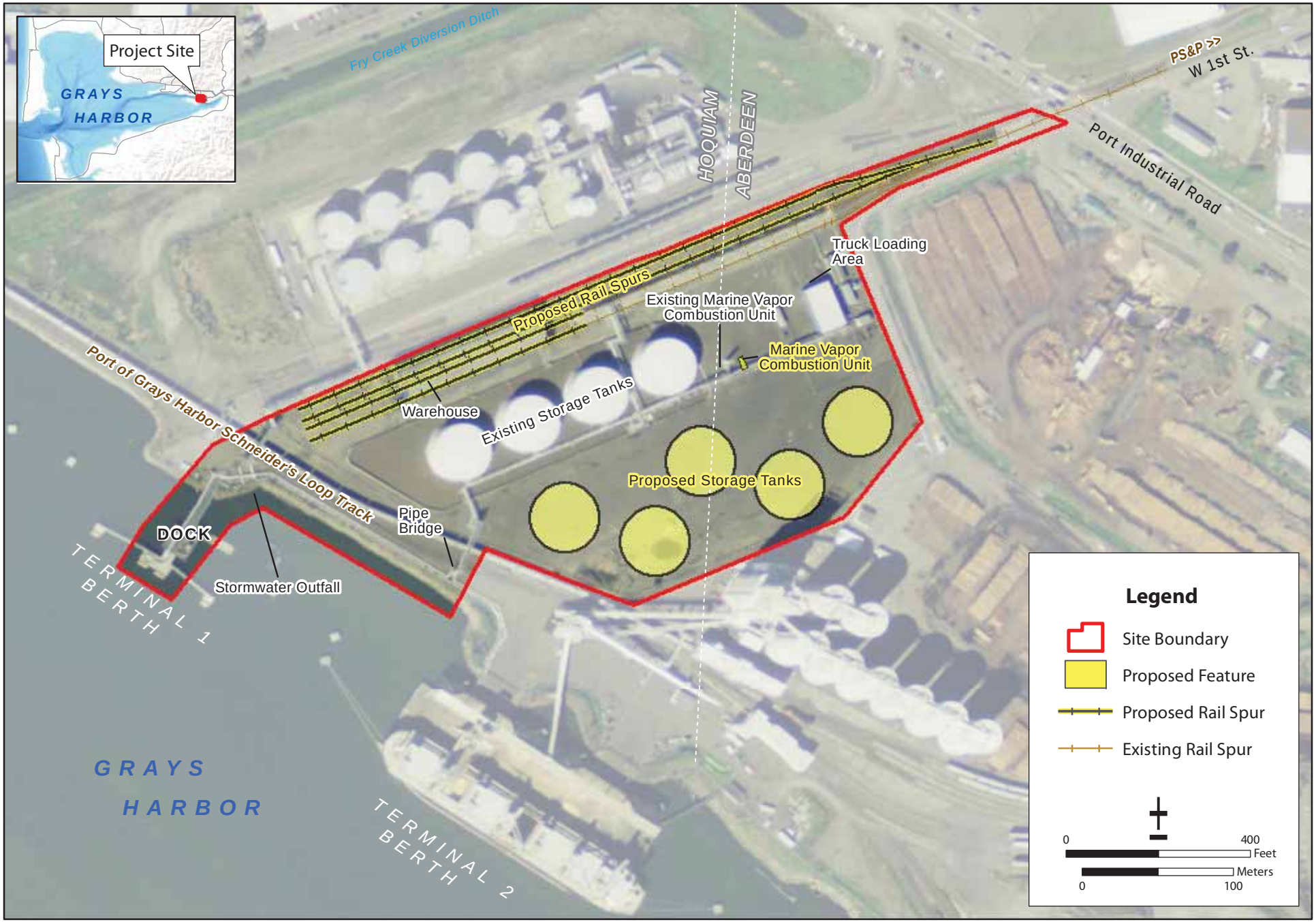
Rail

Under Phase 1, Westway's two existing rail spurs would be lengthened and two new spurs would be added, thereby increasing the total number of loading and unloading stations from 18 to 80. Similar to the existing stations, the new loading and unloading stations would be constructed on top of a containment area—a center-sloped concrete slab that collects and directs any spills to a central sump. This containment area would have the capacity to contain the total volume of a single rail car, plus allow for additional precipitation.



Sources: Navigational Channel, NOAA, 2012; Bathymetry, NOAA, 2005; PSAP Rail Line, ICF, 2014; National Rail Layer, RITA, 2013; Basemaps, ESRI

Figure 1-1
Location of Project Sites
Westway and Imperium Expansion Projects



GIS Data Sources: Site Design, Harris Group, 2014; Aerial Imagery, ESRI Basemap, 2010

Figure 1-2
Westway Project Site
Westway and Imperium Expansion Projects

Construction of the rail facilities would require demolishing an existing warehouse (Warehouse E) then grading and forming the project site. Crews would lay rebar and pour concrete to construct the containment area underlying the new and extended rail spurs. The entire rail area would be built on a solid concrete slab; there would be no wood ties or ballast rock in the rail area. The loading and unloading equipment (racks, hoses, pipelines, and pumps) would then be installed.

Connection of the new spurs to the PS&P rail line would use the existing grade crossing at Port Industrial Road and would require no new track to be constructed offsite. This connection would be maintained by the Port.

Vessel

Improvements to Westway's capability of loading vessels with crude oil would include the construction of a new a hose tower or loading arms above the existing dock at Marine Terminal No. 1 to add structural support for the pipes and the installation of a new marine vapor control system. The marine vapor control system would consist of three parts: a marine safety unit, a vapor blower unit, and the vapor combustion unit. The marine safety and vapor blower units would be installed on top of the dock with no modification to the dock structure in the water. The entire system would be constructed and operated in compliance with U.S. Coast Guard regulations (33 Code of Federal Regulations [CFR] 154) and the applicable air permit.

Pipelines

Under Phase 1, a system of pipelines would be constructed to connect the new rail loading and unloading stations to the storage tanks, and the storage tanks to the vessel-loading facilities at the Marine Terminal No. 1 berth. A 24-inch-diameter carbon steel pipeline would be installed on the existing pipe bridge to connect the storage tanks to the vessel loading facilities at the Marine Terminal No. 1 dock. New 10- or 12-inch-diameter carbon steel pipelines would be installed to move crude oil from the rail unloading areas to the storage tanks. The pipelines would be constructed above ground, in segments.

Buildings

Also under Phase 1, additional office space and support structures would be constructed at the Westway facility. These structures are expected to include a new electrical building south of the existing electrical building and shower and change rooms. Their construction would involve grading and otherwise preparing the project site. The existing warehouse (Warehouse E) is not currently being used and would be removed to make room for the new and expanded rail spurs.

Operations

Under the Westway proposed action, the facility's allowable (permitted) throughput capacity would increase by 17.9 million barrels per year (563.9 million gallons) for a cumulative total of 19.2 million barrels (604.8 million gallons) per year. The applicant intends to continue to handle methanol similar to existing conditions, and the new capacity provided under the proposed action would be dedicated to handling crude oil.

Onsite Operations

No changes would be made to the existing methanol distribution facility under the proposed action. The additional planned capacity would be dedicated to transferring crude oil from rail to tank vessels. Westway would receive crude oil from its future customers (i.e., owners of the oil), who would arrange rail transport to and vessel transport from the project site. Onsite operations would involve receiving and unloading the crude oil from rail cars, storing it, and transferring it onto tank vessels for shipment. Transport via rail or vessel would be under the responsibility of rail and vessel operators. No crude oil would be transported by tanker truck.

Once onsite, rail cars would be pushed onto the loading and unloading spots where the crude oil would be unloaded into a central collection area and then pumped to the storage tanks. The crude oil would be pumped from the storage tanks via the new pipelines to the Marine Terminal No. 1 vessel-loading facilities, where it would be transferred onto the tank vessel by hose.

Offsite Operations

Rail Transport

Crude oil would be transported to the project site via any of the rail corridors along mainline railroads from the source of the crude oil. From Centralia to the Port, the only rail access is via the PS&P rail line. All trains associated with the proposed action would use this corridor to reach the project site. Under the proposed action, increased train traffic would consist of unit trains of approximately 120 cars (1.25 miles long). Unit trains are typically transported by four locomotives and would have to be broken into smaller segments and taken by switch engine to and from the project site. Operation of the proposed action at full capacity would result in approximately 229 loaded unit train trips per year or one unit train round trip every 3 days, on average. This would be 458 total unit trains per year, loaded and unloaded traveling along the PS&P rail line to and from the Westway project site.

Vessel Transport

Crude oil would be transported from the project site by tank vessel. The depth constraints of the Grays Harbor Navigation Channel limit the size of vessels able to enter the harbor. The largest tankers would be Panamax class with the capacity to hold up to 350,000 barrels (14.7 million gallons); however, articulated tug and barge units are expected to be more commonly used. Barge capacity would be in the range of 25,000 to 150,000 barrels (1.05 million gallons to 5.3 million gallons).

Crude oil shipped from the facility would likely be transported by tank vessel to refineries in the Puget Sound area and northern California (Richmond area). Although transport of U.S. crude oil overseas is currently not allowed under U.S. law, it is possible for Canadian oil to be transported abroad, and overseas transport of U.S. oil could occur if current regulations were to change. At full capacity, operation of the proposed action would result in approximately 49 to 60 vessel round trips per year, i.e., approximately one round trip (entry and departure) every 3 days, depending on the type of the vessel used.

No-Action Alternative

Under the no-action alternative, the proposed action would not be constructed and Westway would continue to operate its existing facility under current conditions. For the purposes of evaluating impacts, the no-action alternative includes planned infrastructure improvements that have already been funded or are expected to be permitted prior to 2017 (anticipated operational start date for the proposed action).

Imperium Project

Imperium is proposing to expand its existing biodiesel production and transport facility by developing an additional 10.9 acres of its existing 22.9-acre site to receive, store, and load (for transport) a variety of products. These additional bulk liquids are expected to include: crude oil, ethanol, naphtha, gasoline, vacuum gas oil, jet fuel, no. 2 fuel oil, no. 6 fuel oil, kerosene, renewable jet fuel, renewable diesel, used cooking oil, and animal fat. Imperium would store and use some of these bulk liquids at the facility in the biodiesel production process and would provide transfer services (loading and unloading for future customers as requested) from rail cars, tanker trucks, and tank vessels. Imperium's existing facility is located at Marine Terminal No. 1 of the Port (Figures 1-1 and 1-3).[2]

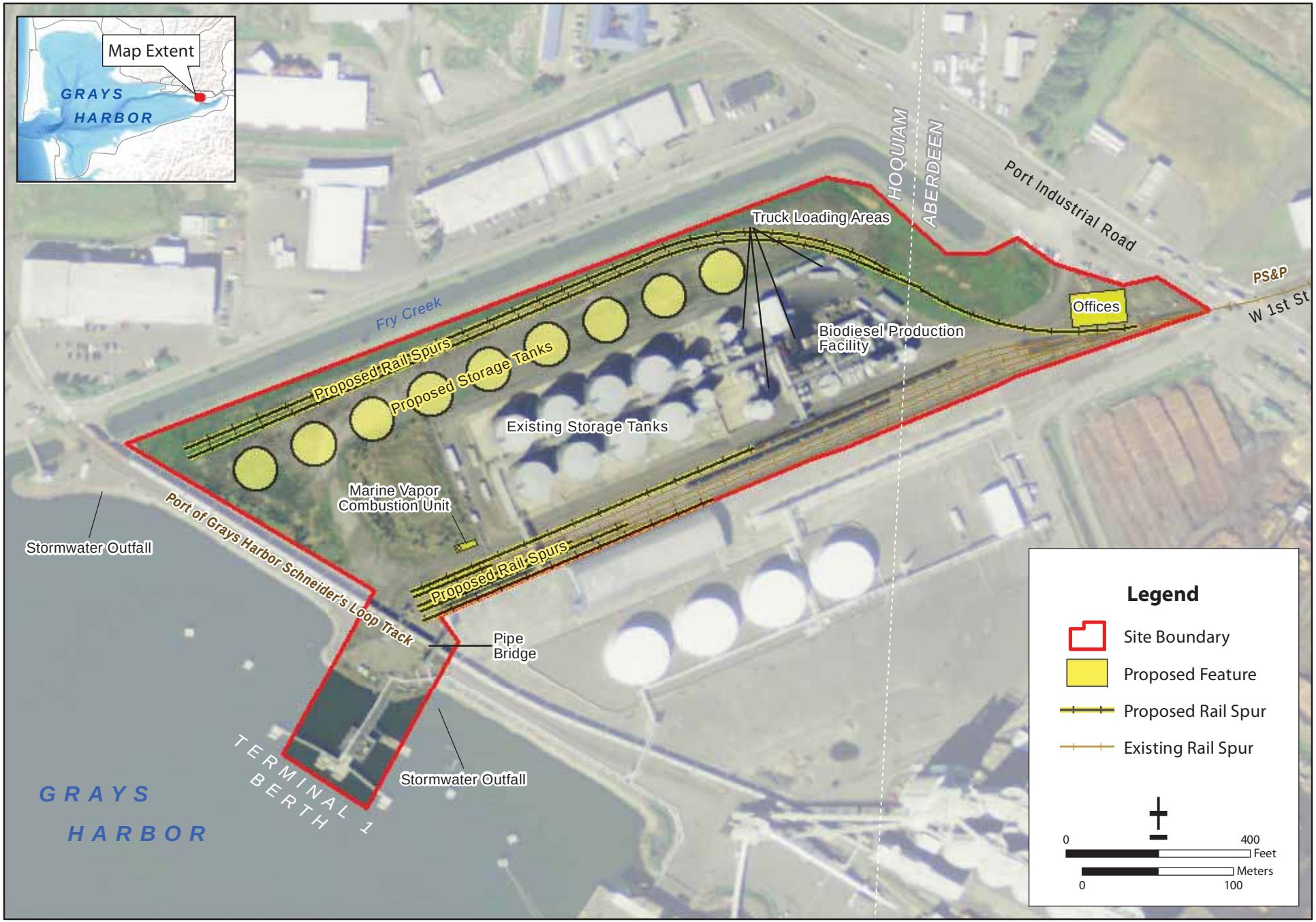
Proposed Action

The Imperium proposed action would be constructed in two phases. Phase 1 would include constructing five new storage tanks; expanding existing onsite rail facilities; and constructing a system of pipelines, a marine vapor combustion unit, and additional buildings. Phase 2 would include constructing four additional storage tanks. Depending on market conditions, Phases 1 and 2 may be constructed at the same time.

Storage Tanks

The Imperium proposed action would involve constructing nine new storage tanks on the Imperium project site to the north/northwest of Imperium's existing storage tanks. Each tank would be approximately 95 feet wide and 64 feet tall and would have the capacity to hold 80,000 barrels (3.63 million gallons) of bulk liquids, for a total additional storage capacity of up to 720,000 barrels (30.2 million gallons).

[2] Tax Assessor's Parcel Information: City of Hoquiam in Section 18, Township 17, Range 9 West, North of the Willamette Meridian, Tax Parcel Number #056402300000; and City of Aberdeen in Section 7, Township 17, Range 9 West, North of the Willamette Meridian, Tax Parcel Number #029902000200.
Latitude: 46.968253, longitude: -123.855871.



Sources: Site Design, Skillings Connely, 2014; Aerial Imagery, ESRI Basemap, 2010

Figure 1-3
Imperium Project Site
Westway and Imperium Expansion Projects

The area where the new storage tanks would be built is currently undeveloped and would require site grading. Approximately 314,000 square feet of earth would be graded with no material removed and 23,000 cubic yards filled. Once graded, an impervious liner, approved by a registered Washington State Professional Engineer, would be constructed over the prepared surface. The liner would be constructed of concrete or covered bentonite clay membrane and would be built on grade-level or elevated foundations in bermed areas made of an impervious material, with the capacity to contain the total volume of the largest tank, plus an allowance for precipitation. Each storage tank would be supported by a series of piles driven approximately 75 feet into the ground.

Loading and Unloading Areas

The Imperium proposed action would involve the expansion and improvement of the Imperium's existing rail and vessel loading and unloading areas. These changes are described below. No changes would be proposed for the facility's existing truck loading and unloading areas.

Rail

All elements of the rail loading and unloading areas would be constructed during Phase 1 with approximately 6,100 feet of new track constructed on the Imperium project site. Two new rail spurs would be constructed at the project site's northern end and the facility's existing five tracks located to the south would be extended. Construction of the rail facilities would require grading and forming the project site to be consistent with the grade of the existing rail.

Forty-one new rail car crude or refined petroleum unloading stations are proposed, which would bring the total up to 105 stations, sufficient to handle a unit train consisting of 105 cars. In addition, 45 new storage stations would be constructed, bringing the total capacity for onsite rail car storage to 161 stations. New and existing loading and unloading stations would be underlain with a center-sloped concrete containment area that collects and directs any spills to a central sump capable of holding the contents of a single rail car plus an allowance for precipitation.

Connection of the new spurs to the PS&P rail line would use the existing grade crossing at Port Industrial Road and would require no track to be constructed off site. This connection would be maintained by the Port.

Vessel

The Imperium proposed action would involve the construction of a marine vapor combustion unit for the transfer of the additional bulk liquids handled at the Imperium facility. The unit would be installed west of the existing storage tanks, and not at the existing dock (other than a small dock safety unit which would be installed on the Marine Terminal No. 1 dock). The marine vapor combustion unit would be used to incinerate displaced vapors during vessel loading and would use natural gas.

Pipelines

During Phase 1, a system of pipelines would be constructed to transfer bulk liquids from the loading and unloading areas to the new storage tanks. The new pipelines would consist of one 24-inch-diameter pipe and one 16-inch-diameter pipe. In general, the pipelines would be routed from the rail unloading areas in the new and expanded rail spurs to the new storage tanks (above grade, on pipe racks) and from the storage tanks over the Port's loop track via an existing pipe

bridge, along the Marine Terminal No. 1 dock (at grade, on concrete block pipe supports) to the berth.

Buildings

Phase 1 would also include constructing new buildings on the Imperium project site to replace existing mobile trailers. The new buildings would provide offices, a laboratory, and maintenance and warehouse facilities.

Operations

Under the Imperium proposed action, total throughput capacity of Imperium's facility would increase to 30 million barrels (1.26 billion gallons) per year. Imperium intends to continue to process and distribute biodiesel in a manner similar to existing operations, and the new capacity provided under the proposed action is currently planned to be used for crude oil. The facility could, however, distribute any one of or a mix of the bulk liquids depending on changes in market demand.

Onsite Operations

Under the Imperium proposed action, no changes would be made to Imperium's current operation of its biodiesel production facility. There are also no changes planned for the receiving, storage, and transport of materials related to biodiesel produced at the project site. Imperium anticipates continuing to receive biodiesel feedstocks, including the newly permitted liquids (used cooking oil and animal fat), and continuing to transport biodiesel and glycerin, similar to existing conditions. It is possible that the receipt, storing, and transferring of crude oil could be handled by these facilities in the future.

The additional planned capacity is anticipated to be dedicated to the transfer of crude oil from rail to tank vessels although Imperium would be permitted to receive, store, and transfer the other proposed bulk liquids. Once on site, rail cars would be pushed onto the loading and unloading spots where bulk liquid materials would be unloaded into a central collection area and pumped to the storage tanks. Under the proposed action, the facility would be capable of unloading one unit train per day. The bulk liquids would be pumped from the storage tanks via the new pipelines to vessel-loading facilities at Marine Terminal No. 1, where it would be transferred onto the tank vessel by hose.

Offsite Operations

Rail Transportation

It is anticipated that bulk liquids would be transported to and from the project site primarily by rail via any of the rail corridors along mainline railroads from the source of the crude oil. From Centralia to the Port, the only rail access is via the PS&P rail line. All trains associated with the Imperium proposed action would use this corridor to reach the project site.

Under the proposed action, increased train traffic would consist primarily of unit trains of approximately 105 cars but up to 120 cars (1.25 miles long). Unit trains are typically transported by four locomotives and would have to be broken into smaller segments and taken by switch engine to and from the project site. Smaller quantities bulk liquids would be transported by rail car as part of PS&P's existing freight traffic and not additional unit train trips. Operation of the proposed action at

full capacity would result in approximately 365 loaded unit train round trips per year, or one loaded unit train round trip every day on average. This would result in 730 total unit trains per year, loaded and unloaded traveling along the PS&P rail line to and from the Imperium project site.

Vessel

Bulk liquids would transported by tank vessel to and from the project site. The depth constraints of the Grays Harbor Navigation Channel limit the size of ships able to enter the harbor. The largest tankers would be Panamax-class vessels with capacity to hold up to 350,000 barrels (14.7 million gallons). Articulated tug and barge units would also be used. Tank barge capacity would range from 25,000 to 150,000 barrels (1.05 million to 6.3 million gallons).

Crude oil shipped from the facility would likely be transported by tank vessel to refineries in the Puget Sound area and northern California (Richmond area). Although transport of U.S. crude oil overseas is currently not allowed under U.S. law, it is possible for Canadian oil to be transported abroad, and overseas transport of U.S. oil could occur if current regulations were to change. Refined and other bulk liquids would be transported to domestic or international ports. At full capacity, operation of the proposed action would result in approximately 200 vessel round trips per year, i.e., approximately one round trip (entry and departure) every other day.

No-Action Alternative

Under the no-action alternative, the Imperium proposed action would not be constructed and Imperium would continue to operate its existing facility under current conditions. For the purposes of evaluating impacts, the no-action alternative includes planned infrastructure improvements that have already been funded or are expected to be permitted prior to 2017 (anticipated operational start date for the proposed action).

Chapter 2
Project Background

Personnel

Christopher Hetzel, senior architectural historian, served as cultural resources lead for this study and principal investigator for the consideration of built environment resources. J. Tait Elder, MA, senior archaeologist, was principal investigator for the consideration of archaeological resources. Melissa Cascella, MA, and Shane Sparks, MA (pending), assisted the principal investigators with the cultural resources survey and in drafting this cultural resources survey report.

Study Area

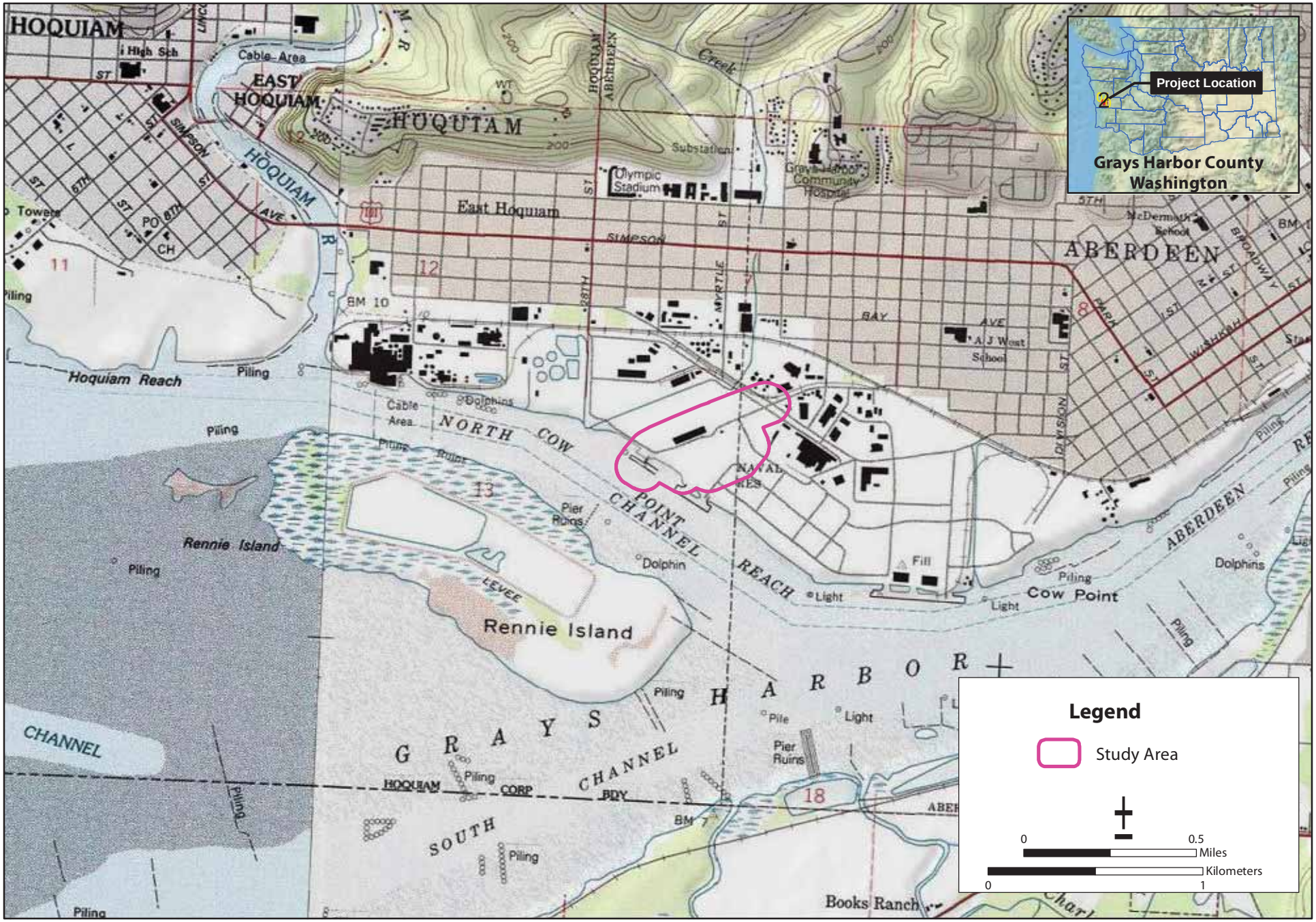
To accommodate the two separate proposed actions under consideration, ICF established separate cultural resources study areas (Figures 2-1 through 2-4). These study areas greatly overlap because the individual project sites are located on adjacent parcels. Therefore, some elements of the cultural resources survey presented in this report have been combined, to reduce redundancy. The cultural resources study areas are hereafter referred to as the *study areas* when combined, or the *Westway study area* and the *Imperium study area* when considered separately.

Both study areas are defined as the legal parcels that comprise the footprints of each project site, plus a 300-foot buffer surrounding these parcels. The project sites are considered as all locations of potential ground disturbance, and staging, construction, and equipment storage areas. The depth of potential ground disturbance is expected to vary across the study areas and according to individual project elements —deeper in areas where piles would be driven and shallower where minor grading or at-grade construction would occur.

In addition to the study areas, ICF also qualitatively considered potential impacts on cultural resources along transportation corridors to and from the project sites. These transportation corridors include the PS&P rail line, which extends from the Port to/from its intersection with the BNSF railway main line in Centralia, Washington, and the navigation channel through Grays Harbor.

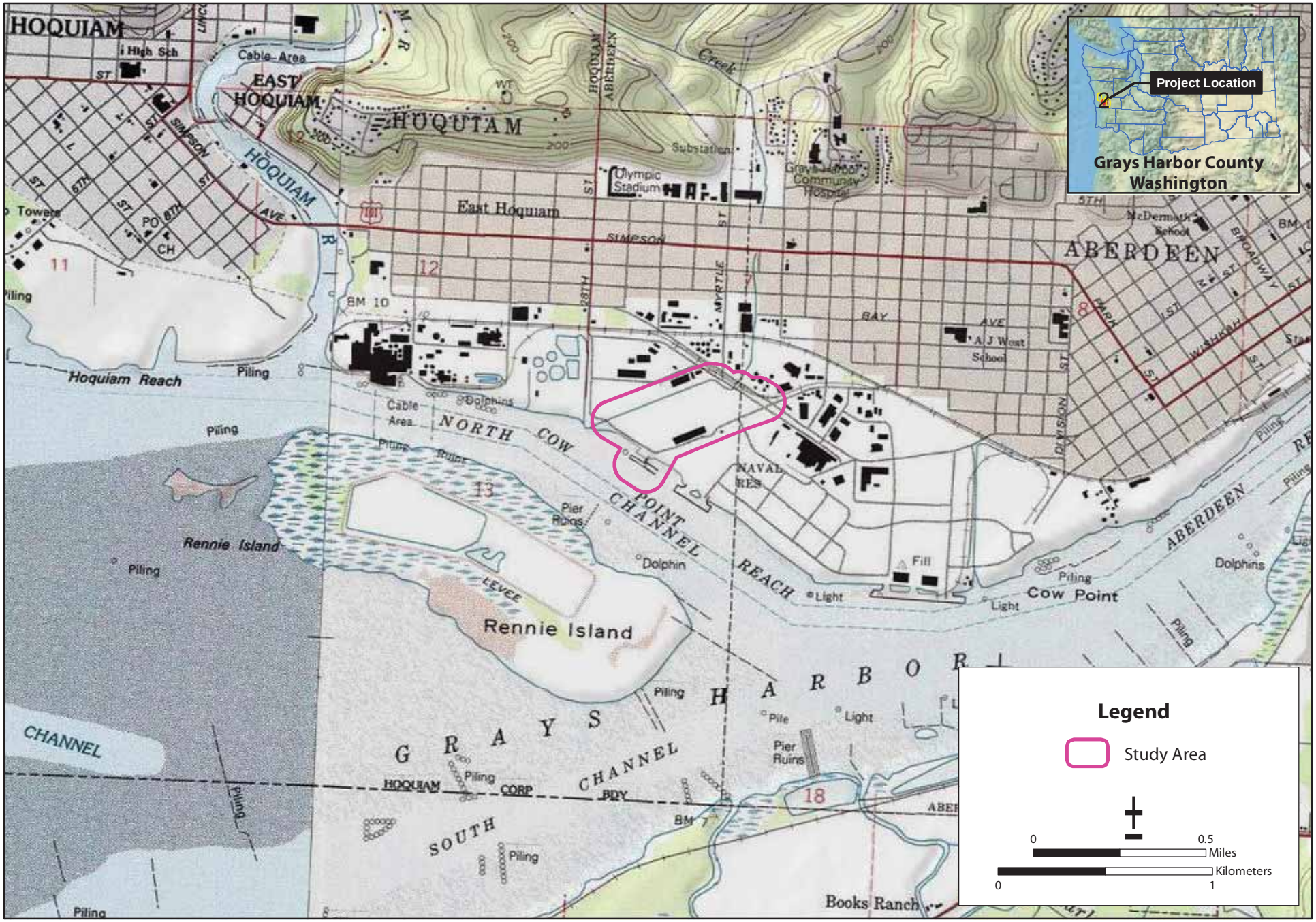
Regulatory Context

Federal, state, and local agency regulations recognize the public's interest in cultural resources and the public benefit of preserving these resources. These laws and regulations require analysts to consider how a project might affect significant cultural resources and to take steps to avoid or minimize potential damage. A cultural resource is considered to be any building, structure, object, site, landscape, or district associated with human manipulation of the environment. These resources are often valued by a particular group of people (monetarily, aesthetically, or religiously), and can be historic in character or date to the prehistoric past (i.e., the time prior to written records). Resource types referred to in this report include archaeological resources, historic resources, and culturally significant properties.



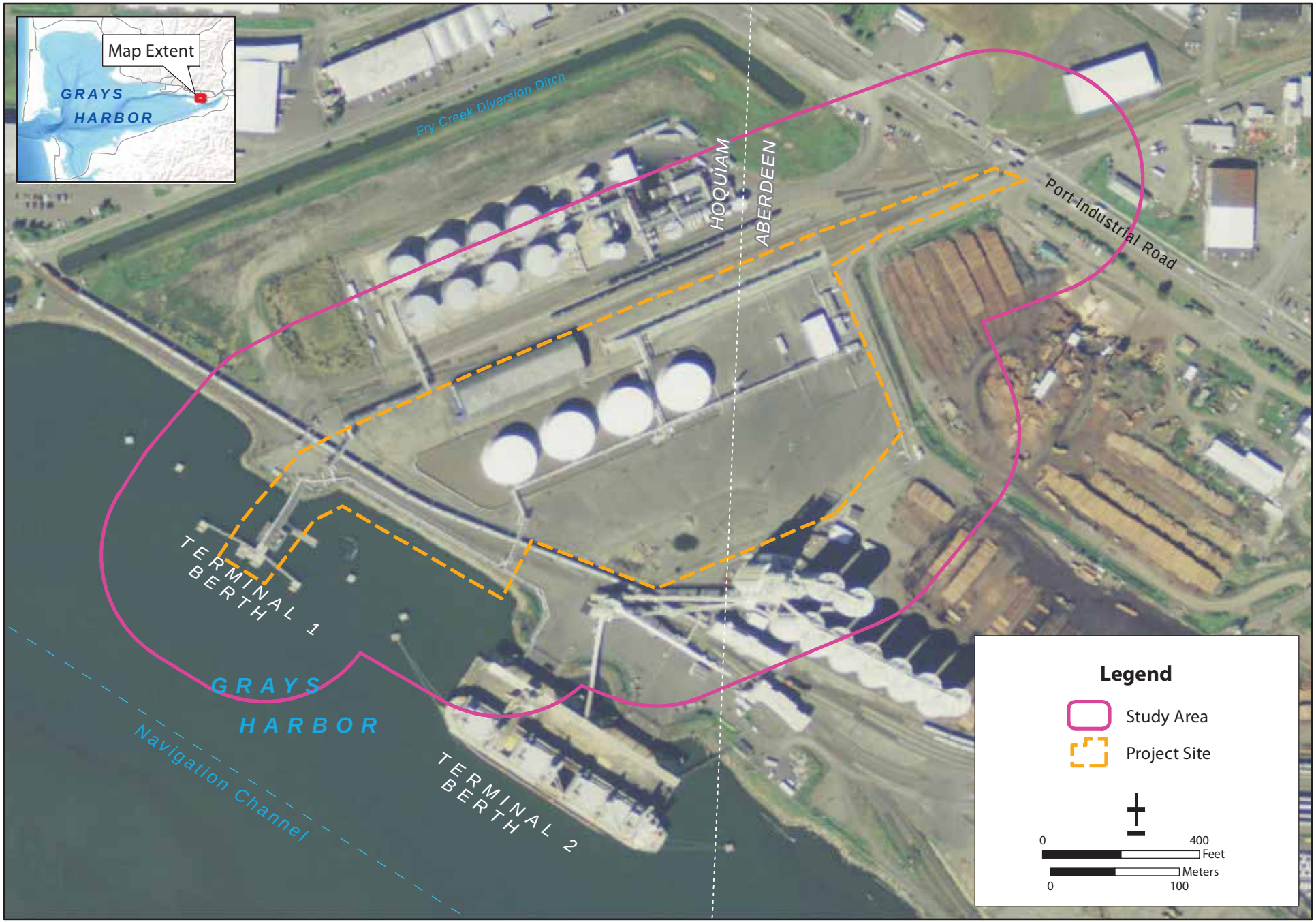
Sources: Site Design, Skillings Connely, 2014; Hoquiam, WA (46123-H8,1984) and Aberdeen, WA (46123-H7, 1984) 7.5" USGS Quadrangles

Figure 2-1
Westway Project Vicinity
Westway and Imperium Expansion Projects



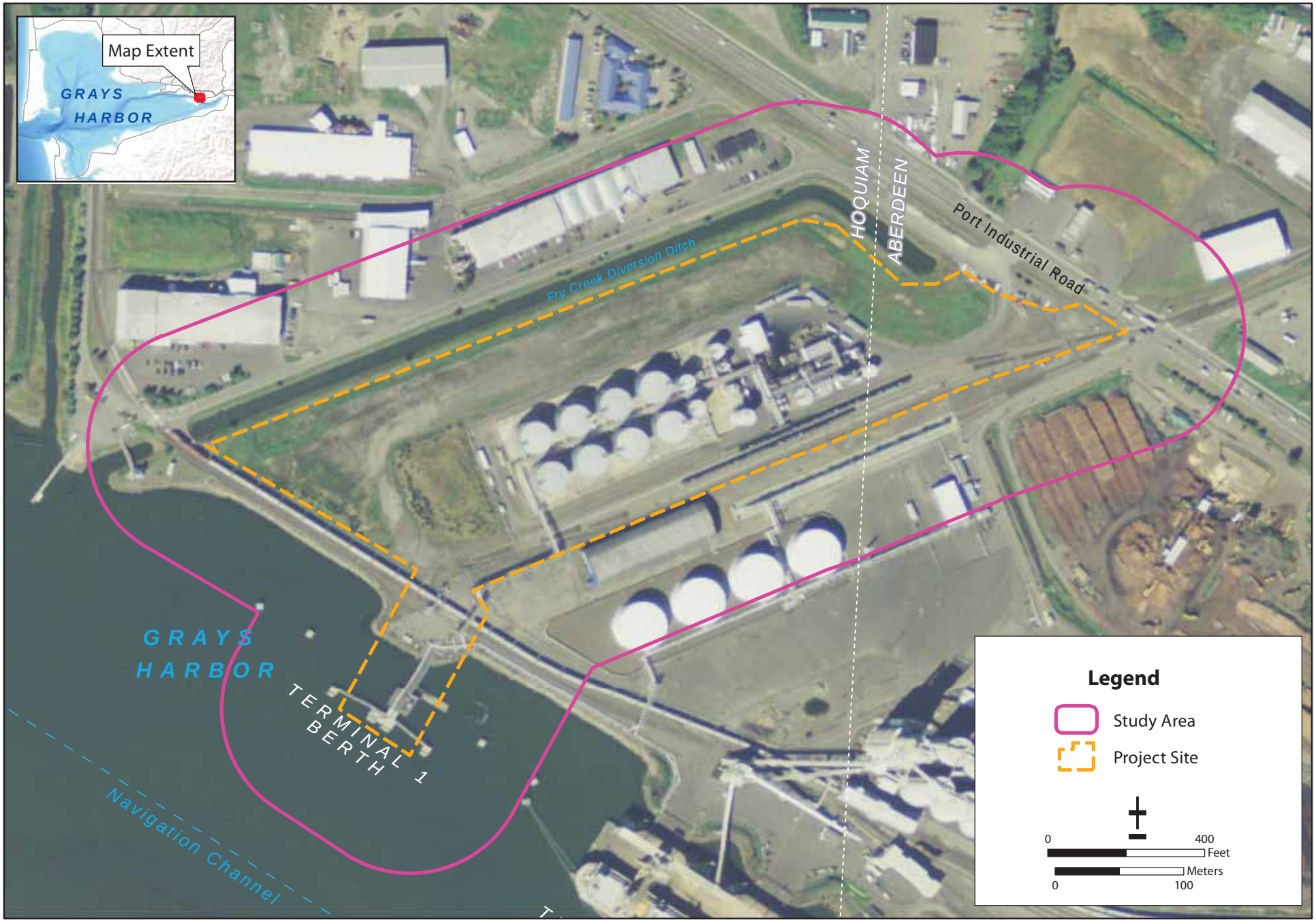
Sources: Site Design, Skillings Connely, 2014; Hoquiam, WA (46123-H8,1984) and Aberdeen, WA (46123-H7, 1984) 7.5" USGS Quadrangles

Figure 2-2
Imperium Project Vicinity
Westway and Imperium Expansion Projects



Sources: Site Design, Harris Group, 2014; Aerial Imagery, ESRI Basemap, 2010

Figure 2-3
Westway Study Area
Westway and Imperium Expansion Projects



Sources: Site Design, Skillings Connely, 2014; Aerial Imagery, ESRI Basemap, 2010

Figure 2-4
Imperium Study Area
Westway and Imperium Expansion Projects

State

The project must be performed in compliance with SEPA, and must, therefore, comply with other state and local cultural resources requirements, as appropriate. The key applicable laws and regulations are described below.

State Environmental Policy Act

SEPA requires that all major actions sponsored, funded, permitted, or approved by state and/or local agencies be planned so that environmental considerations—such as impact on cultural resources—are considered when state agency-enabled projects affect properties of historic, archaeological, scientific, or cultural importance (WAC 197-11-960).

Under SEPA, the Washington State Department of Archaeology and Historic Preservation (DAHP) is the specified agency with the technical expertise to consider the effects of a proposed action on cultural resources and to provide formal recommendations to local governments and other state agencies for appropriate treatments or actions. The degree to which an action may adversely affect districts, sites, buildings, structures, and objects listed in or eligible for listing in the National Register of Historic Places (NRHP) is the primary criterion for determining significant impacts under SEPA. Secondary criteria include whether an alternative has the potential to affect districts, sites, buildings, structures, and objects listed in or eligible for listing in the Washington Heritage Register (WHR), the state equivalent of the NRHP.

First authorized by the Historic Sites Act of 1935, the NRHP was established by the National Historic Preservation Act of 1966 as "an authoritative guide to be used by federal, state, and local governments; private groups; and citizens to identify the nation's cultural resources and to indicate what properties should be considered for protection from destruction or impairment." The NRHP recognizes properties that are significant at the national, state, and local levels, based on the following evaluation criteria.

A. That are associated with events that have made a significant contribution to the broad patterns of our history; or

B. That are associated with the lives of significant persons in or past; or

C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. That have yielded or may be likely to yield, information important in history or prehistory.

The guidelines further state that "Ordinarily, birthplaces, cemeteries, or graves of historical figures; properties owned by religious institutions or used for religious purposes; structures that have been moved from their original locations; reconstructed historic buildings; properties primarily commemorative in nature; and properties that have achieved significance within the past 50 years are not considered eligible for the NRHP," unless they satisfy certain conditions.

The NRHP requires that a resource not only meet one of these criteria, but that it must also possess integrity. *Integrity* is the ability of a property to convey historical significance. The evaluation of a resource's integrity must be grounded in an understanding of that resource's physical characteristics and how those characteristics relate to its significance. The NRHP recognizes seven aspects or qualities that, in various combinations, define the integrity of a property, including: location, design, setting, materials, workmanship, feeling, and association.

The WHR is an official listing of historically significant sites and properties found throughout the state. The list is maintained by DAHP and includes districts, sites, buildings, structures, and objects that have been identified and documented as being significant in local or state history, architecture, archaeology, engineering or culture. To qualify for placement on the WHR, the resource must meet the following criteria.

- A building, site, structure or object must be at least 50 years old. If newer, the resource should have documented exceptional significance.
- The resource should have a high to medium level of integrity (i.e., it should retain important character-defining features from its historic period of construction).
- The resource should have documented historical significance at the local, state, or federal level.

Sites listed on the NRHP are automatically added to the WHR; hence, a separate nomination form does not need to be completed.

Other State Archaeological Resource Laws

Other state laws that govern the protection of archaeological resources include:

- RCW 27.44, Indian Graves and Records provides protection for Native American graves and burial grounds, encourages voluntary reporting of said sites when they are discovered, and mandates a penalty for disturbance or desecration of such sites.
- RCW 27.53, Archaeological Sites and Resources governs the protection and preservation of archaeological sites and resources and establishes DAHP as the administering agency for these regulations.
- RCW 36.70A.020 includes a goal to "[i]dentify and encourage the preservation of lands, sites, and structures that have historical, cultural, and archaeological significance." Cities planning under the Washington State Growth Management Act must consider and incorporate this historic preservation goal.
- RCW 68.60, Abandoned and Historic Cemeteries and Historic Graves, provides for the protection and preservation of abandoned and historic cemeteries and historic graves.

Local

Both the Cities of Aberdeen and Hoquiam, Washington, maintain local registers of historic places, which include individually registered city landmarks, historic districts, or conservation districts (Aberdeen Municipal Code, Title 17, Chapter 17.50 and Hoquiam City Code, Chapter 10.06). The historic preservation commissions in each city are responsible for the administration and oversight of these regulations. Properties are nominated to the local registers of historic places and designated by city council resolution. Changes to the exteriors of listed properties in the study area would be subject to review by these respective commissions.

Agency and Tribal Consultation

Ecology has initiated consultation with DAHP and potentially affected Native American tribes regarding the proposed actions and potential impacts on cultural resources. Consultation to date has included the following.

- April 4, 2014. Ecology sent a letter of notification about the scoping period for both proposed actions to the Quinault Indian Nation, the Confederated Tribes of the Chehalis Reservation, the Coeur d'Alene Tribe, the Yakama Nation, and the Spokane Tribe of Indians,
- May 27, 2014. The Quinault Indian Nation provided scoping comments.
- June 10, 2014. The Quinault Indian Nation sent a letter to Ecology requesting government to government consultation.
- July 18, 2014. A government to government meeting was held conducted by the Quinault Indian Nation and Ecology.
- September 16, 2014. The Quinault Indian Nation sent a letter to Ecology with comments on scoping and government to government meeting.
- September 17, 2014. Letter from DAHP to the City of Hoquiam requesting information about cultural resources investigations.
- October 16, 2014. Ecology letter to the Quinault Indian Nation with response to comments.
- November 24, 2014. Meeting conducted by Quinault Indian Nation and Ecology with technical staff and consultants.
- December 3, 2014. Meeting conducted by the Confederated Tribes of the Chehalis Reservation and Ecology with technical staff and consultants.
- Correspondence between the Quinault Indian Nation President, the Honorable Fawn Sharp, and Ecology Regional Planner, Diane Butorac regarding the scope of the environmental review process. (September and October 2014).

The potentially affected, federally recognized Native American tribes include the Quinault Indian Nation and the Confederated Tribes of the Chehalis Reservation. DAHP and City of Hoquiam are additional consulting parties. Copies of relevant agency and tribal correspondence are provided in Attachment A.

Chapter 3
Environmental and Cultural Setting

This chapter describes the environmental and cultural setting of the study areas. This information helps with characterizing cultural resources sensitivity in the study areas, informs the evaluation of these resources, and is used to frame the research design and methods used for the cultural resources study.

Environmental Setting

Geology

The study areas are located within the Willapa Hills geomorphic province; a region characterized by uplifted bedrock ridges and hills, barrier beaches, and the estuaries of Grays Harbor and Willapa Bay. The province is bounded by the Olympic Mountains to the north, Puget Lowlands to the east, Pacific Ocean to the west, and Columbia River to the south. The study area is underlain by basalts formed during the Eocene epoch (around 56 million to 34 million years ago) and sedimentary rock derived from marine sediments deposited along the Washington coast during the Tertiary period (around 66 million to 2.6 million years ago) (Schuster 2009).

During the Pleistocene epoch (around 2.6 million to 12,000 years ago), the Puget Lowland and northern margin of the Olympic Peninsula were intermittently covered by glacial ice, which advanced southward from British Columbia (Troost and Booth 2008:2). Although the study areas were located below the southern-most extent of the glacial ice, glacial meltwater from the Puget Lowland drained into the Pacific Ocean through the lower Chehalis Valley, within which Grays Harbor and the study areas are located. Most recently, during the Vashon Stade of the Fraser glaciation or Vashon advance (around 18,750 to 16,950 years ago), glacial meltwater that pooled against the southern margin of the Puget Lobe ice sheet flowed into the lower Chehalis valley through a series of low-lying drainages, including the Black Lake spillway in Olympia and Ohop Channel near Eatonville (Bretz 1914). As the water drained through the lower Chehalis valley, thick deposits of gravels and sands were deposited across the valley, including the Grays Harbor basin (Peterson and Phipps 1992). As glacial ice retreated farther north during this period, a lower elevation drainage was exposed along the northeastern edge of the Olympic Peninsula near Chimacum (Troost and Booth 2008). Following the exposure of this drainage, glacial meltwater ceased to drain through the lower Chehalis valley.

As a result of the large volumes of water trapped in continental glaciers during the late Pleistocene epoch, global sea levels were significantly lower than at present; extending as much as 125 meters below their current levels approximately 15,000 years ago. From around 15,000 years ago to around 7,000 years ago, global sea levels rose to around 5 to 8 meters below their current elevation, with sea levels approaching their present elevation approximately 2,000 years ago (Flemming et al. 1998). Although local geologic factors can affect the magnitude of local sea-level change, the Grays Harbor basin appears to have undergone sea-level rise comparable in timing and scale to the global pattern of sea-level rise (Peterson and Phipps 1992). As sea levels rose, the lower course of the Chehalis River became inundated and formed Grays Harbor, which began to in-fill with sands and

silts (Peterson and Phipps 1992; Alt and Hyndman 1995). Geoarchaeological cores collected just over 0.75 mile east of the study areas along the Grays Harbor shoreline revealed that Holocene-aged silts and sands range from 85 to 115 feet in thickness (Phipps 2009), an observation roughly corroborated by geotechnical borings excavated within the study areas (Heller and Phelps 2014).

The Washington coast parallels the Cascadia Subduction Zone, which extends from northern California to southern British Columbia where the Juan de Fuca plate subducts beneath the Pacific plate. As a result of the friction generated at the contact between the two plates, the Washington coastline undergoes long periods of gradual uplift that are interrupted by sudden slips, resulting in rapid coseismic subsidence (Leonard et al. 2010). Evidence of at least eight subsidence events have been documented in the Grays Harbor area from around 5,400 years ago to around 300 years ago (Atwater 1992; Phipps 2007), with rates of subsidence ranging from 0.5 to 2.0 meters (Atwater 1987; Dareienzo and Peterson 1990; Nelson 1992). Coarse-grained sediments deposited by tsunamis, which are the result of the sudden displacement of water associated with rapid subsidence, have been documented in geotechnical cores and cutbanks throughout Grays Harbor (Phipps 2007).

Both the Washington Interactive Geologic Map and the U. S. Soil Conservation Service describe the study areas as being primarily in-water (Washington Geological Survey 2014; Pringle 1986), a function of these areas having been used as slips during the middle to late twentieth century before being diked and filled (see historic context discussion below) (Figure 3-1). Both sources also describe the vicinity of the study areas as comprising alluvial silts and sands (Washington Geological Survey 2014; Pringle 1986).

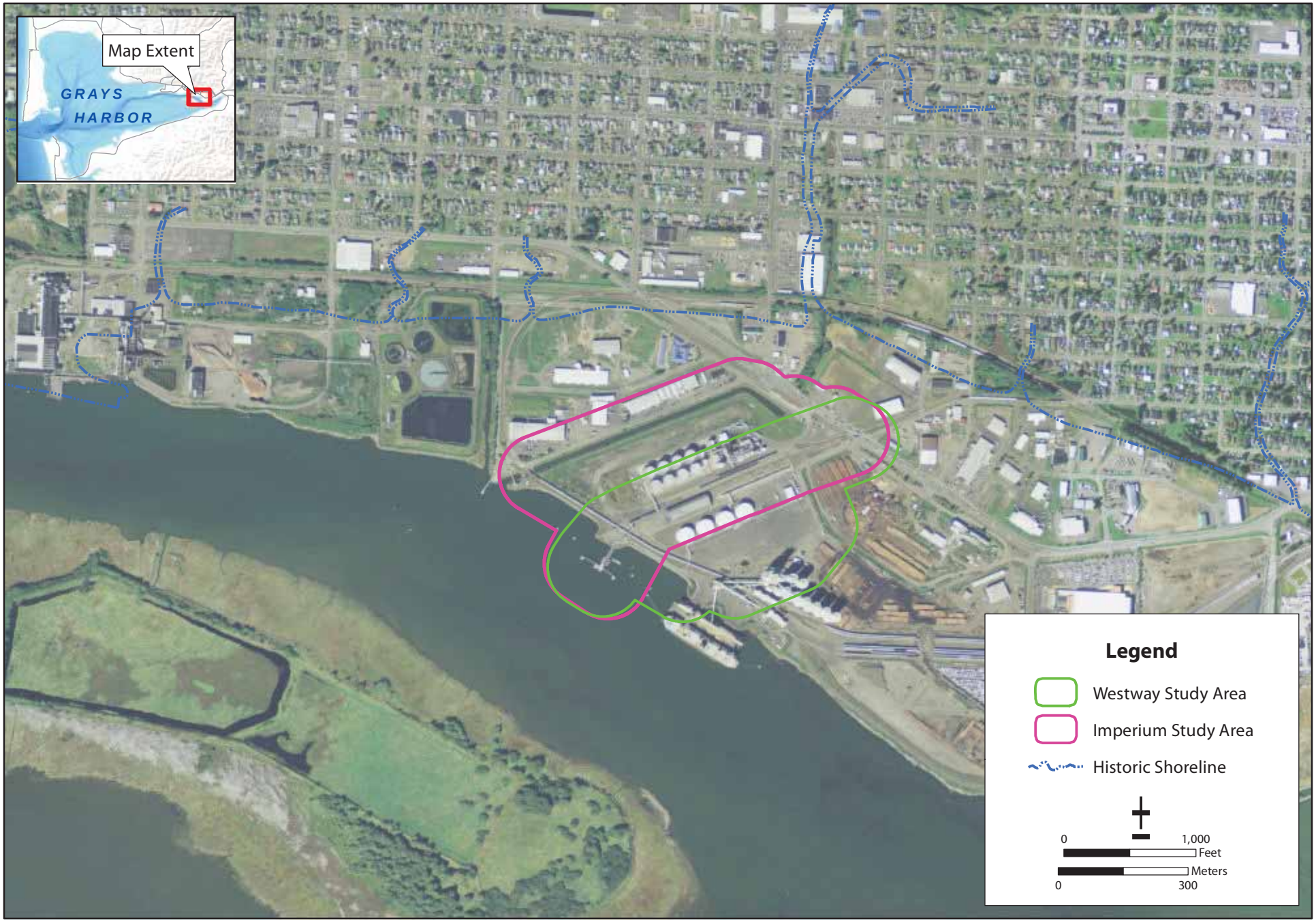
Flora

Grays Harbor is located within the sitka spruce (*Picea sitchensis*) vegetation zone, a long narrow area that stretches along the Washington and Oregon coast. Forests in this area are typically very dense, and most commonly consist of sitka spruce, western hemlock (*Tusga heterophylla*), and western red cedar (*Thuja plicata*). Red alder (*Alnus Rubra*) is most abundant in recently disturbed sites (Franklin and Dyrness 1988). Understory shrubs of potential food value for Native Americans within the sitka spruce zone include, but are not limited to, salal (*Gaultheria shallon*); blueberries and huckleberries (*Vaccinium* sp.); blackberry, salmonberry, and thimbleberry (*rubus* sp.); and red elderberry (*Sambucus racemosa)*. Geophytes, such as common camas (*Camassia quamash*) and tiger lily (*Lilium columbianum*), were collected when available (Pojar and Mackinnon 1994; Gunther 1945).

The study areas are located along the Grays Harbor shoreline, an environment that can support several traditionally used salt-tolerant plant species; including, but not limited to, Pacific silverweed (Potentilla anserina); springbank clover (*Trifolium wormskkjoldii*), northern rice-root lily (*Fritillaria camschatcensis*), and Tule (*Scirpus lacustris*) (Pojar and Mackinnon 1994: Deur 2005)

Fauna

Terrestrial faunal resources in the region include, but are not limited to, mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), black bear (*Ursus americanus*), squirrels (*Scirius* sp.), muskrat (*Ondatra* sp.), and raccoon (*Procyon lotor*) (Eder 2002).



Sources: Site Design, Skillings Connely, 2014; NOAA Historic Shoreline Data (2014) Aerial Imagery, ESRI Basemap, 2010

Figure 3-1
Historic Shoreline Location in the Study Areas and Vicinity (1909-1911)
Westway and Imperium Expansion Projects

Aquatic faunal resources include the river otter (*Lontra canadensis*); ducks, and geese (*Anas sp.*) (Ames and Maschner 1999); Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), and chum (*O. keta*) salmon; and steelhead (*O. gairdnerii*). The Hoquiam River has fall Chinook, chum, and both late and early coho runs (Phinney and Bucknell 1975). Marine faunal resources in the harbor include the cutthroat (*Oncorhynchus clarki clarki*) and steelhead trout (*O. mykiss*), eulachon (*Thaleichthys pacificus*), starry flounder (*Platichthese stellatus*), Pacific herring (*Clupea pallasi*), white (*Acipenser transmontanus*) and green sturgeon (*Acipenser medirostris*), Northern anchovy (*Engraulis mordax*), Pacific lamprey (*Lampetra tridentatus*), and English sole (*Pleronectes vetulus*) (Pacific State Marine Fisheries Commission 1996).

Although Grays Harbor has shellfish resources in addition to vertebrate faunal resources, they tend to decrease in frequency and variety east of where Grays Harbor feeds into the Pacific Ocean. As a result, no shellfish are currently thought to inhabit the shores of the study areas (Herrmann 1972). The mouth of the Hoquiam River, however, was known for large quantities of bay mussels (*Mytilus trossulus*) in the early historical period (Van Syckle 1982).

Cultural Setting

Precontact Context

Cultural developments of the outer Washington coast (hereafter referred to as the Washington coast) have been considered in summaries of regional cultural patterns in the Pacific Northwest (Matson and Coupland 1995; Ames and Maschner 1999; Moss 2011) and with regard to local cultural and archaeological sampling patterns (Wessen 1998). Studies of the archaeology and prehistory of the Pacific Northwest divide the prehistoric cultural sequence into multiple phases or periods from about 12,500 to 225 years BP, and are delineated by changes in regional patterns of land use, subsistence, and tool types over time. These phases are academic constructs and do not necessarily reflect Native American viewpoints. This document uses the Pacific Northwest coast cultural sequence provided by Ames and Maschner (1999) to help describe patterns in precontact cultural developments of the Washington coast. The sequence includes five periods, which are briefly summarized below:

Paleo-Indian (prior to 12,500 BP). The Paleo-Indian period is characterized by sparsely distributed highly mobile groups that primarily used terrestrial resources. Assemblages include large stone bifaces and bone technology. No archaeological sites from the Paleo-Indian period have been documented along the Washington coast. The nearest archaeological sites from the Paleo-Indian period are located in the Puget Sound region on upland glacial plains.

Archaic (12,500 to 6,400 BP). The Archaic period is characterized by increased technological diversity relative to the Paleo-Indian period. Typically located on alluvial terraces, assemblages include leaf-shaped bifaces, cobble, flake, and bone tools. Evidence of littoral resource use begins to appear during this period in the larger Pacific Northwest region; particularly Southeast Alaska and British Columbia; but not along the Washington coast. Some inland lithic artifacts scatters on the Olympic Peninsula appear to have attributes similar to Archaic- to Early Pacific period archaeological assemblages from the Puget Sound.

Early Pacific (6,400 to 3,800 BP). The Early Pacific period is characterized by expanded use of intertidal resources and increased dependence on bone and antler tools relative to the Archaic

period. Assemblages include bone points, barbs, and harpoons; ground stone points and celts; and shell middens. Although evidence for the use of upland and riverine resources continued, the earliest evidence for littoral resource use in the Puget also occurs during this period. No archaeological sites from the Early Pacific period have been documented along the Washington coast.

Middle Pacific (3,800 to 1800–1500 BP). The Middle Pacific period is characterized by the first evidence of permanent social inequality, as well as a shifting emphasis to a storage-based economy, intensification of salmon fishing, an increase in the variety of bone and antler tools, and near-modern art styling. Assemblages include artifacts similar to those associated with the Early Pacific period as well as plank house remains, wooden boxes, toggling harpoons, fish hooks, and fish rakes. Sites situated along the littoral zone become prevalent during this period.

Late Pacific (1800–1500 to around 225 BP). The Late Pacific period is characterized by the emergence of extremely large houses, heavy-duty woodworking tools, and a decreased reliance on chipped stone tools. Assemblages include artifacts similar to those associated with the Middle Pacific period.

The precontact archaeological record for the Washington coast is almost exclusively comprised of sites with contents that are consistent with assemblages from, or have been dated to, the Middle and Late Pacific periods. This clustered chronological distribution is thought to be largely a function of coastal geomorphic processes and archaeological survey design bias (Wessen 1998; Elder et al. 2014). Many of the sites along the Washington coast are shell middens with bone and ground stone tools and very few chipped stone artifacts; consistent with many Late Pacific period archaeological sites. [*Text containing sensitive information was removed.*] Although the contents of the shell middens of the Washington coast are consistent with those located elsewhere on the Pacific Coast, Wessen (1998) observes a distinction between the relative frequency and types of resources represented in shell middens along the northern and southern Washington coast. For example, northern coast shell middens tend to contain an abundance of marine mammal remains, while northern coast shell middens tend to be dominated by terrestrial mammal remains.

Two well-documented archaeological sites with organic materials preserved in saturated environments, termed *wet sites*, are located along the northern Washington Coast. [*Text containing sensitive information was removed.*] The similarity between many of these items and those used by Native Americans during the early historic era illustrates a long-standing continuity in a variety of cultural activities, most notably basket weaving form and style (Croes 1977). In addition to the two wet terrestrial sites identified above, the Washington coast has several documented wooden precontact intertidal fish capture facilities, termed *fish weirs*. [*Text containing sensitive information was removed.*] These facilities, combined with the numerous wood and bone fishing implements identified in middens and wet sites along the entire Washington coast, reflect the importance of marine resources to the precontact inhabitance of the region.

Ethnographic Context

The vicinity of the study areas was traditionally inhabited by the Hoquiam and Wishkah people, who spoke the Lower Chehalis dialects of the Salish language. Both groups lived along the banks of the rivers that share their namesakes. The waters in the vicinity of the study areas, including the mouth of the Hoquiam River, were also seasonally used for fishing by the Quinault people, who spoke the Quinault dialect of the Salish language (Gibbs 1877; Curtis 1913; Hajda 1990).

Grays Harbor, the landscape feature that the study areas fall within, was an important hub for habitation, resource collection, and travel for coastal Native American groups. It served as a passage for coastal tribes to the Puget Sound by way of the Chehalis River, and to the Columbia River by way of the Chehalis River and then the Cowlitz River. As a productive fishing area, Grays Harbor was used by numerous Lower Chehalis-speaking groups, as well as the Quinault. As a result of this use, the Native American groups of Grays Harbor maintained strong relationships and trade networks with each other and with neighboring groups from the Upper Chehalis, Quinault, and Shoalwater Bay—relationships strengthened by intergroup marriages (Miller 2009).

The waters of Grays Harbor were traditionally, and continue to be, important fishing areas for Native Americans in the region, while the shores served as productive hunting and plant gathering areas. Consistent with many Salish speaking groups, the precontact peoples of the Grays Harbor area relied on fisheries for a large portion of their diet. Salmon fishing occurred throughout Grays Harbor and its associated rivers and creeks; and was particularly fruitful at the mouth of the Hoquiam River (Welsh 1942:10; VanSyckle 1982:74). Salmon were caught with weirs, hooks and line, spears, gaffs, and drift nets. In addition to salmon, precontact peoples also caught eulachon, flounder, herring, lamprey, smelt, sole, and sturgeon. Sturgeon were usually caught with a large hook and line, but were also netted in conical bag nets between two canoes. Herring, smelt, and eulachon were caught with rakes and dip nets from canoes (Miller 2009); and the Hoquiam people used weirs built on or near eelgrass beds where herring spawned (Adamson 1969:329–342). Flounder and sole were captured by feeling along the mudflats with the feet and either impaling the fish with a sharp stick between the toes or holding it to the ground with the foot while another participant would dive down and grab it. Lampreys were captured by hand at night using a pitch torch (Miller 2009).

The Grays Harbor shoreline provided habitat for terrestrial mammals, avians, and plant resources. Land game, which included bear, beaver, deer, elk, and otter, were hunted with bow and arrow, spears, and traps. Waterfowl was caught using duck spears, pole nets thrown from canoes, submerged or aerial net traps. Edible plants, such as berries, roots, and bulbs, were collected along the rivers and tide prairie. Sweetgrass (a particularly important traditionally used plant), cattail, swampgrass, and stinging nettle were collected for weaving and textiles. Nettle was also used to make nets and line for fishing (Miller 2009).

Contact with European Americans prompted rapid change to traditional life among Native Americans in the Pacific Northwest. Starting in the early nineteenth century, fur trade routes were established and a limited number of European Americans regularly visited the region, introducing metal tools, new clothing styles, and foods. This initial contact was followed shortly thereafter by a malaria epidemic that devastated native populations (Boyd 1985). Beginning in the 1840s, large groups of European Americans made their way into the region as part of a large wave of settlers and homesteaders, prompted in part by the passing of the Treaty of Washington in 1846 and the Oregon Donation Act of 1850. As a result of this influx, traditionally used lands became increasingly inaccessible (Ruby and Brown 1995).

Following unsuccessful negotiations with Governor Isaac Stevens for the establishment of a reservation in 1855, the United States government obtained title to Native American lands in Grays Harbor without consent. After being removed from their traditional lands, descendants of the Hoquiam and Wishkah now live on the Confederated Tribes of the Chehalis Reservation, Quinault Reservation, or live in communities in the vicinity of their traditional territory (James and Martino 1986; Ruby and Brown 1995).

Ethnographically Named Places near the Study Areas

At least three ethnographically named places are located within a few miles, but outside, of the study areas. These places include: *xwa'qwyamc* (the Hoquiam River), *Ho-kwa-im-its* (a village located at the mouth of the Hoquiam River), and Cow Point (a fishing area/camp east of the study area) (James and Martino 1986; Miller 2009). Although other areas of ethnographic significance are undoubtedly located in the vicinity of the study areas, they do not appear to be documented in the available literature.

Historic Context[3]

Maritime explorers and fur traders were the first Euro-Americans to explore what is now known as Grays Harbor, arriving during the late eighteenth century. Captain Robert Gray, sailing the American ship Columbia Rediviva, first entered the mouth of the Columbia River on May 7, 1792, seeking to establish a fur trade foothold for Boston merchants (Scofield 1993; Van Syckle 1982). He next traveled further north, where he encountered Grays Harbor and named it "Bulfinch's Harbor" after his ship's owner. About 6 months later, Lieutenant Joseph Whidbey of the Vancouver expedition followed Gray's route, entered Grays Harbor, and renamed the bay in honor of Gray (Hanable 2004; Hayes 1999; Van Syckle 1982). Many years later, in 1824, a Hudson Bay Company crew traveling to the Puget Sound via the Columbia River next passed through the vicinity of present-day Aberdeen and Hoquiam initiating the first of many Euro-American incursions into the region.

Settlement

Settlement in the Grays Harbor region increased significantly following the signing of the Oregon Treaty in 1846, in which Britain ceded all claims to land south of the 49th parallel to the United States. The Washington Territory was established in 1853 and Chehalis County (whose name was changed to Grays Harbor County in 1915) formed the following year (Douglas 1914; Wilkes 1845; Wilma 2006; Work 1912). Although Grays Harbor would eventually become the sawmill capital of Western Washington, the area's earliest settlers were typically cattle and dairy farmers who sought to clear the land of its thick forests. Discoveries of gold in the Fraser River region of British Columbia helped further spur this development, due to the increased demand for beef and butter.

Several communities emerged to support this early settlement. Cosmopolis, a lumber-company town, was founded in the early 1850s on the Chehalis River's south shore, approximately 3.5 miles east of present-day Aberdeen, followed by the towns of Hoquiam and Aberdeen in the late 1850s.

Hoquiam

Hoquiam was initially established on the west bank of the Hoquiam River where it enters Grays Harbor. The first settlers in what is now Hoquiam were Samuel James, Roger James, Edward Campbell, Selucius Garfield, and James Karr. Samuel James claimed land along the harbor's north shore in 1857 and John Rogers James filed a 160-acre claim that encompassed nearly all of present-

[3] Portions of this section were adapted from David W. Harvey and Katheryn H. Krafft, *Historic Resources Survey and Inventory of the Cities of Aberdeen and Hoquiam, Washington*, prepared for the Washington State Department of Community Development and the Washington State Department of Archaeology and Historic Preservation (1988).

day Hoquiam that same year. Similarly, Campbell and Garfield staked claims on the Hoquiam River's east bank in 1858 and James Karr moved into Grays Harbor from Oregon in 1859 (Lamb 1948).

Edward Campbell applied for and received a commission from the United States government to establish a post office at the mouth of the Hoquiam River in 1867. When applying for the commission, Campbell chose the name "Hoquiam," after some wrangling over its spelling. The local indigenous name for the Hoquiam River, it was commonly spelled "Hokium" at the time Campbell served as Hoquiam's postmaster until his retirement in 1887 (Goings 2008).

By the mid-1860s the land along the lower Hoquiam River was largely settled, increasing demand for infrastructure such as roads, schools, and mail service. However, Hoquiam and other Grays Harbor communities remained largely isolated from the outside world with only a few scattered farms and few established transportation routes until the 1880s. In 1879, the arrival of the steam schooner Kate & Ann initiated greater access to the region's vast timber and fishing resources for the first time and introduced an outlet for local products (Birks 1938). Shipping routes between Grays Harbor communities, Portland, and an increasing number of other cities nationwide soon enabled the development of the region's logging and timber industries (Van Syckle 1982).

During this period, Hoquiam transformed from a small agricultural community into a modern industrial city. Spurred by new sawmills, logging camps, and the potential for a local Northern Pacific terminal, the town's population increased from 400 to 1,500 between 1889 and 1890 and doubled again between 1890 and 1900. By 1910, the population was 8,200 and featured "three theatres, nine churches, two banks, a public library, a Young Men's Christian Association (YMCA) facility, three major hotels, numerous boarding houses, and dozens of up-scaled residences" (Hoquiam Public Library). In 1913, the city reached a population of 14,000 residents with the largest payroll per capita in the state.

Aberdeen

Aberdeen is located at the confluence of the Wishkah River where it enters Grays Harbor. Like Hoquiam, it emerged in the late-nineteenth century as a prominent industrial center based on harvesting, processing, and exporting the region's natural resources. The location that would eventually become downtown Aberdeen was originally settled by Samuel Benn. Benn had first claimed a tract of land in the Chehalis River valley in the 1850s and later traded this claim for land at the mouth of the Wishkah River. He eventually owned 600 acres in the area. By 1875, the James Stewart and Alexander Young families joined Benn, also with claims along the Wishkah River. These three families constituted the small settlement through the early 1880s.

A turning point in Aberdeen's development occurred in 1883 when civil engineer D.W. Fleet surveyed and platted the townsite of Wishkah on the river's east side. Later that year, Fleet likewise platted the townsite of Aberdeen on the river's west side for Samuel Benn. The new town was named by stockbrokers of the Aberdeen Packing Company, which established a cannery at the mouth of the Wishkah River in 1877. Their home city of Aberdeen, Scotland, featured a similar cannery also built at the mouth of a river.

Recognizing the potential of the harbor's vast timber resources, Benn provided the necessary land inducements for lumber companies to establish mills on Aberdeen's waterfront. A. J. West established the first sawmill in Aberdeen in 1884, and was soon followed by J. M. Weatherwax (the Anderson-Middleton Mill), Emery, Mack & Wood (the American Mill), and the Wilson Brothers mill (on the present site of the Wishkah Mall).

With this development, the community's population increased from its first three families in 1875 to over 1,400 people by 1890, despite the town being rebuilt twice due to devastating fires. It was initially populated primarily by single men, who worked in the nearby mills, shipyards, and logging camps, with a transient population of as many as 2,000 single men living on lower Heron and Wishkah streets at one time.

By the turn of the century, the lumber industry had turned Aberdeen into an industrial giant. The city had six sawmills, a stave factory, one cooperage, sash and door factories, salmon canneries, and two shipyards. In 1900, the mills' daily output of cut lumber was reported as being as high 450,000 board feet and a staggering total of 250 million logs were delivered to the mills (Weinstein 1978:25). This industrial development led to an ever larger residential population. The town's population reached 14,000 residents by 1909 and exceeded over 20,000 residents by the end of World War I.

Industry

Harvesting and processing local natural resources, primarily timber, has defined the communities of Aberdeen and Hoquiam since their founding. Benefiting from vast expanses of fir, hemlock, cedar, and spruce trees combined with deep wide rivers, the Grays Harbor region was quickly discovered and exploited by enterprising lumbermen. Grays Harbor's first sawmill was constructed on the bank of the Chehalis River in early 1852, followed by many other small operations. By 1881, local lumber mills began to export lumber to distant markets. When the Simpson-Emerson mill was completed in 1882, it became the first sawmill in the area created specifically for export (Lamb 1948; Pettit 1939; Van Syckle 1980, 1982). Soon after opening, the mill reached a daily production volume of 100,000 board feet, and schooners waited their turn in the bay to load their cargoes.

By 1890, the local lumber industry had evolved into a large-scale commercial business and had diversified to include wood shingles and ship building. Growth continued with completion of a railroad to the area in 1898, which connected Grays Harbor to new markets and provided access to regional and national rail transport (Cox 1974). By the end of the nineteenth century, these qualities made Grays Harbor one of the most important lumber-shipping ports on the West Coast (Andrews 1957; Cox 1974; Lucia 1965).

The lumber-dependent economy of Grays Harbor thrived in the early 1900s and peaked in the 1920s. Responding to the insatiable demands of East Coast, Asian, and California markets, especially in San Francisco following the 1906 San Francisco earthquake, Grays Harbor became the leading exporter of timber and finished lumber on the West Coast during the first two decades of the twentieth century. Related industries also developed and succeeded in direct relation to the mills. Hoquiam's first electric light plant was built on the Simpson-Emerson Mill yard in 1883, and the North Shore Electric Company was built on the tideflats west of the shingle mill in 1891 (Sanborn Fire Insurance map 1902; Van Syckle 1982). Electric plants in the area provided power to the mills and electric railways alike (Van Syckle 1982).

The economic hardships of the Great Depression greatly impacted the Grays Harbor region, as it did other parts of the country. During the 1930s, nine Grays Harbor's mills ceased operations and closed due to the collapse of the national housing industry and decreased demands for lumber (Pettit 1939; Van Syckle 1980). Despite the slowdown, however, several significant technological advances emerged during this period, which partially mitigated the area's economic decline. The most prominent of these advances was the formation of new wood products from wood fibers, such as

plywood. During the 1930s, Grays Harbor became the leading plywood-producing center on the West Coast for plywood production.

Despite the advancements of the plywood industry, Grays Harbor's timber and lumber industries never fully recovered from the Great Depression. Old-growth forests were decimated from years of unchecked harvesting, and an absence of proper resource management resulted in a lack of new stands of timber for decades. Modern forest management practices were implemented in the 1940s and the Forest Practices Act was enacted in 1946 to help alleviate these issues and stabilize future timber resources (Wilma 2006).

In the late twentieth century, increased foreign demand and lower overseas labor costs posed another substantial threat to the timber industry. During Asia's economic boom in the 1960s, foreign mills subsidized by the Japanese government were able to outbid the American mills time and again. Washington State consequently lost as much as 40% of its wood-processing capacity between 1965 and 1975. Since then, the lumber and wood products industry has been Washington's third largest manufacturing sector, accounting for 10% of all manufacturing output (Wilma 2006).

Transportation

Since Grays Harbor was not the primary consumer of most of its wood products, transportation of the milled and raw lumber played a key role in the development of the region's industry and local economy. The two primary modes of transportation were by ship or by rail. The development of each involved overcoming certain financial and natural barriers, specific to Grays Harbor's unique characteristics and geography.

Shipping

Shipping by water was the primary method for getting finished lumber to Grays Harbor's increasingly distant customers, prior to the development of railroads. However, navigating the waters of Grays Harbor was no easy task. In the late-nineteenth century, approximately nine-tenths of Grays Harbor consisted of exposed tideflats at low tide, making it nearly impossible for ships to access the shoreline (Davidson 1889). The first dredging of the Grays Harbors Navigation Channel began in 1889. Regular dredging continued to be carried out to provide safe passage for ships well into the twentieth century and remains a significant issue today.

A regional shipbuilding trade also emerged in Grays Harbor in the late-nineteenth century. Given its high volume of shipping and readily available supply of lumber, Grays Harbor attracted some of the country's best-known shipbuilders to the region. The first vessel built in Grays Harbor, a schooner, was constructed in 1887 at the Northwestern mill in Hoquiam. Grays Harbor's shipyards produced all kinds of ships, including three and four masted schooners and steam schooners (Van Syckle 1980). The 1906 San Francisco earthquake, in particular, spurred the industry by creating a large demand for lumber from Grays Harbor to rebuild the city, and for the ships to transport it. Soon, finished lumber was transported to destinations around the world by ships built in Grays Harbor. Between 1895 and 1915, some 50 vessels were built by local shipyards and, at the height of World War I, nearly 4,000 men were on shipyard company payrolls (Van Syckle 1980).

Railroad

The Northern Pacific Railroad was the first major railroad line to serve the Grays Harbor region. Its arrival spurred the early growth of Aberdeen, Hoquiam, and other burgeoning communities in the area, as they competed to become the railroad's west coast terminus.

The first portions of the Northern Pacific's Grays Harbor Branch were completed in 1892. The railroad extended west from Elma to Junction City near Aberdeen, but then turned south over the Chehalis River to Cosmopolis. The Northern Pacific Railroad initially elected to bypass the towns of Hoquiam and Aberdeen, instead opting to establish an entirely new town to serve as the line's terminus. The new town was a speculative venture named Ocosta-by-the-Sea, today known simply as Ocosta.

Despite its billing as the "Metropolis of the West," its location proved a poor chose for the railroad, due to the harbor's shallows and failed attempts to dredge the bay's south channel. As early as 1891, the Northern Pacific entered into discussions with the town of Aberdeen for relocation of the terminus and the construction of a railroad depot. The Depression of 1893 and a widespread railroad strike in 1894 provided even more impetus to the Northern Pacific to search for a more viable terminus.

In 1893, the Northern Pacific reached an agreement with Aberdeen for the construction of a new 2-mile spur line into the town from Junction City. Resourceful Aberdeen and Hoquiam citizens recognized the opportunity to finally have full railroad service and decided to build the connecting spur to the Northern Pacific line at Junction City themselves. In Aberdeen, local lumbermen donated materials for tracks and ties, and Samuel Benn offered free lots to those that volunteered their labor. The line was completed in 1895 and subsequently turned over to Northern Pacific. Local folklore maintains that the Aberdeen spur was constructed using rails salvaged from the British bark Abercorn, which sank at the entrance to Grays Harbor in June of 1888. The rails, which had lain in salt water for nearly six years and were pitted, reportedly creating a unique sound when trains ran across them.

In 1898, the Northern Pacific extended the Grays Harbor Branch rail line an additional 4.6 miles over the Wishkah and Hoquiam Rivers, through central Aberdeen to Hoquiam. Construction of the railroad included a wood bridge over the Hoquiam River, a wood trestle over the tide flats, and the erection of Hoquiam's Northern Pacific Railroad Depot. The wood bridge was replaced by the existing bridge in 1909 and the wood trestle was removed and in-filled with dredge materials.

The railroad line through Aberdeen and Hoquiam serviced the many mills and industries that once existed along the waterfront in these communities, and provided passenger service between Grays Harbor and the Seattle/Tacoma area. The Northern Pacific Railroad line continued west toward the Pacific, terminating in the town of Moclips, Washington. The railroad later became connected with three transcontinental routes. Regularly scheduled passenger service continued through the 1950s, when the Northern Pacific canceled the Seattle-Hoquiam passenger trains in February 1956. Today, the route is operated by the PS&P rail line and carries freight service for the Port and other area industries.

Port of Grays Harbor[4]

The Port was first established in 1911, following the passage of the Washington Port District Act in March of that same year. Prior to the act's passage, port facilities largely consisted of docks and piers built by the private mill companies in Aberdeen, Hoquiam, and other communities, for their own use. Many of these mills were located along the shorelines of Grays Harbor or the Chehalis or Wishkah Rivers. These locations more easily accommodated the processing of timber, which would be rafted down rivers from logging camps, and the subsequent export of milled lumber on ocean-going ships to distant markets.

The intent of the Port District Act was to provide the basis for comprehensive planning efforts and large-scale infrastructure improvements that would foster increased economic development in Washington's port cities. The Panama Canal was under construction in 1911 and provided strong incentives to local businessmen to help ensure that Grays Harbor was able to handle the influx of large cargo vessels expect to pass through the canal. Grays Harbor was the only deepwater port north of San Francisco on the United States' west coast, and its location was much closer to Asian ports than either California or Puget Sound ports at the time. The economic opportunities were tremendous, and many other Washington ports faced similar challenges and opportunities.

The act authorized the formation of public port districts, which could develop new port facilities and fund their construction with property taxes, bond issues, and by other means. Dredging Grays Harbor's inner harbor channels, for example, required significant outlays of capital that no one business typically could afford. By dredging the harbor, new docks and common freight-handling facilities could be developed that would help attract new businesses to the region.

Three months after the act's passage, area business owners organized an effort to create the Port. County commissioners agreed to put the measure before voters in December 1911. Proponents of the port district's creation targeted the County's farmers for support, arguing that a developed port would provide more markets for farm produce, as well as increase land values. Many of Grays Harbor's timber and mill companies, the County's largest landowners, opposed the plan. They opposed the increased taxes it would incur and stood to gain less in the short term from the creation of a public port, as they already had their own docks and operated their own freight-handling equipment.

Voters overwhelmingly approved the creation of the Port on December 12, 1911. The Port was the second in the state (after the Port of Seattle) and its jurisdiction encompassed the entire county, divided into three districts: Hoquiam, Aberdeen, and East County. From 1911 through the 1920s, the Grays Harbor Port commissioners worked to establish a public terminal, acquire land, develop a comprehensive plan, and overcome opposition to port development. Initial improvements included dredging navigation channels, adding piers and slips, filling tidelands, adding a railroad avenue in Hoquiam, and removing two bends in the Wishkah River.

Marine Terminal No. 1, the Port's first public terminal facility, was constructed at Cow Point in 1921–1922. The land for the facility was deeded to the Port in 1913 by the Washington legislature, initially amounting to 68.744 acres. It was purposely located on the waterfront at the border of

[4] Portions of this section were adapted from Jennifer Ott, "Port of Grays Harbor becomes Washington's second public port on December 12, 1911," *HistoryLink.org* Essay 9390 (April 08, 2010), online document: http://www.historylink.org/index.cfm?DisplayPage=output.cfm&file_id=9390, accessed December 2014.

Hoquiam and Aberdeen, to prevent disputes over which town would benefit more from future improvements. The facility was designed by Charles A. Strong, a civil engineer from Tacoma, who was hired by the Port in March 1920 to develop a 5-year plan for carrying out Port projects. The plan called for an extensive dredging program for the inner harbor and river, and the construction of new dock facilities at Cow Point.

The dock at Cow Point, known as Pier 1, opened on September 22, 1922. It featured a 2,000-foot by 300-foot dock with a slip along its west side (Slip 1). To facilitate the transfer and storage of goods, a large warehouse was constructed on the dock, which could hold 20 million board feet of lumber. The terminal was likewise equipped with a 5-ton traveling crane and other freight-handling equipment. A second slip (Slip 2) was constructed east of the new pier shortly thereafter.

Grays Harbor residents immediately received a positive return on their investment, when the Trans-Marine Corporation announced that it would begin direct shipments to Grays Harbor instead of sending cargo through San Francisco. New development continued through the 1920s as Grays Harbor experienced prodigious growth in lumber exports, and expected shipping from the Panama Canal began to realize its full potential. Lumber exports grew enormously each year, and the Port celebrated its billionth board foot on December 21, 1924. Thereafter, exports surpassed a billion feet annually until the onset of the Great Depression, making the Port the largest lumber-exporting port in the world during this period.

The Great Depression abruptly ended the region's lumber boom. The Port struggled to maintain its facilities and to continue dredging operations during the 1930s, but recovered with assistance from the federal government. Thereafter, lumber exports continued to fuel the economy of Grays Harbor and provided the bulk of the Port's business into the 1980s.

Capitalizing on postwar growth, the Port established a newly formed Industrial Development Districts in the 1960s to attract new commercial and industrial industries to the area. This effort included the construction of new warehouses, manufacturing plants, and other facilities in the previously undeveloped lands around Marine Terminal No. 1. For example, the original warehouse on Pier 1 was removed in 1962 and replaced by the construction of Warehouse E, now on Westway's property. The Longshore Federal Credit Union at 3107 John Stevens Way and the warehouse now occupied by Paneltech, Inc., at 2999 John Stevens Way were also constructed during this period.

The Port pursued further development in the late 1970s and 1980s, which significantly altered the Port's waterfront facilities. The Port began the construction of Marine Terminal No. 2 in 1979 and coordinated with the U.S. Army Corp of Engineers (USACE) to dike and fill Slips 1 and 2. Slips 1 and 2 were diked and filled by the Port beginning in 1983 to create new areas for development. Fill material largely consisted of dredge spoils from maintenance dredging at Cow Point and navigation channel improvement projects carried out in the late 1980s and early 1990s. Both slips were completely filled by 1992 (Cowan 2013). The construction of Marine Terminal No. 2 was completed during this period, and a berth for large ocean-going vessels dredged in front of the new pier (U.S. Army Corps of Engineers 1978a, 1978b, and 1989).

Some of the Port's most recent improvements have included the development of a Walmart on Port property along Port Industrial Road, a federally funded dredging project to further deepen the inner harbor's navigation channels to accommodate ever-larger ocean-going vessels, and the construction of the Imperium Grays Harbor biodiesel processing and storage facility in 2006 and the Westway Terminals LLC's liquid bulk transfer facility in 2009, both at Marine Terminal No. 1 (Ott 2010; Port of Grays Harbor 2014; Boersema 2013). The Port likewise retains an active railway connection,

currently operated by the PS&P. It connects with the BNSF and the Union Pacific lines near Chehalis, Washington. The dredging project and the rail connection, in particular, have made it possible for the Port to construct a bulk handling facility at Marine Terminal No. 2 and establish a new auto export operation. The former was developed by AG Processing in 2010 and the latter by The Pasha Group in 2011 (Port of Grays Harbor 2013).

Chapter 4
Literature Review

In September 2014, ICF conducted a literature review and records search using DAHP's online Washington Information System for Architectural and Archaeological Records Database (WISAARD) to identify previously completed cultural resources studies and previously documented archaeological, ethnographic, and historic resources within a 1-mile radius of the study areas. WISAARD contains all the records and reports on file with DAHP, including completed cultural resources survey reports, properties listed in or determined eligible for listing in the NRHP, documentation of WHR-listed properties, archaeological sites, cemeteries, and inventoried built environment resources.

[*Text containing sensitive information was removed.*] Table 4-1 summarizes the findings of previous cultural resources surveys.

Table 4-1. Cultural Resources Studies Conducted within 1 Mile of the Study Areas[a]

NADB #	Report Title	Author/Date	Description	Resources
N/A	*Cultural Resources Assessment for the Grays Harbor Rail Terminal, LLC Proposed Liquid Bulk Facility, Hoquiam, Grays Harbor County, Washington*	Chambers et al. 2014	Pedestrian Survey, Geotechnical Testing, Shovel Probes	None
N/A	*A Cultural Resources Assessment and Survey of the Westway Grays Harbor Terminal Expansion Project, Grays Harbor County, Washington*	Boersema 2013	Pedestrian Survey, and Shovel Probes	None
1682042	*Archaeological Monitoring Report, State Route (SR) 520 Bridge Replacement and High-Occupancy Vehicle (HOV) Program Pontoon Construction Project, Aberdeen Log Yard*	Perkins 2012	Archaeological Monitoring	None
1352766	*Cultural Resources Assessment for Port of Grays Harbor Port Industrial Road Improvement Project, Aberdeen and Hoquiam, Washington*	Shaw, Perrin, Gilpin, and Hicks 2009	Pedestrian Survey, Shovel Probes	None
1330208	*Grays Harbor FY 1980 Channel Widening, Cultural Resources: Reconnaissance and Testing of Dredge Disposal Area "A."*	Munsell 1980	Pedestrian Survey and Shovel Probes	None
1332091	*Cultural Resources Survey, Three Sites on Grays Harbor, Grays Harbor County,*	Munsell 1976	Pedestrian Survey and Shovel Probes	None

NADB #	Report Title	Author/Date	Description	Resources
	Washington			

Notes:
[a] Text containing sensitive information was removed.
NADB = National Archaeological Database; N/A = not applicable.

[*Text and tables containing sensitive information were removed.*]

Chapter 5
Research Design

This chapter defines the objectives of the cultural resources investigations, the expectations used to assess the potential for identifying cultural resources in the study areas, and the specific methods selected to perform the study based on these expectations.

Objectives

The primary objective of the cultural resources investigations is to determine whether cultural resources (including archaeological sites, historic resources, and culturally significant properties) are located in the study areas. In the absence of previously documented resources, the secondary objective is to assess the potential for encountering undiscovered archaeological sites.

Archaeological Expectations

The following expectations about archaeological site potential are based on the geologic and cultural context outlined in Chapter 3, *Environmental and Cultural Setting*.

- The archaeological and ethnographic record of the Grays Harbor area indicates that the region was important for habitation and resource gathering, as well as a key travel corridor to the southwestern Washington interior and Puget Sound. Precontact peoples used the upland shorelines of Grays Harbor for habitation, plant gathering, and hunting; and the waters of Grays Harbor for fishing and shellfish harvesting. Of these activities, habitation and facility-based fishing tend to leave the most robust archaeological traces. However, review of the development history of the study areas reveals that both the Westway study area and Imperium study area have been subject to deep and widespread ground disturbance. Therefore, although the likelihood that these areas were used by precontact peoples is high, the possibility that archaeological evidence of these activities was preserved during the twentieth century is low. Since no subsurface ground disturbance is anticipated for the transportation corridors associated with the proposed actions, the likelihood of encountering precontact archaeological sites in this area is considered low.
- Review of the study areas' development history revealed that both study areas were nearly entirely seaward of the historic shoreline during the early-twentieth century, and consisted of dredged slips during the middle and late twentieth century. These slips were diked and filled during the late twentieth century—less than 45 years ago—therefore, the potential for encountering historical archaeological sites is considered low in these areas. Since no subsurface ground disturbance is anticipated for the transportation corridors associated with the proposed actions, the likelihood of encountering historical archaeological sites in these areas is considered low.

Based on the information presented above, the likelihood of encountering archaeological sites is considered low.

Methods

This section describes the methods used to identify cultural resources in the study areas, and to assess the study areas' archaeological sensitivity.

Research Methods

Cultural Setting

ICF conducted general and property-specific archival research to establish precontact, ethnographic, and historic contexts for the study areas. Materials examined included the previous cultural resources studies found during the literature review, as well as primary and secondary resources from local repositories. ICF reviewed existing cultural resources studies performed within or directly adjacent to the study areas and considered the methods used for these studies and any possible data gaps. ICF reviewed research materials obtained from the following repositories:

- City of Hoquiam Archives
- Timberland Regional Library, Hoquiam and Aberdeen
- University of Washington Library
- Seattle Public Library
- Jones Photo Historical Collection (http://www.jonesphotocollection.com)

Landform History Analysis

ICF conducted a landform history analysis to assess the extent to which the local geology and development history affects the potential for encountering archaeological deposits in the vicinity of each portion of the study areas. This was accomplished by analyzing geologic and historical maps, publications, and existing geotechnical bore logs to develop area-specific contexts for each alternative site.

The following sources were used to accomplish this analysis.

- U.S. Geological Survey Publications Warehouse (http://pubs.er.usgs.gov/#home:7:30)
- Washington State Department of Natural Resources (WDNR), Division of Geology and Earth Resources Subsurface Geology Information System (https://fortress.wa.gov/dnr/geology/?Site=subsurf)
- Washington State Department of Natural Resources, Division of Geology and Earth Resources Publications (http://www.dnr.wa.gov/ResearchScience/Topics/GeologyPublicationsLibrary/Pages/pubs.aspx)
- Geological Society of America (http://www.gsapubs.org)
- Science Direct (http://www.sciencedirect.com)
- Historic Aerials by NETROnline (http://www.historicaerials.com)
- Historic Map Works (http://www.historicmapworks.com)
- Dataquick (http://www.dataquick.com)

Field Methods

Archaeological Investigations

ICF archaeologists performed subsurface archaeological investigations in the study areas. Subsurface investigation methods included mechanical trenching and geoarchaeological borings. All subsurface investigations were spaced at approximately 100-foot intervals where subsurface project-related ground disturbance is anticipated. The subsurface investigations were performed in accordance with the proposed actions' cultural resources workplan, which was developed based on comments and feedback from DAHP (Attachment F).

Mechanical Trenching

Mechanical trenches were excavated in unpaved areas where buried utilities were unlikely to be encountered. Since the entirety of the Westway project site is paved, mechanical trenching was exclusively used in the Imperium project site. Mechanical trenches were excavated to the maximum vertical reach of the excavator arm (24 feet) or until the sidewalls of the trench slumped and the trench infilled faster than it could be excavated. Trench dimensions varied depending on local logistical factors, but were typically around 20 feet long and 6 feet wide. All trenches were excavated in successive shallow lifts to a depth of 15 feet below the ground surface. Below this depth, larger lifts were taken because of excavator arm leverage constraints.

Two archaeologists were present during the excavation of mechanical trenches; one oversaw excavations and inspected trench profile walls and the other carefully inspected the spoils pile. A metal shovel was used to break-up any large peds to inspect them for archaeological materials. No sediments that warranted additional closer inspection were identified, so no sediment samples were screened.

Once each trench was completed, it was photographed and plotted using a handheld global positioning system (GPS) unit. Trench contents, stratigraphy, depth to undisturbed native landforms, and other relevant information were recorded on a standard trench summary form. All mechanical trenches were backfilled and compacted.

Geoarchaeological Borings

Geoarchaeological borings were used in paved areas and to supplement mechanical trenching. As a result, most of the geoarchaeological borings were excavated in the Westway study area. Geoarchaeological borings were excavated to a minimum depth of 40 feet below the ground surface in all instances. Two-inch internal diameter sediment samples were continuously collected in 5-foot increments via the direct push sample collection method using a Geoprobe 7730 rig.

ICF archaeologists performed a detailed analysis of each sediment sample. Sample attributes, such as color, grain size, gravel angularity, structure, interface, compaction, and notable inclusions, were recorded and used to determine depositional context. Sample attributes were analyzed at no less than two points for each sediment sample. If stratigraphic contacts were present, sediments were analyzed at two additional points per contact—directly above and below each contact. This information was recorded on a standardized bore log form.

Upon completion of the analysis, each sediment sample was photographed and the entire of the contents of the screened through 0.25-inch mesh. Upon completion, all borings were mapped with a

handheld GPS unit and refilled using a structurally appropriate substrate as directed by the landowner.

Historic Resources Survey

A historic resources survey was performed within the study areas. The survey involved examining and evaluating all buildings and structures in the study areas determined to be 45 years of age or older. Buildings and structures less than 45 years old were not evaluated to determine NRHP and WHR eligibility. The target age of 45 years old was selected to include all resources 50 years old at time of survey, plus any that might become 50 years old through the course of the site development or initial use. ICF senior architectural historian, Christopher Hetzel, MA, conducted the historic resources survey and evaluated all of the identified properties in the study areas to determine their eligibility for listing in the NRHP and WHR.

ICF conducted a parcel-by-parcel, reconnaissance-level field survey of properties in both study areas in August 2014. Construction dates were established using data from the Grays Harbor County tax assessor and based on visual inspection. Properties built on or before 1969 were identified and information collected about their physical characteristics. The data collected included one or more photographs of each property from the public right-of-way, the architectural style of each resource (if identifiable), the type and materials of significant features, and the existence of alterations and overall physical integrity. Properties identified as 45 years of age or older were evaluated to determine their eligibility for listing in the NRHP and WHR, and recorded in the Washington State Historic Property Inventory Form Database, per DAHP reporting standards. Printed forms for recorded properties are provided in Attachment B.

Chapter 6
Results

This chapter presents the results of the cultural resources investigations of the study areas, including both study areas.

Landform History Analysis

This section summarizes the depositional sequence and sea-level change that occurred in the vicinity of the study areas during the Holocene epoch. The purpose of this section is to provide a geologic framework and local depositional context with which to consider the results of the archaeological investigations. This information is necessary to assess whether a given coastal landform would have been accessible for precontact human use and the depth at which buried archaeological deposits could be present. The information used in this analysis is based on the sedimentary and stratigraphic findings of the archaeological field survey, as well as previous geotechnical (Heller and Phelps 2014; CH2M Hill 2010), geological (Peterson and Phipps 1992) and geoarchaeological (Phipps 2008, 2010) studies performed along the northern Grays Harbor shoreline.

Depositional Sequence

Review of field notes from the archaeological field survey and previous geotechnical and geoarchaeological findings revealed three widespread but stratigraphically discrete Quaternary-aged deposits in the upper (eastern) Grays Harbor basin; including anthropogenic fill, intertidal flats, and high-energy alluvium. In some instances, these deposits were further subdivided based on local variations in deposit composition. For the purposes of considering the timing of formation and origin of the various deposits, however, the more general categories listed above were used. These deposits are discussed in greater detail below in order from youngest to oldest. The stratigraphy of the upper Grays Harbor basin differs markedly from the lower Grays Harbor basin. A detailed discussion of the stratigraphy of the lower Grays Harbor basin was developed by Peterson and Phipps (1992).

Anthropogenic Fill

Anthropogenic fill has had multiple origins, resulting in varying compositions depending on location and depth. In many instances, anthropogenic fill deposits commonly comprised structural fill (gravels and sands) at the ground surface. These deposits were underlain by mixed silts, sands, gravels, wood debris, and occasional historic-era items; laminated silt and silty sand; or sand with occasional organics, sawn wood fragments, or other historic-era items. Both hydraulic fill and refuse fill are known to have been used to reclaim the Aberdeen and Hoquiam tideflats, including areas in both study areas, during the twentieth century (Schneyder et al. 2010:2-32–2-35; U.S. Army Corps of Engineers 1978a:1-2 and 1978b: 4; 1989:3-3, 3-15).

In some instances, including during the current archaeological investigations, the distinction between hydraulic fill and intertidal flat deposits is difficult to decipher (Phipps 2010:7). This is

particularly noticeable in the study areas. Based on the results of the archaeological field investigations, anthropogenic fill ranged from 17 to 35 feet thick in the Imperium study area and from 7 to 34 feet thick in the Westway study area. Fill thicknesses at the Westway study area are considered to be minimum measurements, however, because the distinction between anthropogenic fill and intertidal flat deposits is less clear in this location.

Intertidal Flat

Intertidal flat deposits typically comprise silt, sandy silt, or (less commonly) silty sand or sand. Phipps (2010:7–8) notes a distinction between upper intertidal flat deposits (referred to as *mud, silt & very fine sand*) that appear to either lack or contain sparse amounts of organics and lower intertidal deposits (referred to as *mud with some peat content*). The latter appear to have higher amounts of organics and tend to take on a brownish tint. This distinction is important because increased peat content has been linked to shallower water estuarine environments in the Pacific Northwest (Barnett 1997). One study noted a similar distinction west of the Wishkah River (CH2M Hill 2010:18–22), while no such distinction was documented in a related geotechnical study in the vicinity of the study areas or during the current archaeological investigations.

Based on the radiocarbon synthesis presented below and a previous geological study of the Grays Harbor basin (Peterson and Phipps 1992), intertidal flat deposits began to form in the Grays Harbor basin during the early Holocene as marine water began to infill the basin, and continue to form in the present day. Review of previous geotechnical studies in the Imperium study area revealed that the terminal depth of intertidal flat deposits is around 130 feet below the ground surface (Heller and Phelps 2014:3).

High-Energy Alluvium

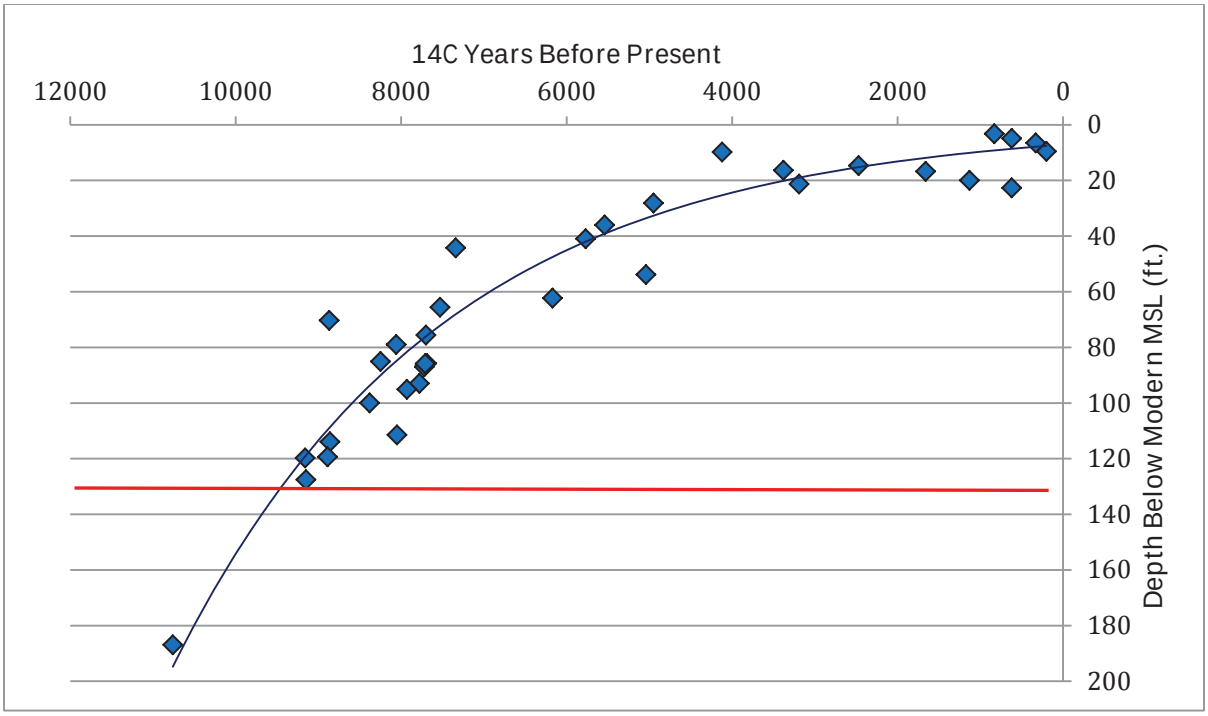
Comprising rounded gravels and sands, the origin of high-energy alluvium deposits has alternately been attributed to the downslope movement of gravels from the Olympic, Coast, and Cascade mountain ranges, fluvial reworking of Pleistocene glacial deposits (Peterson and Phipps 1992:280), or glacial outwash events (Phipps 2010:8). The latter inferred origin is neither supported by the spatial pattern of this deposit (Peterson and Phipps: 280) nor the results of previous radiocarbon analyses (Blukis Onat et al. 2007:84; Phipps 2010: associated documents). Previous geotechnical studies performed approximately 0.75 mile east of the Westway study area revealed that the terminal depth of high energy alluvial deposits is around 200 feet below the ground surface. These deposits are underlain by weathered siltstone (CH2M Hill 2010:18).

Sea-Level Change

A total of 68 radiocarbon samples from four studies, including one sample collected during the current archaeological investigations, were compiled to generate an updated sea-level curve for the Grays Harbor basin (Figure 6-1, Attachment G). This data was used to update a sea-level curve previously produced by Peterson and Phipps using 28 radiocarbon samples. Half of these prior samples were collected from marine shellfish (Peterson and Phipps 1992:280–281). This detail is important because the measured age of marine shellfish must be calibrated to account for the marine reservoir effect and the magnitude of this effect changes over space and time (Stuiver and Braziunas 1993; Stuiver et al. 1998; Deo et al. 2004). To eliminate the uncertainty associated with dating marine shellfish, only radiocarbon samples obtained from plant remains are used in the

current study. The purpose of generating an updated sea-level curve is to increase the resolution of the curve, if possible.

Figure 6-1. Relative Sea-Level Curve for the Grays Harbor Basin plus Red Trendline Showing Terminal Depth of Intertidal Flat Deposits in the Study Areas



The relative sea-level curve presented in Figure 6-1 appears to be generally consistent with curves previously developed for the Grays Harbor basin (Peterson and Phipps 1992) and the larger southern Cascadia subregion (Shugar et al. 2014). Like many sea-level curves developed for the outer coast of Washington and Oregon, local sea levels appear to have risen dramatically from the end of the Pleistocene epoch until around 4,000 radiocarbon years BP. In this instance, sea levels appear to have transgressed around 160 feet between 11,000 BP and 4,000 BP. Between 4,000 BP and the present, sea levels transgressed another 30 feet with much of this transgression occurring before 2,000 BP.

Uncertainty

In considering the results of this analysis, it is important to acknowledge that a number of uncontrolled variables introduce uncertainty. The standard error associated with radiocarbon analysis is not considered to be a significant source of uncertainty. Error associated with coseismic movement, too, is considered to be negligible since the magnitude of coseismic subsidence is thought to be inversely equal to or less than the cumulative extent of interseismic strain (Leonard et al. 2004). However, other factors, such as basin subsidence and use of detrital organics, are considered likely to introduce a greater degree of uncertainty. These factors are discussed in greater detail below.

Basin Subsidence

Sedimentary loading in estuaries can cause the consolidation of compressible sediments, resulting in subsidence (Atwater et al. 1977:9; Weller 1959:290). No studies evaluating the nature and extent of basin subsidence in Grays Harbor have occurred, but the geologic conditions are conducive to such an occurrence (CH2M Hill 2010:30). If basin subsidence has occurred, it would result in a sea-level curve that underrepresents the true extent of local sea-level change. As a result, the lack of information about basin subsidence introduces uncertainty into the analysis.

Detrital Organics

To precisely depict sea-level change, one must obtain radiocarbon samples from floral and faunal specimens that would have been located at sea level when they were alive. Atwater et al. (1977:10–11), for example, selected roots and rhizomes of floral species that typically inhabit salt marshes in order to generate a sea-level curve for the San Francisco Bay. Unfortunately, no such samples were identified during the four studies that have occurred in the Grays Harbor basin to date. Instead, all of the recovered samples appeared to be detrital in origin. Unlike roots and rhizomes, detrital organics can be deposited on both intertidal and subtidal landforms. In addition, their origin and the length of time in which they were transported before deposition are unknown. As a result, use of detrital organics introduces uncertainty into the analysis and may result in individual samples registering ages that are younger or older than the sea-level elevation that they are taken to represent.

Summary

Review of the depositional sequence for the upper Grays Harbor basin, including the study areas, reveals that the study areas were located in an active estuarine environment prior to the twentieth century. The sea-level curve presented in Figure 6-1 indicates that the study areas have been estuarine environments since around 9,500 BP. Prior to 9,500 BP, the study areas appear to have been located in a high-energy alluvial environment. This environment is most likely associated with the ancestral Chehalis River channel, which appears to have had a high-gradient before the Grays Harbor basin infilled during marine transgression.

Westway Study Area

Consideration of Archaeological Resources

In 2013, Cascadia Archaeology, LLC, (Cascadia) performed an archaeological study for the Westway project site and two associated tree planting areas that are not associated with the current proposed action. The Cascadia study included an analysis of landscape history in the vicinity of the study area, a pedestrian survey of the Westway project site, and a shovel/auger probe survey of the two associated tree planting areas. A copy of the Cascadia study is provided in Attachment C.

Cascadia's analysis of the area's landscape history revealed that the Westway study area is located seaward of the predevelopment Grays Harbor shoreline in the tidelands (Boersema 2013:6–7). This conclusion is supported by the U. S. General Land Office's 1860 cadastral survey map of the region and environmental studies conducted by USACE in 1978 for the construction of Marine Terminal No. 2, the expansion and modification of Marine Terminal No. 1, and in 1989 for proposed dredging and

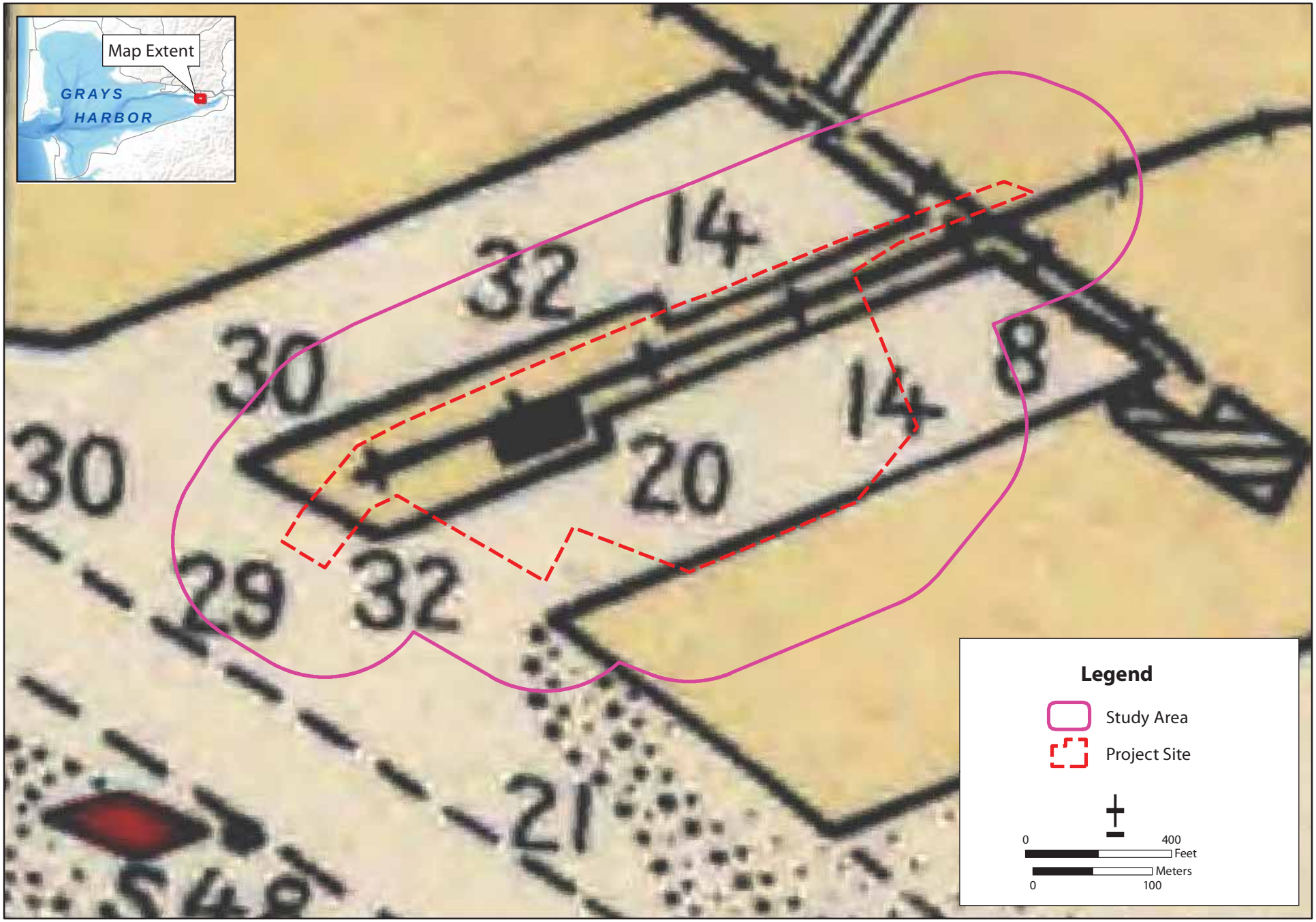
navigation channel improvements. Each of these studies provides information on changes to landforms within the Westway study area (U.S. General Land Office 1860a; U.S. Army Corps of Engineers 1978a, 1978b, 1989) (Figure 6-1).

Beginning in the early 1920s, the Port established Marine Terminal No. 1 at Cow Point within what is now the Westway study area. Marine Terminal No. 1 was the Port's first public terminal facility. The land for the facility was deeded to the Port in 1913 by the Washington legislature, initially amounting to 68.74 acres, and its initial construction was completed in 1921–1922. The first dock at Cow Point, known as Pier 1, opened on September 22, 1922. It featured the excavation of a 2,000-foot by 300-foot dock with a slip along its west side (Slip 1). A second slip (Slip 2) was constructed east of the new pier shortly thereafter (Ott 2010; Boersema 2013:11–12).

The northwestern two-thirds of the Westway project site is located within the area of what was once Slip 2 (Figure 6-2). Both Slips 1 and 2 were diked and filled with dredge spoils beginning in 1983, with work completed in 1992 (Boersema 2013:11–12). The areas affected by these activities, including the fill depths of Slip 2 and the composition of the fill materials, were addressed by EISs issued by USACE in May 1978 (U.S. Army Corps of Engineers 1978a, 1978b). These studies were prepared in response to an application from the Port for the "construction of a new pier, dredging of a berth in front of this pier, and filling of tidelands between the new pier and adjacent to Slip 2 at the Port in Aberdeen, Washington." The new pier and shipping berth became the Port's existing Marine Terminal No. 2.

The following is a brief outline of the activities, which affected changes to the landforms of the Westway project site, between 1983 and 1992. A site plan and cross section profiles from the 1978 report, illustrating the depth of fill in Slip 2 and elsewhere, are provided in Attachment D.

- The pier for Marine Terminal No. 2 was constructed in a slightly offshore location and the space behind the new pier was filled, including existing tidelands between the bank and the pier. The pier was constructed of reinforced concrete over steel and concrete pilings (U.S. Army Corps of Engineers 1978a:1).
- Fill behind the new pier involved the filling of about 1.7 acres of intertidal and subtidal land (measured from the ordinary high water mark to the toe of the dike). It was filled to 18 feet above mean lower low water (MLLW). Fill material consisted of approximately 31,000 cubic yards of rehandled dredge material taken from USACE's maintenance dredging at Cow Point. This material was stock piled at two sites in the area, and consisted of clean, sandy gravel (U.S. Army Corps of Engineers 1978a:1).
- Slip 2 was filled to expand the cargo storage areas of Marine Terminals No. 1 and No. 2. Construction of the dike across slip No. 2 occurred in two stages. The first stage involved partial construction of a dike across three-fourths of the slip opening. A section of Marine Terminal No. 1 was demolished during this first stage, to an elevation of +5 MLLW. The second stage involved extending the dike completely across the opening and the entire structure raised to an elevation of +18 MLLW. The amount and type of material required was the same as the first stage. Fractured basalt was used for riprap: 8,000 cubic yards for stage 1, and 4,000 cubic yards for stage 2 (U.S. Army Corps of Engineers 1978a:1–2, 1978b:4).



Sources: Site Design, Harris Group, 2014; Coast Geodetic Survey Gray's Harbor, WA, 1928.

Figure 6-2
Overlay of Historic Coast Geodetic Survey Map (1928) and Westway Study Area
Westway and Imperium Expansion Projects

As with the area behind the new pier, Slip 2 was filled with rehandled dredged material from USACE's maintenance dredging at Cow Point. The surface material for the filled portion of the new pier and for Slip 2 was approximately 24 inches of quarry rock, with runways of asphalt. When complete, Slip 2 was filled with approximately 250,000 cubic yards of rehandled clean, sandy gravel and inorganic, nonpolluting material such as concrete slabs and asphalt from on-site demolition. The fill covered approximately 9 acres of intertidal and subtidal land (U.S. Army Corps of Engineers 1978a:1–2, 1978b:4).

- A berth for large ocean-going vessels was dredged in front of the new pier at Marine Terminal No. 2. Dredged material from this site was placed in one of the disposal sites used for Slip 2 filling. The berth was to be dredged to about -37 MLLW in front of the new pier. About 250,000 cubic yards of sandy soil was removed from about 15 acres of subtidal land by hydraulic dredge (U.S. Army Corps of Engineers 1978a).
- Two new dolphins, 37 pilings each, were placed at the end of the new vessel berth (U.S. Army Corps of Engineers 1978a:3, 1978b:4).
- A pier addition to terminal No. 1 was also constructed. It was constructed on pilings and surfaced with asphalt to provide better access to the pier (U.S. Army Corps of Engineers 1978a:1, 1978b:4).

Cascadia archaeologists performed a pedestrian survey of the Westway study area in 2013. No shovel/auger probes were excavated in the study area because of the presence of a thick layer of asphalt at the ground surface. Twenty-seven shovel/auger probes were excavated in the tree planting area, which was associated with the proposed action at that time. These probes revealed deposits of gravelly fill at the ground surface, ranging from 40 to 90 centimeters (16 to 35 inches) in thickness, underlain by fine-grained alluvium. No archaeological deposits were identified during the survey (Boersema 2013:15–17).

As a result of this study, Cascadia concluded that the proposed action would not encounter documented archaeological sites. Their findings also stated that the potential for encountering as-yet undocumented archaeological sites was low because project-related ground disturbance was not anticipated to be deeper than the depth of the previous dredging and filling. No further archaeological investigations or restrictions were recommended (Boersema 2013:20–21).

ICF's review of Cascadia's data and supplemental research corroborates Cascadia's findings in the northwestern two-thirds of the Westway study area. However, the southeastern third of the study area is located outside of the footprint of Slip 2 and appears to have only been subject to filling of an indeterminate depth during the historic era. Review of historic aerial imagery (Anderson & Middleton Company n.d.) and U.S. Coast and Geodetic Survey maps (1928, 1948) of the undeveloped areas located directly east of the Westway study area reveal that this area was likely located on unvegetated intertidal flats prior to development. ICF's archaeological review and supplemental research on the Westway study area revealed no documented archaeological sites and limited potential for encountering as-yet undocumented archaeological sites across much of the Westway study area. The northwester two-thirds of the Westway study area was subject to widespread dredging that ranged from just below MLLW to -37 feet below MLLW in depth (or between 18 and 55 feet below the current ground surface)during the early-twentieth century. This area was subsequently filled during the late-twentieth century (U.S. Army Corps of Engineers 1978a). None of the proposed ground-disturbing activities in this area, except one, are expected to disturb sediments at a depth greater than was previously disturbed and removed during the prior dredging activities.

Only the proposed driving of piles is anticipated to encounter undisturbed native sediments. However, no sediments would be excavated as part of this activity. Based on the available documentary data, it is unclear whether proposed ground-disturbing activities other than the driving of piles would encounter undisturbed native sediments.

Archaeological Investigations

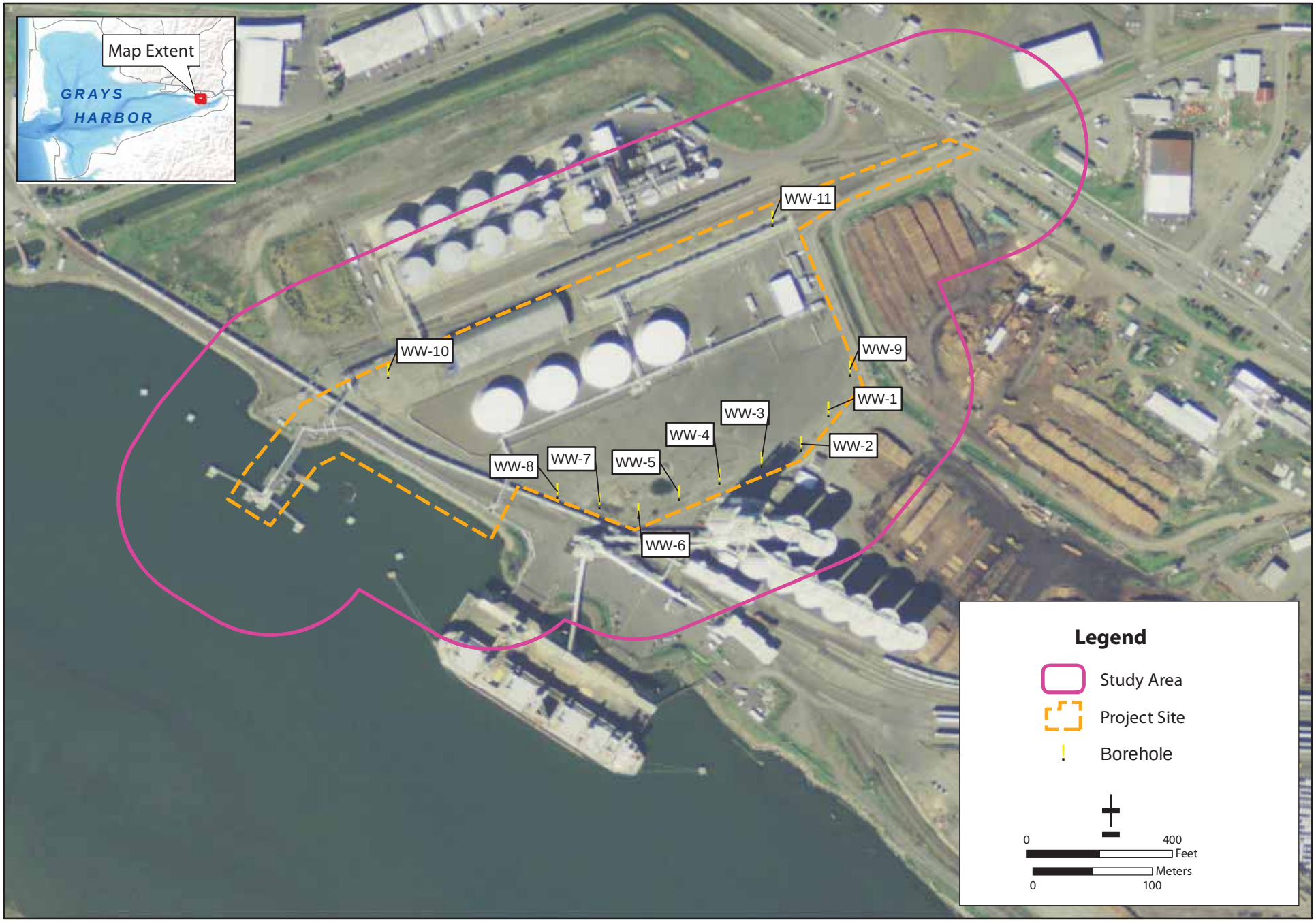
ICF archaeologists J. Tait Elder and Anna Robison-Mathes performed an archaeological field survey in the Westway study area between April 20 and 24, 2015. Weather conditions during this period ranged from overcast with occasional showers to partly sunny. The field survey consisted of the excavation of 11 geoarchaeological borings (Figure 6-3). No archaeological deposits or buried terrestrial surfaces were identified during the archaeological field survey.

Review of the sedimentary and stratigraphic data obtained during the archaeological investigations revealed four deposits with differing inferred origins and a fifth deposit for which origin could not be verified with the data obtained during the investigations. These deposits are described in Table 6-1, in the vertical sequence in which they were encountered, and generally appear to correspond with the development history described in the historic context and previous archaeological studies. Figure 6-4 depicts the stratigraphic relationship and relative thickness of the deposits across the Westway study area, while Figure 6-5 depicts the distribution of boreholes relative to the historic Slip 2 footprint.

Table 6-1. Deposits Identified in the Westway Study Area and their Inferred Depositional Environment

Field Designation	Description	Inferred Depositional Environment
Asphalt	N/A	N/A
Structural Fill	Massive to blocky dry to moist gray, very dark gray, and bluish gray sand and small angular gravels. Occasional beds of very dark gray silt with sparse decomposing organics.	Mass filling using structurally stable materials.
Undifferentiated Fill	Laminated to massive loose saturated very dark gray silt, sandy silt, or sand, occasional decomposing organics, angular gravels, wood debris, sawn and wood fragments, sparse shell unidentified shell fragments.	A combination of mass and hydraulic filling.
Unknown Origin	Laminated to massive loose saturated gray, dark gray, or dark bluish gray silt or sandy silt with occasional lenses of fine to medium sand, occasional flecks of mica and sparse detrital organics.	Indistinguishable – intertidal flat or hydraulic fill.
Intertidal Flat	Laminated firm saturated grayish brown to dark gray silt with trace sand, occasional lenses of fine sand and detrital organics, sparse in-situ *Macoma* sp. valves.	Low-energy tidally influenced deposition prior to the historic era.

Notes:
N/A = not applicable.



Sources: Site Design, Harris Group, 2014; ESRI Imagery, 2014.

Figure 6-3
Westway Borehole Locations
Westway and Imperium Expansion Projects

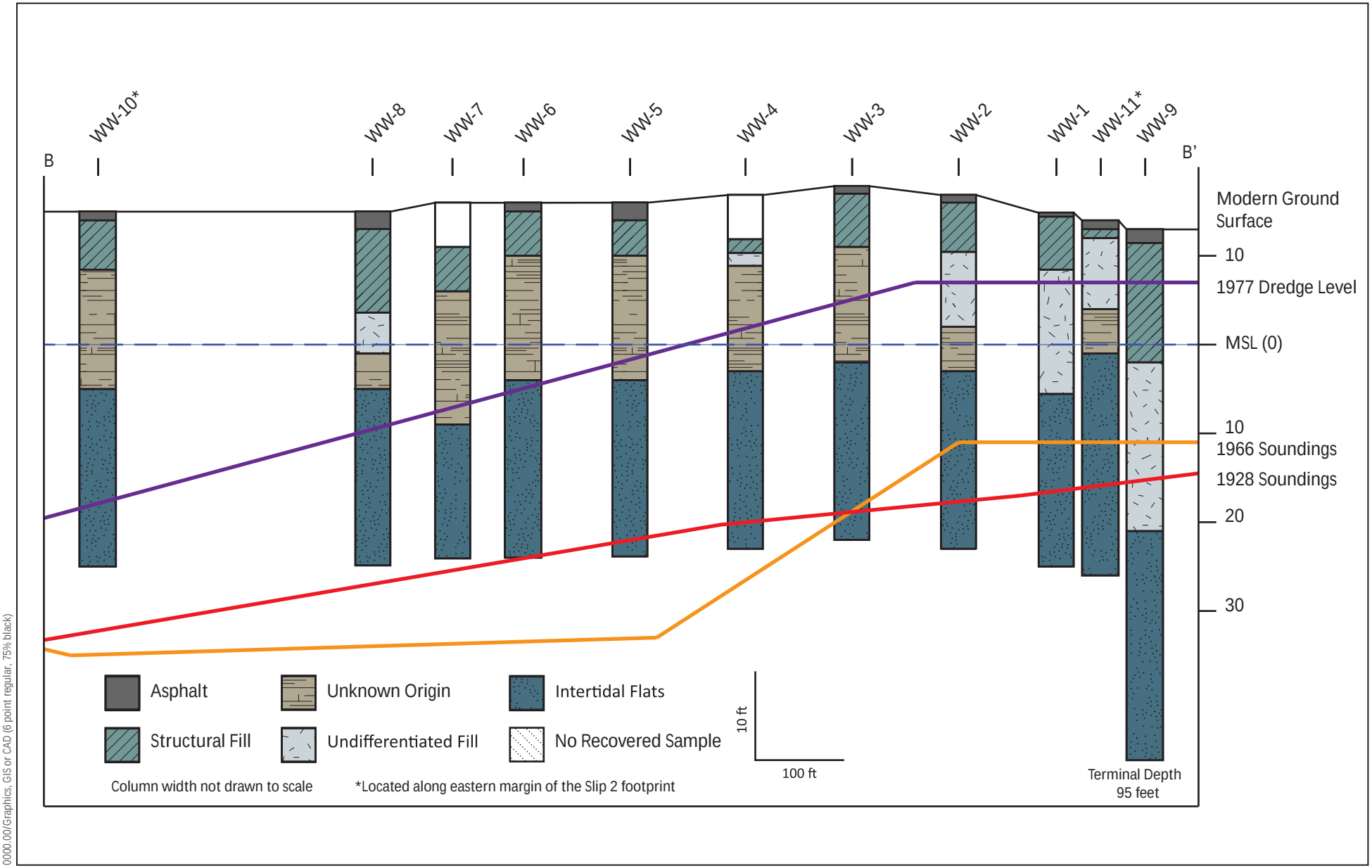


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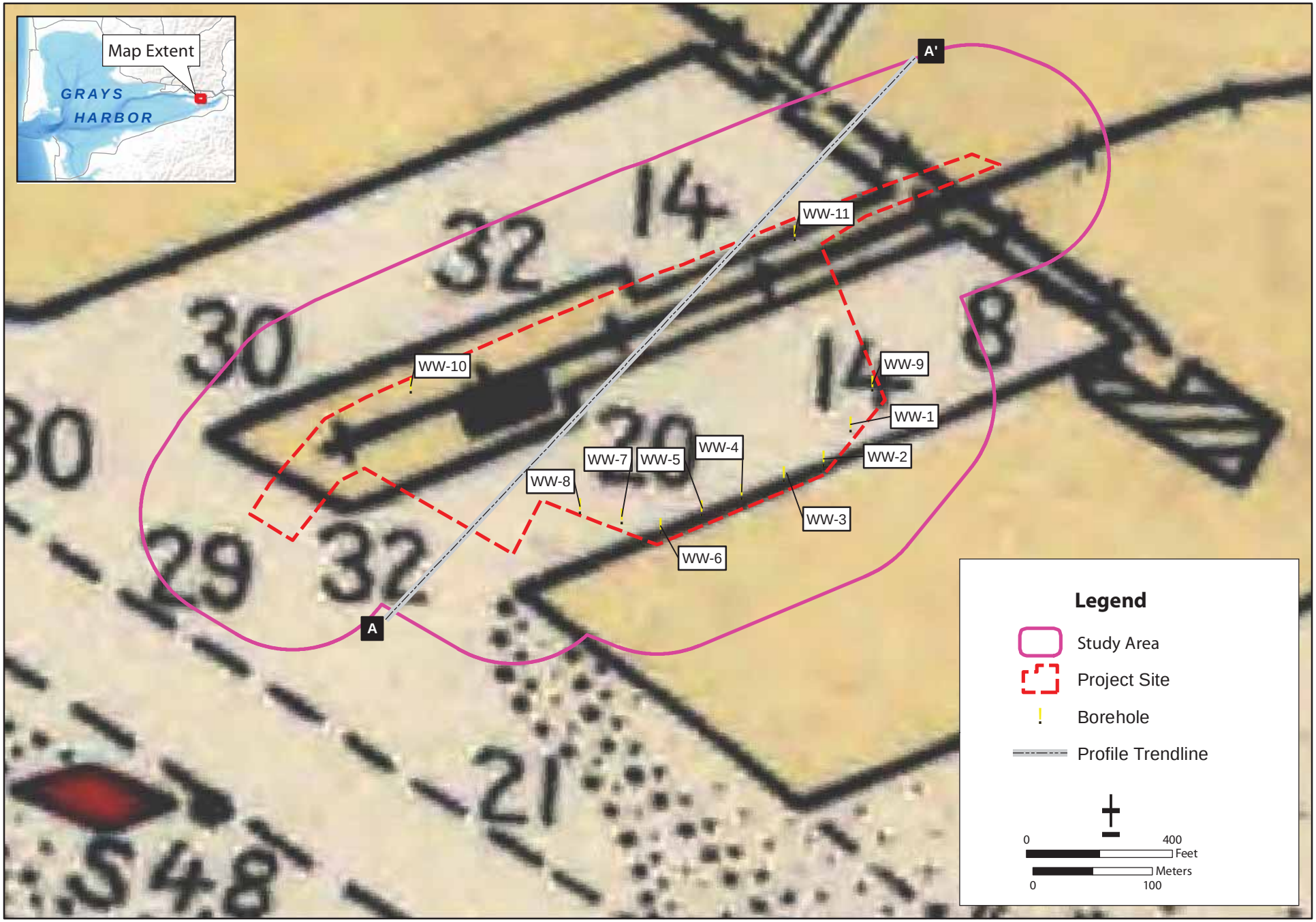
Figure 6-4
Westway Geologic Fence Diagram
Westway and Imperium Expansion Projects



Sources: Site Design, Harris Group, 2014; Coast Geodetic Survey Gray's Harbor, WA, 1928.

Figure 6-5
Westway Borehole Locations with Profile Trendline
Westway and Imperium Expansion Projects

Asphalt was located at the ground surface in all but one instance (WW-11), and ranged from 0.5 to 1 foot in thickness. Structural fill was located below asphalt in every instance in which asphalt was encountered and at the ground surface in WW-11. The thickness of structural fill ranged from 4.5 to 15 feet, but was fairly consistent across the Westway study area. For example, eight boreholes had structural fill that ranged from 5 to 6 feet. The composition of this deposit appeared to have widespread horizontal continuity, which is likely representative of the use of a limited set of borrow sources to fill the property.

Undifferentiated fill was identified in six instances (WW-1, WW-2, WW-4, WW-8, WW-9, and WW-11). In many instances, undifferentiated fill was difficult to distinguish from intertidal flat deposits because of a shared color, composition, and structure. Only in instances where angular gravels, sawn wood fragments, mixed or fractured structure, or sediments with a composition not indicative of low-energy alluvial depositional environment were present could the origin of undifferentiated fill be verified. Based on the depth of soundings taken while Slip 2 was in use (U.S. Coast and Geodetic Survey 1928, 1948) combined with the known maximum elevation of unvegetated intertidal flats (which tends to be just over mean sea level) (Readings and Collinson 1996:213), it is anticipated that undifferentiated fill is located at greater depths than could be determined during this study. Therefore, no thickness range for undifferentiated fill could be determined at all but three borehole locations (i.e., WW-1, WW-7, WW-8, and WW-9) in the Westway study area.

Deposits of unknown origin were identified in seven instances (WW-2 through WW-6, WW-10, WW-11). These deposits were described as such because their color, composition, and structure provided no reasonable basis to conclude that they were not intertidal flat deposits. However, the elevation at which they were encountered was less than the recorded depth of previous dredging activity (i.e., U.S. Coast and Geodetic Survey 1928, 1948; U.S. Army Corps of Engineers 1989:3-3, 3-15) or mean sea level. Identification of origin was particularly difficult because it is recorded that the materials used to fill Slip 2 were dredged tidal flat deposits from the Cow Point vicinity (U.S. Army Corps of Engineers 1978a:1-2, 1978b:4), less than 1 mile east of the Westway study area.

Native intertidal flat deposits were identified in five instances (WW-1, WW-7 through WW-9 and WW-11). They were defined as such because they were encountered below the depth of previous dredging activity within the former Slip 2 footprint or below mean sea level outside of the former Slip 2 footprint. In several instances, native intertidal flats contained in-situ mature *Macoma* sp. valves. Dredging would have removed any in-situ bivalves in the zone in which dredging occurred, and bivalves would not have been able to reestablish populations unless there were stable surfaces exposed for several years (Garbutt and Boorman 2009:779). Therefore, it is hypothesized that the presence of in-situ valves can be used as a bellwether to differentiate native intertidal flat deposits from hydraulic fill deposits.

The upper interface of the intertidal flat deposits could not be determined with confidence in several boreholes, but appeared to range from 15 to 34 feet below the ground surface. The latter depth was documented in WW-9, which was located within the former Slip 2 footprint. The lower interface of intertidal flat deposits could not be established because the boring technology used could not excavate to depths greater than 90 feet below the ground surface. As a result, this study can only confirm that intertidal flat deposits extend greater than 90 feet below the current ground surface. This conclusion is consistent with the findings of previous geotechnical and geoarchaeological studies that have occurred in the study area vicinity (Heller and Phelps 2014; Phipps 2010).

Summary

Subsurface investigations revealed no buried surfaces or archaeological resources in the Westway study area. Although fill deposits were documented across the entirety of the Westway study area, the terminal depth of these deposits was ambiguous. In many instances, there were no clear attributes that could be used to differentiate the undifferentiated fill from the native intertidal flat deposits. This is most likely because most of the deposits used to fill Slip 2 were intertidal flat deposits dredged from an area just east of the Westway study area and therefore had comparable attributes. Review of previous U.S. Coast and Geodetic Survey maps and fill plans, however, indicates that fill deposits likely range from 15 to 34 feet in thickness. In two instances (WW-9 and WW-11), deposits with in-situ bivalve shells were documented below the depth documented as having been previously dredged. Based on their depth and the presence of in-situ bivalves, these deposits were considered to be native intertidal flat deposits. Although the terminal depth of these deposits was not established during subsurface investigations, previous geotechnical and geoarchaeological investigations in the study area vicinity indicate that the interface is located between 120 and 130 feet below the ground surface.

Historic Resources Survey

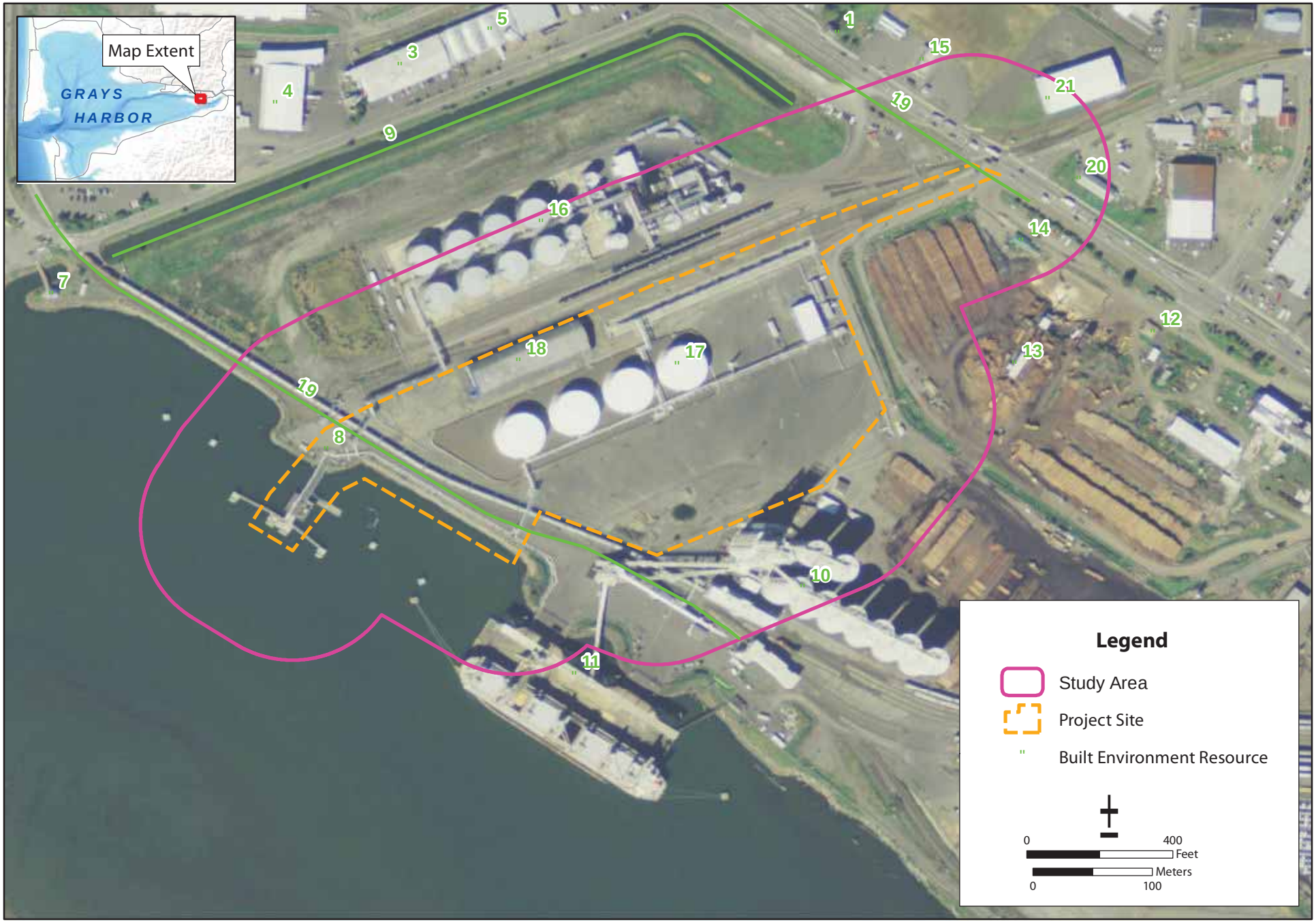
The historic resources survey of the Westway study area identified 12 buildings and structures (Figure 6-6; Table 6-2). Based on Grays Harbor County tax assessor data and field observations, only two properties were identified as being 45 years of age or older. Of the two, the literature review revealed that one of these properties was identified and evaluated by a previously completed cultural resources study and recorded in WISAARD (Schneyder et al. 2010). ICF newly evaluated the other property for the current study.

DAHP determined that the one previously evaluated property is not eligible for listing in the NRHP, within the past five years. ICF's review of the resource corroborates this evaluation.

ICF evaluated the one newly identified property and concluded that it does not appear eligible for listing in the NRHP. The property, known as Warehouse E, is located on the Westway project site at 3128 Port Industrial Road. It was first built as a warehouse for the Port's Marine Terminal No. 1 in 1962, and was originally twice its current length. The building's eastern half was removed during a renovation in 2009 and the exterior cladding replaced. These changes appear to have occurred during construction of the Westway facility.

ICF found no evidence to suggest that the property is associated with events that have made a significant contribution to the broad patterns of history, nor with the lives of significant persons, in the local community, the state/region, or the nation. It exhibits a common architectural style and building type, but has been substantially altered with changes to its plan and exterior cladding, such that it does not appear capable of conveying historical significance. Furthermore, there is no evidence to suggest the property is associated with a significant designer or craftsman. Finally, the property is not considered to have the potential to be a principal source of historical information based on their common construction and building types.

ICF concluded that all of the other properties in the Westway study area are less than 45 years old. These properties were not evaluated for NRHP eligibility, due to their age, based on DAHP cultural resources reporting guidelines.



Sources: Site Design, Harris Group, 2014; Aerial Imagery, ESRI Basemap, 2010

Figure 6-6
Identified Buildings and Structures in the Westway Study Area
Westway and Imperium Expansion Projects

Table 6-2. Buildings and Structures Identified in the Westway Study Area

ID	APN	Property Name	Address	Build Date	NRHP Evaluation
8	56402300000	Port of Grays Harbor Marine Terminal No. 1	PGH Terminal 1	c1985	Less than 45 years
10	29902000200	Port of Grays Harbor Bulk Handling Facility	PGH Terminal 2	2010	Less than 45 years
11	56402300000	Port of Grays Harbor Marine Terminal No. 2	PGH Terminal 2	1979	Less than 45 years
13	29902000200	Local Manufacturing, Inc.	2421 Port Industrial Road, Aberdeen	c1985	Less than 45 years
14	29902000200	Local Manufacturing, Inc.	2609 Port Industrial Road, Aberdeen	c1975	Less than 45 years
15	29902000200	Petit Oil Company (Fueling Station)/ Coffeeman	2616 Port Industrial Road, Hoquiam	c2000	Less than 45 years
16	56402300000	Imperium Grays Harbor	3122 Port Industrial Road, Hoquiam	2006	Less than 45 years
17	56402300000	Westway	3128 Port Industrial Road, Hoquiam	2009	Less than 45 years
18	56402300000	Westway /Warehouse E	3128 Port Industrial Road, Hoquiam	1962/ 2009	Not Eligible
19	56402300000 29902000200	Port of Grays Harbor Railroad Spur	N/A	c1995	Less than 45 years
20	29902000200	California Petroleum Corp. Warehouse	2519 W 1st Street, Aberdeen (aka 2421 W 1st Street)	c1925	Not Eligible (Previously Evaluated)
21	29902000200	Warehouse	2510 1st Street, Aberdeen	c1970	Less than 45 years

Notes:
PGH = Port of Grays Harbor; c = circa; N/A = not applicable.

Imperium Study Area

Consideration of Archaeological Resources

The Imperium study area was subject to a cultural resources desktop review conducted in 2013 (Cowan 2013). Similar to the Westway study area, the desktop review revealed that the Imperium project site was previously subject to deep dredging beginning in the 1920s and subsequently filled from 1983 to 1992. Based on this information, the desktop review recommended that the project site had limited potential for encountering archaeological sites. A copy of the Cowan (2013) study is provided in Attachment E.

ICF archaeologists further supplemented the research performed by Cowan (2013) with additional geological and historical documentary research. This research revealed that the landscape history of the Imperium study area mirrors that of the Westway study area, as presented by Cascadia. Cascadia study, the U. S. General Land Office's 1860 cadastral survey map of the region, and USACE's 1978

and 1989 studies all corroborate the Cowan study's conclusions. The Imperium study area is located seaward of the predevelopment Grays Harbor shoreline and the Imperium project site is located within the footprint of former Slip 1, which was diked and filled from 1983 to 1992 (U. S. General Land Office 1860b; Boersema 2013:6-7; U.S. Army Corps of Engineers 1978a, 1978b, 1989) (Figure 6-7).

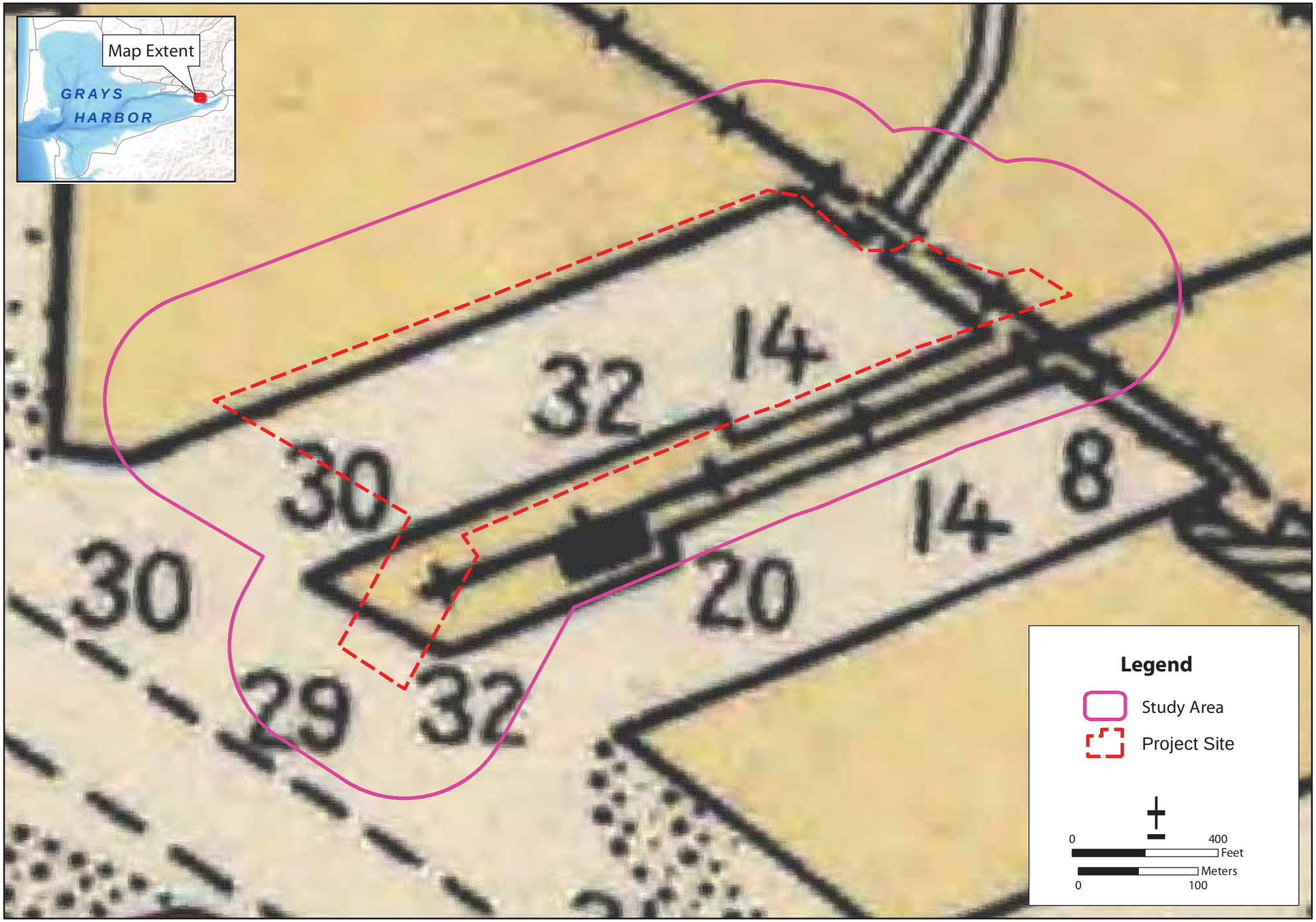
In February 1989, USACE prepared the *Final Supplemental Environmental Impact Statement for the Grays Harbor Navigation Improvement Project*. The study described Slip 1 as an abandoned terminal slip measuring approximately 28.0 acres in size. The Port had diked the slip in 1984 and the area was being used as a disposal area for dredge materials. Frye Creek flowed into the upper end of the slip, but had been diverted around the disposal area. It also reported that prior to diking, the slip had a maximum depth of -30 feet MLLW (-48 feet below the current ground surface) with a mean depth of -10 feet MLLW (-28 feet below the current ground surface), and the volume of fill was expected to measure approximately 585,000 cubic yards of silty material (U.S. Army Corps of Engineers 1989:3-3, 3-15).

Available literature supports the conclusion that nearly the entire Imperium project site was dredged beginning in the 1920s to create Slip 1. Slip 1 was subsequently diked and filled beginning in 1983, with work completed in 1992 Boersema 2013:11–12).

Geotechnical investigations in the Imperium study area performed by GeoEngineers in 1995–1996 and 2006 revealed that granular fill extends from the ground surface to a depth of 1.5 meters (5 feet) below the ground surface. The granular fill is underlain by dredge fill, which is described as extending to a depth of around 23 meters (75 feet) below the ground surface, although this appears to be significantly deeper than the depth of the dredged slip reported by USACE in 1989. Native fine alluvium was documented below the dredge fill to a terminal excavated depth of 39.5 meters (130 feet). Previous geotechnical investigations performed by GeoEngineers in the vicinity indicate that native fine alluvium would transition into dense alluvial gravels and sands – inferred to be glacial outwash, at depths ranging from 39.5 meters (130 feet) and 43 meters (140 feet) (Heller and Phelps 2014).

Based on a review of historic documents and geotechnical data, ICF has concluded that dredging performed in the early-twentieth century appears to have removed the predevelopment ground surface of the Imperium project site to a depth of at least -28 feet below the ground surface. Starting in the early 1980s, the dredged area was backfilled to the elevation of the current ground surface. As a result, it is unlikely that archaeological deposits in primary depositional context would be encountered to a depth of -28 feet below the ground surface in the Imperium study area.

ICF's archaeological review and supplemental research on the Imperium study area revealed no documented archaeological sites and limited potential for encountering as-yet undocumented archaeological sites. The Imperium study area was subject to widespread and deep dredging during the early-twentieth century, and was subsequently filled during the late twentieth century. None of the proposed ground-disturbing activities in this area, except one, are expected to disturb sediments at a depth greater than was previously disturbed and removed during the prior dredging activities. Only the proposed driving of piles is anticipated to encounter undisturbed native sediments. However, no sediments would be excavated as part of this activity.



Sources: Site Design, Skillings Connely, 2014; Coast Geodetic Survey Gray's Harbor, WA, 1928.

Figure 6-7
Overlay of Historic Coast Geodetic Survey Map (1928) and Imperium Study Area
Westway and Imperium Expansion Projects

Archaeological Investigations

ICF archaeologists J. Tait Elder and Anna Robison-Mathes performed an archaeological field survey within the Imperium study area on April 24 and April 27, 2015. Weather conditions on these days were sunny and dry. The field survey consisted of the excavation of three geoarchaeological borings and nine mechanical trenches (Figure 6-8). No archaeological deposits or buried terrestrial surfaces were identified during the archaeological field survey.

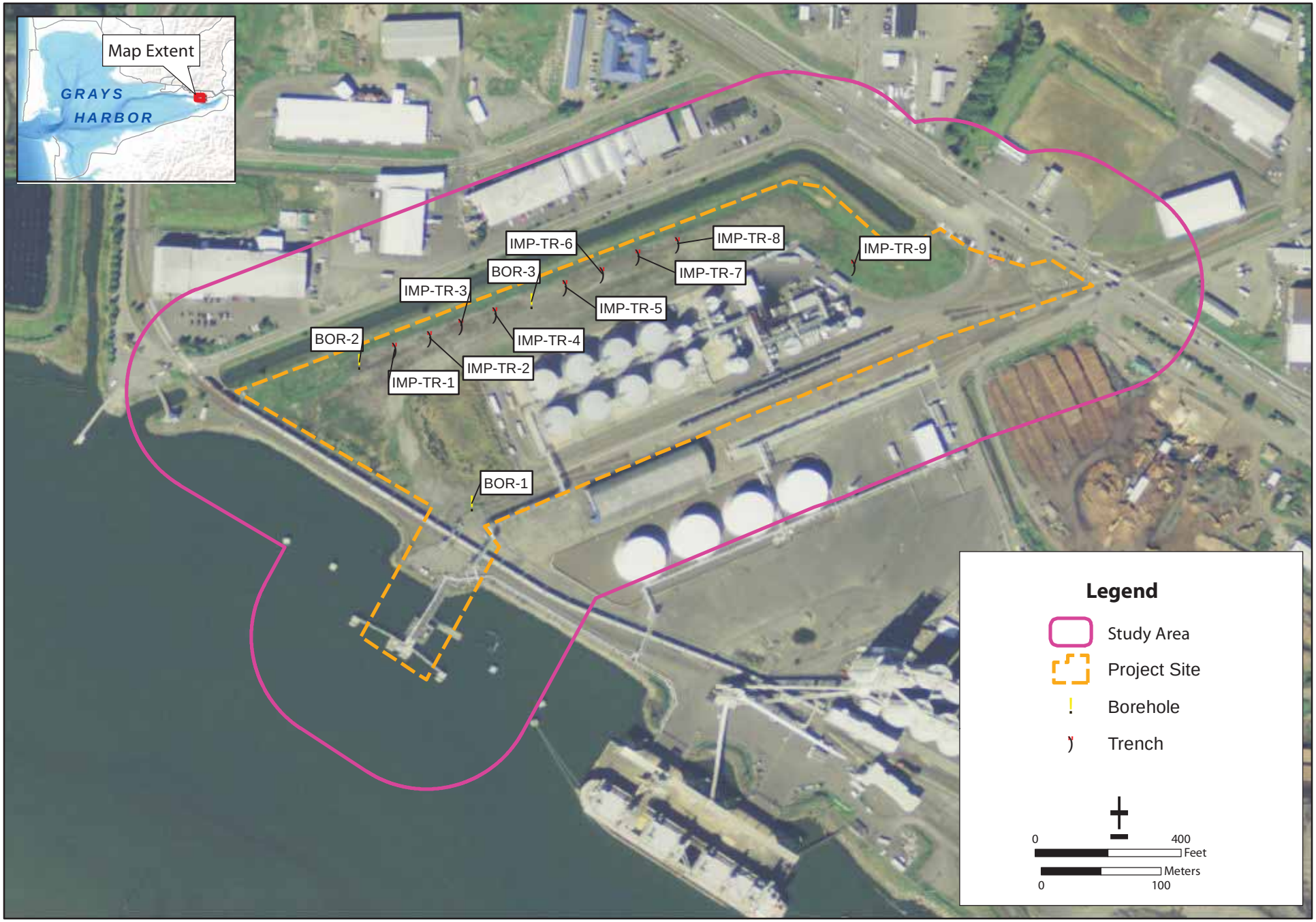
Review of the sedimentary and stratigraphic data obtained during the field survey revealed two deposits with differing inferred origins during the field survey. These deposits are described in Table 6-3 in the vertical sequence in which they were encountered. Figure 6-9 depicts the stratigraphic relationship and relative thickness of the deposits across the Imperium study area, while Figure 6-10 depicts the distribution of boreholes relative to the former Slip 1 footprint.

Table 6-3. Deposits Identified in the Imperium Study Area and their Inferred Depositional Environment

Field Designation	Description	Inferred Depositional Environment
Undifferentiated Fill	Laminated to massive loose saturated very dark gray silt, sandy silt, or sand, occasional decomposing organics, angular gravels, wood debris, sawn and wood fragments, sparse shell unidentified shell fragments.	A combination of mass and hydraulic filling.
Intertidal Flat	Laminated firm saturated grayish brown to dark gray silt with trace sand, occasional lenses of fine sand and detrital organics, sparse in-situ *Macoma* sp. valves.	Low-energy tidally influenced deposition prior to the historic era.

Undifferentiated fill was identified at the ground surface in all geoarchaeological borings and mechanical trenches. This deposit extended below the maximum depth of all mechanical trenches, and ranged from 18 to 37 feet thick. Unlike the undifferentiated fill and deposits of unknown origin in the Westway study area, the undifferentiated fill in the Imperium study area frequently contained occasional angular gravels, woody debris with sawn wood fragments, and sediments with mixed or fractured structure, often in association with each other. These depths generally corroborated the sounding depths taken while Slip 1 was in use (U.S. Coast and Geodetic Survey 1928, 1948; Figure 6-9). In two trenches, individual valves from a historically introduced shellfish species, *Mya arenaria*, were identified within fill deposits (Elder 2006).

Native intertidal flat deposits were identified in all three geoarchaeological borings, but extended below the maximum depth of mechanical trenches in the locations where geoarchaeological borings and mechanical trenches were excavated in the vicinity of each other. Like the Westway study area, in-situ bivalves were identified in the intertidal flat deposits. Although the lower interface of the intertidal flat deposits were not established within the Imperium study area, a previous geotechnical study that occurred in the study area indicates that *native fine alluvium* (inferred here to be a proxy or intertidal flat deposits) are located as deep as 130 feet below the current ground surface (Heller and Phelps 2014).



Sources: Site Design, Skillings Connely, 2014; ESRI Imagery, 2014.

Figure 6-8
Imperium Trench and Borehole Locaitons
Westway and Imperium Expansion Projects

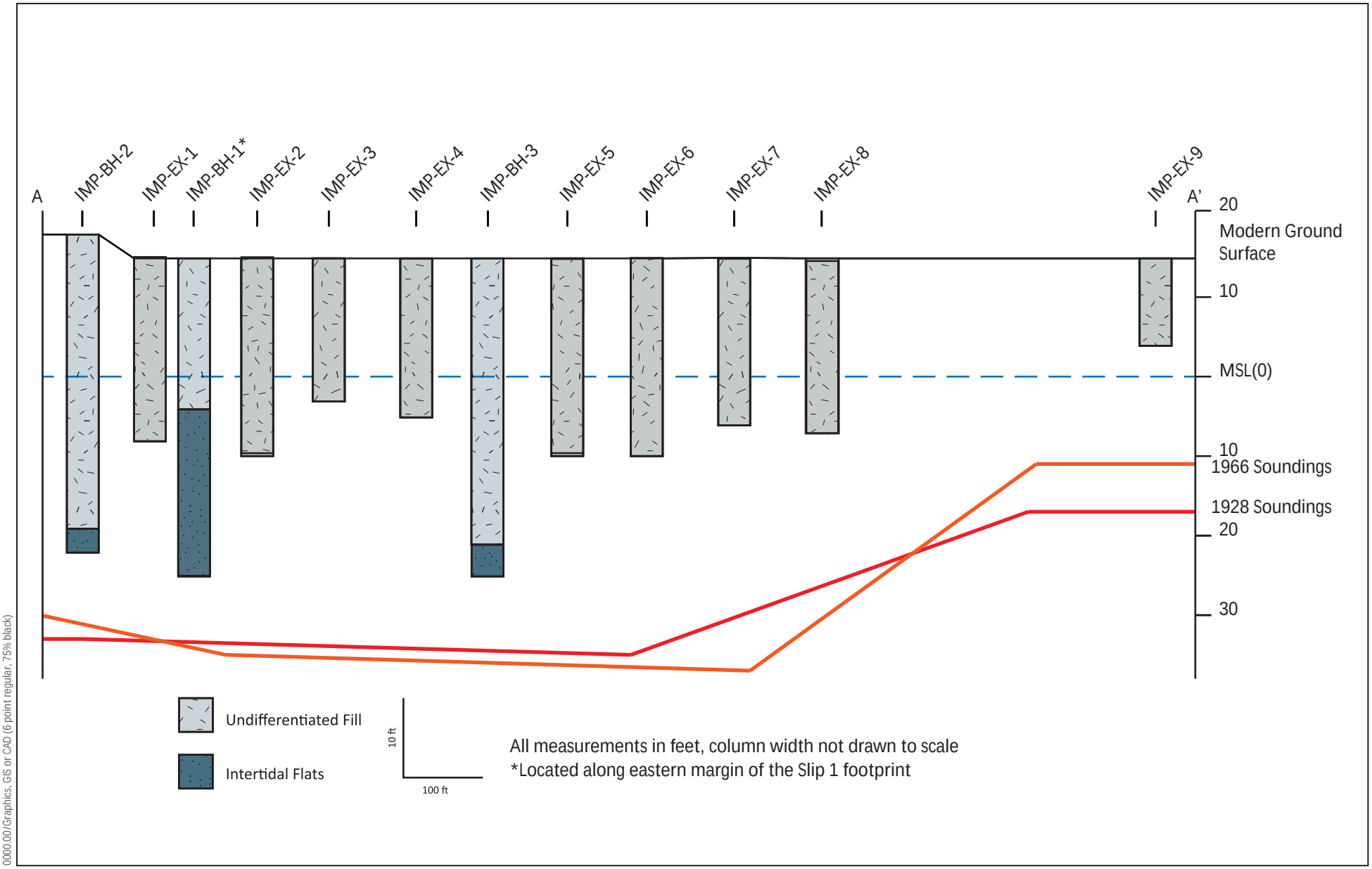


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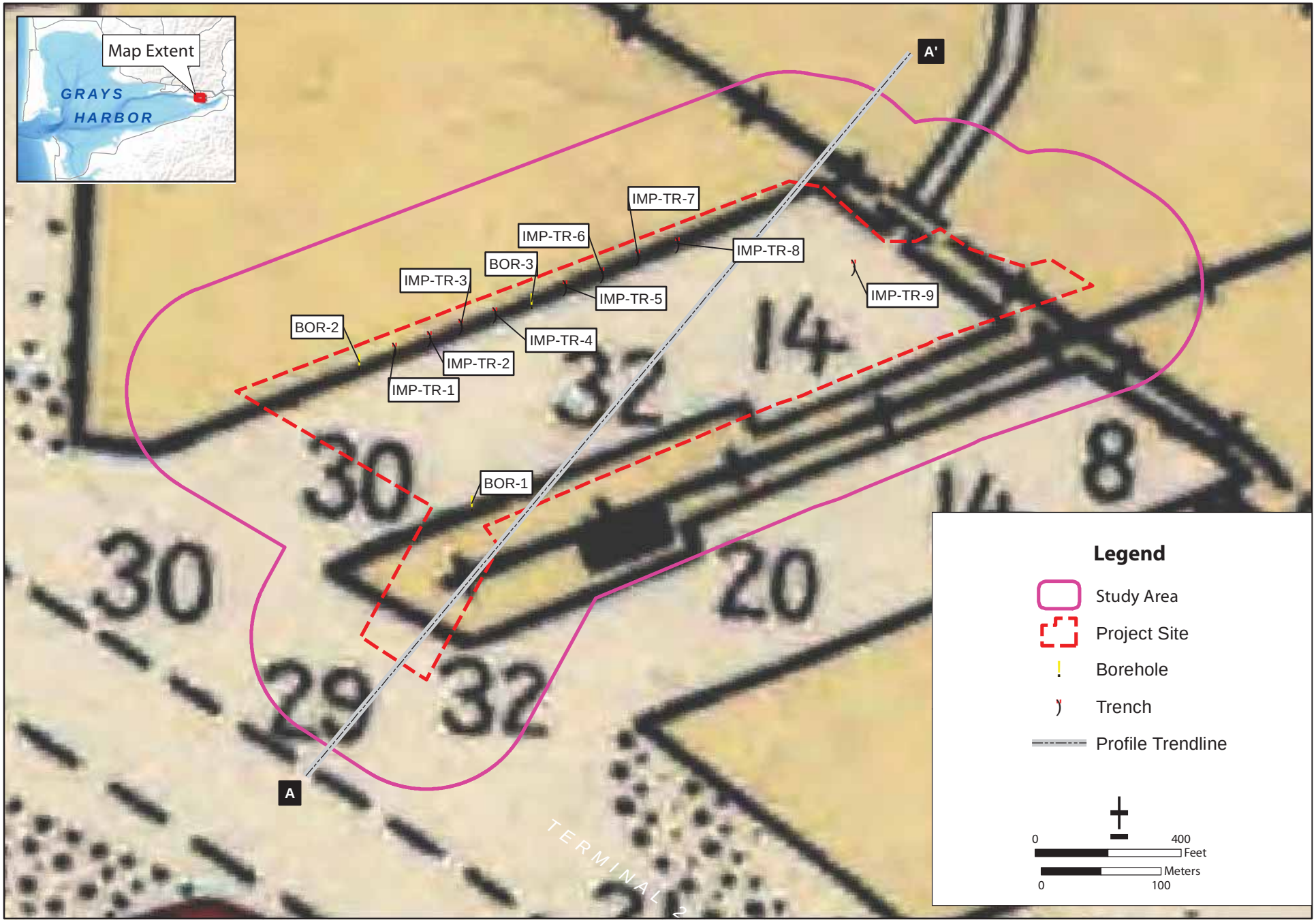
Figure 6-9
Imperium Geologic Fence Diagram
Westway and Imperium Expansion Projects



Sources: Site Design, Skillings Connely, 2014; Coast Geodetic Survey Gray's Harbor, WA, 1928.

Figure 6-10
Imperium Trench and Borehole Locaitons with Profile Trendline
Westway and Imperium Expansion Projects

Summary

Subsurface investigations revealed no buried surfaces or archaeological resources in the Imperium study area. Unlike the Westway study area, undifferentiated fill deposits in the Imperium study area retained the attributes necessary to differentiate them from the underlying intertidal flat deposits. Undifferentiated fill ranged from around 17 feet thick along the eastern margin of the Imperium study area to between 36 and 37 feet thick along the central portion of the Imperium study area. Native intertidal flat deposits were identified below undifferentiated fill in all three instances where subsurface investigations extended below the depth of fill. Although the lower interface of the intertidal flat deposits were not established in the Imperium study area, it is inferred that the terminal depth of the native intertidal flat deposits range from 120 to 130 feet below the ground surface (Heller and Phelps 2014; Phipps 2010).

Historic Resources Survey

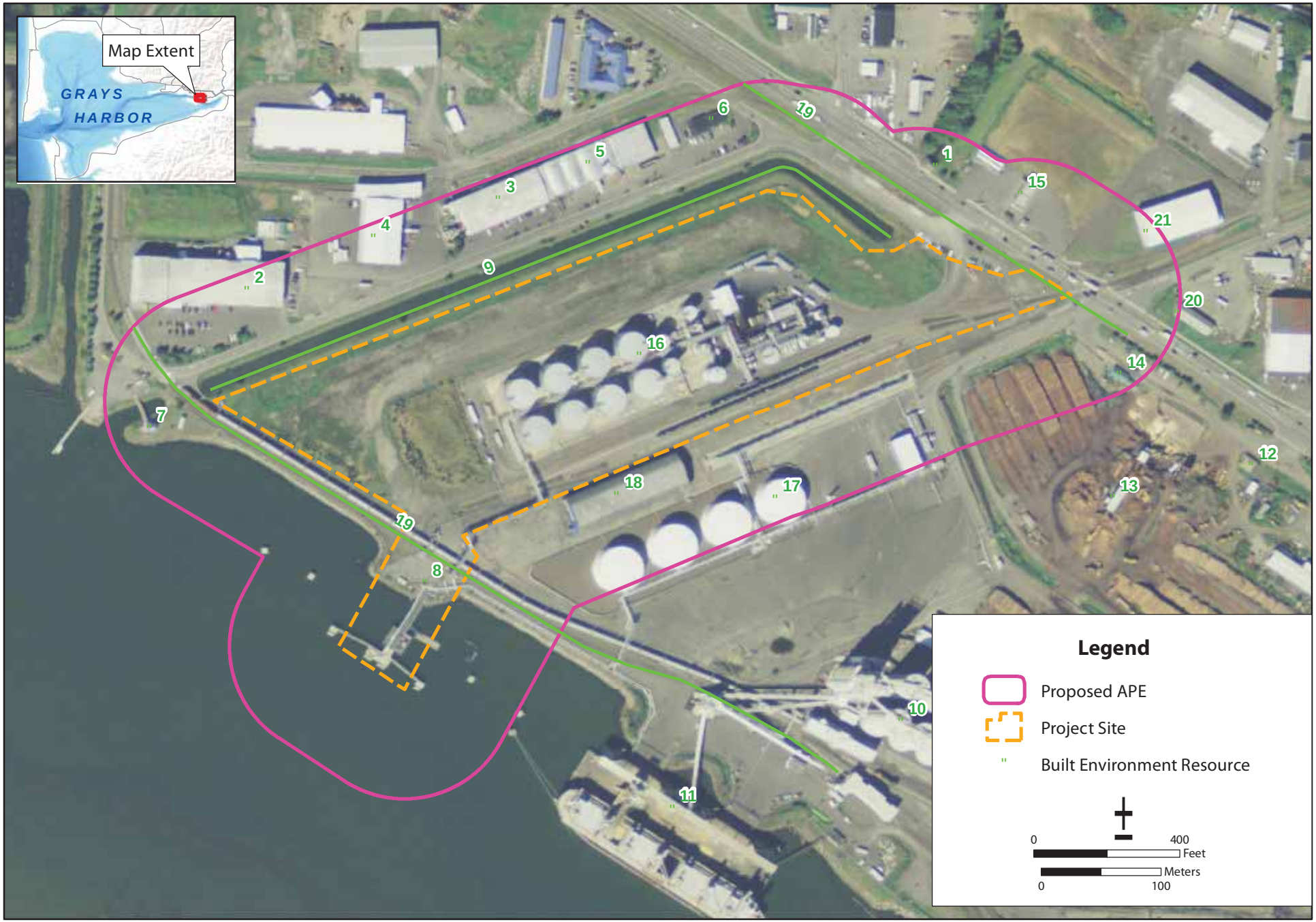
The historic resources survey of the Imperium study area identified 18 buildings and structures (Figure 6-11; Table 6-4). Based on Grays Harbor County tax assessor data and field observations, four of these properties were identified as being 45 years of age or older. Of the four, the literature review revealed that two of these properties were identified and evaluated by a previously completed cultural resources studies and recorded in WISAARD (Schneyder et al. 2010). ICF newly evaluated the other two properties for the current study.

DAHP determined that the previously evaluated properties are not eligible for listing in the NRHP, within the past five years. ICF's review of these resources corroborates these evaluations.

ICF evaluated the other two newly identified properties and concluded that none appear eligible for listing in the NRHP. These properties include the following:

- Paneltech Products, Inc. Warehouse. The property contains a one-story industrial warehouse at 2999 John Stevens Way, currently occupied by Paneltech Products, Inc., and associated with the company's adjacent office building. The warehouse was constructed in the mid-1940s, sometime before 1948.
- Warehouse E. The property contains a one-story industrial warehouse building at 3128 Port Industrial Road, currently occupied by Westway. The building was first built as a warehouse for the Port's Marine Terminal No. 1. The existing structure was constructed in 1962 at twice its current length. The building's eastern half was removed during a renovation in 2009 and the exterior cladding replaced. These changes appear to have occurred during construction of the Westway facility.

ICF found no evidence to suggest that either of these properties are associated with events that have made a significant contribution to the broad patterns of history, nor with the lives of significant persons, in the local community, the state/region, or the nation. They exhibit common architectural styles and building types, and do not appear to embody characteristics or methods of construction that would warrant special recognition. Moreover, Warehouse E has been substantially altered with changes to its plan and exterior cladding, such that it does not appear capable of conveying historical significance. There is no evidence to suggest that either property is associated with a significant designer or craftsman. Finally, the properties are not considered to have the potential to be a principal source of historical information based on their common construction and building types.



Sources: Site Design, Skillings Connely, 2014; Aerial Imagery, ESRI Basemap, 2010

Figure 6-11
Identified Buildings and Structures in the Imperium Study Area
Westway and Imperium Expansion Projects

ICF concluded that all of the other properties in the Imperium study area are less than 45 years old. These properties were not evaluated for NRHP eligibility, due to their age, based on DAHP cultural resources reporting guidelines.

Table 6-4. Buildings and Structures Identified in the Imperium Study Area

ID	APN	Property Name	Address	Build Date	NRHP Evaluation
1	29902000200	Pump Station	2700 John Stevens Way, Hoquiam	1983	Less than 45 years
2	56402300000	Westport Shipyards	2850 John Stevens Way, Hoquiam	c2000	Less than 45 years
3	56402300000	Paneltech Products Inc./Warehouse G	2999 John Stevens Way, Hoquiam	c1995	Less than 45 years
4	56402300000	Paperstone Products	2999 John Stevens Way, Hoquiam	c2000	Less than 45 years
5	56402300000	Warehouse (Paneltech Products Inc.)	2999 John Stevens Way, Hoquiam	c1945	Not Eligible
6	56402300000	Longshore Federal Credit Union	3107 John Stevens Way, Hoquiam	1960	Not Eligible (Previously Evaluated)
7	56402300000	Port of Grays Harbor View Tower	John Stevens Way, Hoquiam	c1985	Less than 45 years
8	56402300000	Port of Grays Harbor Terminal 1	PGH Terminal 1	c1985	Less than 45 years
9	56402300000	Fly Creek (Channelized)	PGH Terminal 1	1983	Less than 45 years
13	29902000200	Local Manufacturing, Inc.	2421 Port Industrial Road, Aberdeen	c1985	Less than 45 years
14	29902000200	Local Manufacturing, Inc.	2609 Port Industrial Road, Aberdeen	c1975	Less than 45 years
15	29902000200	Petit Oil Company (Fueling Station)/ Coffeeman	2616 Port Industrial Road, Hoquiam	c2000	Less than 45 years
16	56402300000	Imperium Grays Harbor	3122 Port Industrial Road, Hoquiam	2006	Less than 45 years
17	56402300000	Westway Terminal Company	3128 Port Industrial Road, Hoquiam	2009	Less than 45 years
18	56402300000	Westway Terminal Company/Warehouse E	3128 Port Industrial Road, Hoquiam	1962/ 2009	Not eligible
19	56402300000 29902000200	Port of Grays Harbor Railroad Spur	N/A	c1995	Less than 45 years
20	29902000200	California Petroleum Corp. Warehouse	2519 W 1st Street, Aberdeen (aka 2421 W 1st Street)	c1925	Not Eligible (Previously Evaluated)
21	29902000200	Warehouse	2510 1st Street, Aberdeen	c1970	Less than 45 years

Notes:
c = circa; PGH = Port of Grays Harbor; N/A = not applicable.

Chapter 7
Impacts Analysis

This chapter analyzes the proposed actions' potential impacts on identified cultural resources in the study areas, based on the results presented in Chapter 6, *Results*. The proposed actions would be considered to have an adverse effect or impact, if it were to alter the characteristics of a cultural resource (archaeological, historic, or ethnographic) that is listed in or eligible for listing in the NRHP or WHR, or is otherwise protected by applicable state regulations. All qualifying characteristics of cultural resources are considered, including those that might have been identified subsequent to the property's original evaluation. Adverse effects might also include reasonably foreseeable effects caused by the proposed actions that could occur later in time, be farther removed in distance, or be cumulative.

Both of the proposed actions and the no-action alternatives were analyzed for their potential to have impacts on cultural resources identified in their respective study areas, and qualitative consideration of potential impacts on cultural resources in the proposed actions' associated transportation corridors. A discussion of cumulative impacts is also provided.

Westway Study Area

Proposed Action

The Westway proposed action would involve the construction of five new storage tanks, two new railroad spurs, containment walls and basins, and other new infrastructure. Rail access to the expanded facility would continue to be provided via the existing connection to the PS&P rail line, which itself connects with the BNSF railway main line in Centralia, Washington. Construction of the facility would require ground disturbance on the project site, consisting of mechanical excavation and grading to prepare the ground surface and pile driving to a maximum depth of 150 feet.

It is considered unlikely that the proposed action would encounter undisturbed native sediments or archaeological deposits in primary depositional context. Of the proposed action activities, only the piles would be driven to a depth that would encounter undisturbed native sediments. However, no sediments would be excavated to drive the piles and archaeological investigations designed to sample these sediments would be impractical because of the great excavation depth required. Therefore, no additional cultural resources studies are recommended.

No historic resources eligible for listing in the NRHP or WHR are known to exist in the Westway study area. Therefore, the proposed action would not be expected to affect any significant historic resources.

No archaeological sites are known to exist in the Westway study area and none were identified during subsurface archaeological investigations. Therefore, the Westway proposed action would not be expected to affect any archaeological resources. Based on the results of the subsurface investigations and landform history analysis, only the proposed driving of piles is anticipated to encounter undisturbed native sediments.

No-Action Alternative

Under the no-action alternative, the Westway proposed action would not occur. The use of the Westway study area would remain unchanged from its current conditions, retaining its current functions and use. However, unrelated to the proposed action, Westway anticipates expanding its existing methanol distribution facilities to accommodate an increase in bulk throughput of approximately 40 tons per year. This would entail installing a new vapor control unit. This construction is not expected to result in ground-disturbing activities. No historic resources eligible for listing in the NRHP or WHR are known to exist in the Westway study area. Therefore, the proposed action would not be expected to affect any significant historic resources.

Cumulative Impacts

No significant cultural resources were identified in the Westway study area, the proposed action is not expected to have impacts on cultural resources. Consequently, there would be no cumulative impacts on cultural resources.

Imperium Study Area

Proposed Action

The Imperium proposed action would involve the construction of nine new storage tanks, two new railroad spurs, the extension of five existing railroad spurs, and the construction of containment walls, containment basins, and other new infrastructure. Rail access to the expanded facility would continue to be provided via the existing connection to the PS&P rail line, which itself connects with the BNSF railway main line in Centralia, Washington. Construction of the facility would require ground disturbance on the project site, consisting of mechanical excavation and grading to prepare the ground surface and pile driving to a maximum depth of 75 feet.

It is considered unlikely that the proposed action would encounter undisturbed native sediments or archaeological deposits in primary depositional context. Of the proposed action's activities, only the piles would be driven to a depth that would encounter undisturbed native sediments. However, no sediments would be excavated to drive the piles and archaeological investigations designed to sample these sediments would be impractical because of the great excavation depth required. Therefore, no additional cultural resources studies are recommended.

No historic properties eligible for listing in the NRHP or WHR are known to exist in the Imperium study area. Therefore, the proposed action would not be expected to affect any significant historic resources.

No archaeological sites are known to exist in the Imperium study area and none were identified during subsurface archaeological investigations. Therefore, the proposed action would not be expected to affect any archaeological resources. Based on the results of the subsurface investigations and landform history analysis, only the proposed driving of piles is anticipated to encounter undisturbed native sediments.

No-Action Alternative

Under the no-action alternative, the Imperium proposed action would not occur. The use of the Imperium study area would remain unchanged from its current conditions, retaining its current functions and use. There would be no change in activities associated with the Imperium project site, and the physical settings of the study area would not be altered. Because no change in use would occur under the no-action alternative, no effects on any cultural resources would be expected as a result of the no-action alternative.

Cumulative Impacts

No significant cultural resources were identified in the Imperium study area, and the proposed action is not expected to have impacts on cultural resources. Therefore, there would be no cumulative impacts on cultural resources

Transportation Corridors

PS&P Rail Line

As described in Chapter 1, *Introduction*, the proposed actions would result in increased rail traffic along the existing PS&P rail line between the Port and Centralia, Washington, and the project sites. This rail line has not been surveyed to identify individual historic resources in its vicinity. However, it is possible that increased rail traffic under the proposed actions could affect historic resources located in close proximity to this route. Potential impacts would be expected to include visual and audible intrusions or vibrations caused by rail traffic related to the proposed actions. Affected resources might consist of railroad-related structures, single and multifamily residences, and commercial and industrial properties.

Despite possible visual and audible intrusions and vibrations, operational use of the railroad is not expected to adversely affect historic resources within its vicinity. The PS&P rail line is an existing, active railroad corridor that is already trafficked by a relatively high volume of railroad traffic between the Port and the BNSF main line in Centralia, Washington. The anticipated volume of railroad traffic required by the proposed actions is not expected to exceed existing amounts of noise and vibration already created by railroad traffic along this corridor. For this reason, it is considered unlikely that the proposed actions' operational activities would affect historic resources along the railroad in a manner that would adversely affect their historical significance.

No construction activities or ground disturbance related to the proposed actions are anticipated along the railroad. Therefore, the likelihood of the proposed actions affecting archaeological sites along this corridor is considered minimal.

Rail traffic is addressed in more detail in Section 3.15 of the EISs.

Grays Harbor Navigation Channel

As described in Chapter 1, *Introduction*, the proposed actions would result in increased tank vessel traffic along the Grays Harbor navigation channel. This increase vessel traffic could affect onshore cultural resources in the vicinity of the navigation channel as a result of incremental increase in

shoreline erosion or potential visual effects to onshore archaeological, historic, or ethnographic resources. An onshore resource would be visually impaired by vessel traffic along the navigation channel if the view from the resource to the water were considered a character-defining feature and a view-altering development were introduced that compromised the integrity of this feature. Onshore resources could be affected if shoreline erosion altered or destroyed the landforms on or in which resources are located.

Surveys have not been conducted to identify individual cultural resources along the navigation channel. However, affected resources might consist of single and multifamily residences, commercial and industrial properties, and archaeological sites or culturally significant properties, such as archaeological districts, village sites, rock shelters, pictographs/petroglyphs, shell middens/mounds, cemeteries/burials, lithic scatters, rock alignments/stacked rock features, and fish weirs/traps.

For most of these resource types, vessel traffic along the navigation channel would not be expected to negatively affect cultural resources, because the navigation channel is already trafficked by a relatively high volume of vessels. Increased vessel traffic under the proposed actions is expected to have little change in the overall degree and frequency of shoreline erosion and ephemeral changes in the visual landscape or viewsheds associated with cultural resources along the navigation channel, and not permanent changes to their settings or contexts.

For increased vessel traffic under the proposed actions to pose an adverse impact, the qualities of a cultural resource would need to be materially altered to the extent the resource is no longer considered significant. Even for resources for which the ocean view is a prominent and distinctive character-defining feature, the alteration of the view would not materially impact these resources to the extent that they would no longer be considered historically significant. Moreover, potential levels of shoreline erosion due to project operations is expected to be only incrementally greater from that already posed by natural processes and existing vessel traffic. It is therefore expected that no onshore cultural resources along the navigation channel would be adversely affected as a result of increase vessel traffic related to the proposed actions.

Vessel traffic under the proposed action is described in more detail in Section 3.17 of the EISs.

Chapter 8
Conclusions and Recommendations

Conclusions

No significant cultural resources were identified in the study areas. Therefore, neither proposed action is expected to have impacts on cultural resources.

Consideration of archaeological resources and subsurface archaeological investigations revealed no archaeological sites in the study areas and limited potential for encountering as-yet undocumented archaeological sites. Both of the study areas were subject to widespread and deep dredging beginning in the 1920s and were subsequently filled in the 1980s. Although the precise depth of fill could not be verified at the Westway study area based on the results of the subsurface archaeological investigations alone, the information obtained from both study areas revealed that all but one of the proposed ground-disturbing activities are unlikely to disturb sediments at a greater depth than was previously disturbed and removed during the dredging of Slips 1 and 2 or greater than the depth of filling over unvegetated intertidal flats during the twentieth century. Only the proposed driving of piles is anticipated to encounter undisturbed native sediments but no sediments would be excavated during this activity. Review of the local landform development history and deep borings excavated in both study areas reveals that the undisturbed deposits below the fill include intertidal flat and high energy alluvial deposits.

The historic resources survey conducted for the proposed actions identified a total of 21 buildings and structures in the study areas. Four of these properties were found to be 45 years of age or older. Of these four properties, two were identified by previously completed cultural resources surveys and determined not eligible for listing in the NRHP. ICF concluded that the other two resources do not appear eligible for listing in the NRHP.

Along transportation corridors associated with the proposed actions, potential impacts on cultural resources are considered low. The transportation corridors have not been surveyed. However, no ground disturbance is anticipated along these routes and the likelihood of the proposed actions affecting an archaeological site is considered minimal. The PS&P rail line and Grays Harbor Navigation Channel also both consist of existing, active transportation corridors that are already trafficked by a relatively high volume of traffic similar to that potentially associated with the proposed actions. The proposed actions are not expected to exceed existing thresholds for noise and vibration affects along the railroad corridors and visual effects or erosion along the navigation channels. For these reasons, it is considered unlikely that the proposed actions' operational activities would affect historic resources along the transportation corridors in a manner that would adversely affect their historical significance.

Recommendations

No further consideration of cultural resources is recommended for either the Westway study area or the Imperium study area, based on the results of this cultural resources study and assuming that the

depth of proposed ground-disturbing activities (excluding the driving of piles) does not exceed the depth of anthropogenic fill deposited in either study area during the twentieth century.

In the Westway study area, if the depth of proposed ground-disturbing activities would result in the excavation and exposure of subsurface deposits (i.e., not pile driving) greater than 15 feet below the current ground surface in the Westway study area, then it is recommended that the proponent for the proposed actions commit to having a qualified professional archaeologist monitor ground disturbing activities. If archaeological monitoring reveals fill deposits at greater depths than listed above, these results will be used to establish a 100 foot buffer around the location of the discovery in which no additional archaeological monitoring would be needed to the maximum depth at which fill deposits have been documented.

For both proposed actions, an Unanticipated Discovery Plan should be prepared and implemented to address previously unidentified archaeological resources should any be discovered during construction.

Chapter 9
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Attachment A

Agency and Tribal Correspondence

EARTHJUSTICE

ALASKA CALIFORNIA FLORIDA MID-PACIFIC NORTHEAST NORTHERN ROCKIES
NORTHWEST ROCKY MOUNTAIN WASHINGTON, DC INTERNATIONAL

May 31, 2013

Via Federal Express and Email

Brian Shay, City Administrator
City of Hoquiam
609 - 8th Street
Hoquiam, WA 98550
bshay@cityofhoquiam.com

Sally Toteff, Southwest Regional Director
Washington Dep't of Ecology
P.O. Box 47775
Olympia, WA 98504-7775
sally.toteff@ecy.wa.gov

Re: Imperium Bulk Liquid Facility Project: Mitigated Determination of Non-Significance

Dear Mr. Shay and Ms. Toteff:

The following comments are submitted on behalf of the Quinault Indian Nation on the proposed State Environmental Policy Act ("SEPA") Mitigated Determination of Non-Significance ("MDNS") for the Imperium Bulk Liquid Facility Project—the second crude-by-rail oil shipping proposal to be given an MDNS this spring. The Quinault Indian Nation is a sovereign tribal government that has federally-guaranteed treaty rights and other interests in Grays Harbor and the Chehalis River. We appreciate the opportunity to comment.

As we expressed in our comments on the Westway proposal, we are deeply concerned about this decision, which will effectively authorize the construction of another new oil shipping terminal in Grays Harbor. With the addition of up to nine new storage tanks of 80,000 barrels each, the proposal would give Imperium the capacity to store 720,000 barrels of crude oil and other petroleum products at any given time. The decision to authorize this type of facility, particularly given the acknowledgement that two additional facilities for crude-by-rail—amounting to **tens of millions of barrels of crude oil annually through Grays Harbor**—are also being proposed in the same area, poses **major environmental risks to the Grays Harbor community and the Quinault Indian Nation.**

The Quinault Indian Nation has usual and accustomed fishing areas in Grays Harbor and the Chehalis River, and tribal members' right to access currently-used fishing, hunting, and gathering sites will be impacted by increased vessel and rail traffic. Grays Harbor and the

705 SECOND AVENUE, SUITE 203 SEATTLE, WA 98104-1711
T: 206.343.7340 F: 206.343.1526 E: eajuswa@earthjustice.org W: www.earthjustice.org

tributaries that feed it are critical nursery areas for many Quinault harvested species including Dungeness crab, an economically vital fishery on the coast of Washington. Additionally, an oil spill would devastate the fish, shellfish, eel grass, and cultural plant populations they rely on for commercial and subsistence harvest and cultural activities. Tribal members have always and continue to live and work in the Grays Harbor area. The Quinault Indian Nation is also concerned about the global warming impacts of this terminal. While Imperium acknowledges that approximately 45,211 metric tons/year of CO_2 equivalent will be generated annually (measured within Washington State borders) from rail, marine vessel, automobile, and Marine Vapor Combustion of this project alone, Imperium under-estimates rail transportation emissions by at least 68%, fails to account for all marine transportation emissions, and wholly fails to account for emissions from drilling, pumping, refining, and burning.

It is inconceivable that a decision to build an oil pipeline and associated oil shipping terminal would be reviewed without an environmental impact statement; the transport of crude oil by railcar does not lessen the significant environmental risks associated with this proposal. In many ways, this pipeline-on-wheels system is more risky than a conventional pipeline, as it involves continually mobile vehicles and a greater number of transfer points. At the same time, proposals to build coal export terminals in Washington are receiving full SEPA review, and many of the coal terminal impacts—increased rail and marine vessel impacts, impacts to marine and aquatic life, impacts to tribal treaty rights and cultural historic sites, life-cycle greenhouse gas emissions—are just as significant for this proposed crude-by-rail project.

Even with the proposed mitigation, there are probable and significant adverse environmental impacts from this project. For the reasons discussed below, MDNS and the proposed permits are inconsistent with SEPA and its implementing regulations, RCW 43.21C & WAC 173-11; the Shoreline Management Act and its implementing regulations, RCW 90.58 & WAC 173-27-180; and the City of Hoquiam code.[1] We strongly urge you to withdraw the inadequate MDNS for Imperium's proposal and suspend all permitting until this project is given closer scrutiny by the public and state and local decisionmakers through a complete environmental impact statement.

Moreover, proceeding with Imperium's proposal through a Mitigated Determination of Non-Significance on a Shorelines Management Act permit violates Washington law on financial responsibility for transport of petroleum products (RCW 88.40) and protection of ocean resources (RCW 43.143). Finally, Imperium's proposed crude-by-rail facility falls under the jurisdiction of Washington's Energy Facility Site Evaluation Council, not the City of Hoquiam and Ecology, and this project should be proceeding under the requirements and provisions of RCW 80.50.

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[1] We also incorporate by reference the comments of Friends of Grays Harbor *et al.*

I. BACKGROUND

A. Imperium Proposal

Imperium Terminal Services, LLC has proposed to expand its existing bulk liquid storage terminal at the Port of Grays Harbor to accept, store, and then ship petroleum projects, including crude oil. The proposed project (on a 10.907 acre site) will result in a tank farm, rail spurs (approximately 6,100 feet of new track), pipelines, and new office, laboratory, and warehouse buildings. The Imperium proposal would accept crude oil brought to the facility by rail, store it in large tanks, and then load the crude onto ships and barges that would take it to U.S. refineries, presumably in Washington or California. The oil will come by train, most likely from North Dakota, Montana, and Alberta, Canada. Imperium proposes nine new storage tanks with the capacity to store a total of 720,000 barrels or 30,240,000 gallons.[2] With a capacity to receive 78,000 barrels per day, Imperium may ship almost 28.5 million barrels of crude oil per year. Imperium estimates that the terminal would add 730 train trips annually, equaling two, 105-car trains (one loaded with oil on the way in, one empty on the way out) per day. The company estimates 400 ship/barge transits through Grays Harbor per year. Imperium must obtain at least a Shorelines Management Act Substantial Development Permit and a Conditional Use Permit for its proposal.

B. Additional Crude-By-Rail Proposals

The Imperium project is one of three crude-by-rail projects being proposed for this area of Grays Harbor, the other two proposals being put forth by Westway Terminal Company and U.S. Development Group.

Westway Terminal Company has also proposed a crude-by-rail facility at Terminal 1. After a public comment period, the City of Hoquiam issued a Shorelines Substantial Development Permit for Westway on April 26, 2013. Quinault Indian Nation and five conservation organizations have appealed that permit to the Shorelines Hearings Board (SHB Nos. 13-012, 13-013). The Imperium MDNS admits that the Westway proposal has the potential for cumulative impacts, WAC 197-11-792, although the MDNS only discusses combined vessel and rail traffic impacts resulting from the two proposals. According to the MDNS, Westway's proposal adds 243 train trips and 120 vessel transits annually to the Grays Harbor/Hoquiam area; Westway estimates shipping at least 10 million barrels of crude oil annually.

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[2] One barrel of oil = 42 U.S. gallons. For "light" crude oil, such as that from the Bakken, the ideal rail tank car capacity is 30,000 to 32,000 gallons (or 714-761 barrels). Ass'n of American Railroads, *Moving Crude Petroleum by Rail* (Dec. 2012) at 8. Imperium estimates its tank car capacity at 743 barrels per car.

U.S. Development Group is proposing a crude-by-rail facility at Terminal 3. The MDNS does not mention or consider any impacts from this proposal. While the permit applications have not yet been submitted, the U.S. Development Group proposal is reasonably foreseeable. The Port of Grays Harbor website describes the U.S. Development proposal as a facility that would handle "multiple grades of crude oil" up to "50,000 barrels per day" (18.25 million barrels a year) with two 120-car unit trains every two days and 90-120 vessels transits per year, depending on vessel size. *See* http://www.portofgraysharbor.com/about/CBR-Project.php (last visited April 5, 2013).

It should be noted that crude-by-rail is a recent phenomenon. "As recently as 2008, U.S. Class I railroads originated just 9,500 carloads of crude oil. By 2011, this had jumped to 66,000 carloads, and in 2012 will exceed 200,000." Ass'n of American Railroads, *Moving Crude Petroleum by Rail* (Dec. 2012) at 1.

C. Interests of the Quinault Indian Nation

The Quinault Indian Nation is a signatory to the Treaty of Olympia (1856) in which it reserved a right to take fish at its "usual and accustomed fishing grounds and stations" and the privilege of gathering, among other rights, in exchange for ceding lands it historically roamed freely. Treaty rights are not granted to tribes, but rather are "grants of rights from them—a reservation of those not granted." *U.S. v. Winans*, 198 U.S. 371, 380-381 (1905). Treaty rights are akin to easements running with the lands or places they burden and include a right of access to those places. *Id*. at 381. As such, treaty rights are property rights within the meaning of the fifth amendment and cannot be "taken" without compensation. *Muckleshoot v. Hall*, 698 F. Supp. 1504, 1510 (W.D. Wash. 1988).

Treaties are the highest law of the land and create a special fiduciary duty and trust responsibility upon all agencies of the United States and states to protect treaty rights, including fishing rights. *Seminole Nation v. United States*, 316 U.S. 286, 297 (1942). These rights cannot be abrogated except by explicit Congressional authorization. Federal courts have consistently required the federal agencies and states to keep the treaty promises upon which the Tribes relied when they ceded huge tracts of land by way of the Treaties. *See, e.g., U.S. v. Winans*, 198 U.S. 371 (1905); *Confederated Tribes of Umatilla Indian Reservation v. Alexander*, 440 F. Supp. 553 (D. Or. 1977); *U.S. v. Oregon*, 718 F.2d 299, 304 (9th Cir.1983); *Muckleshoot v. Hall*, 698 F. Supp. 1504 (W.D. Wash. 1988); *Northwest Sea Farms v. U.S. Army Corps of Eng'rs*, 931 F. Supp. 1515 (W.D. Wash. 1996); *U.S. v. Washingto*n, 2007 WL 2437166 (W.D. Wash. 2007).

In a landmark court case known as the "Boldt decision," a federal court confirmed that Indian tribes have a right to half of the harvestable fish in state waters and established the tribes as co-managers of the fisheries resource with the State of Washington. *U.S. v. Washington*, 384 F. Supp. 312 (W.D. Wash. 1974). Specific to the Quinault Indian Nation, the Boldt decision

affirmed the Quinault usual and accustomed fishing areas include "Grays Harbor and those streams which empty into Grays Harbor." *Id*. at 374.

The Quinault have been called the Canoe people because of the primacy of the ocean, bays, estuaries, and rivers to every aspect of tribal life.[3] The Quinault Indian Nation's Division of Natural Resources manages all aspects of its many fisheries, both on and off the reservation. Quinault fishermen catch salmon, sturgeon, steelhead, halibut, cod, crab, oysters, razor clams, and many other species in Grays Harbor.

The Chehalis and the Humptulips Rivers and the Grays Harbor estuary into which they flow, provide the freshwater and marine habitat that support natural production for chinook, chum, and coho salmon and steelhead of critical importance to the Quinault Nation's Treaty-protected terminal river fisheries within Grays Harbor, managed jointly by the Quinault Nation and Washington State Department of Fish and Wildlife and governed by seasonal plans and agreements. Grays Harbor nourishes other species of fish important to the Nation's Treaty-protected fisheries such as White Sturgeon and Dungeness Crab. Grays Harbor produces numerous species of invertebrates and finfish that provide important prey to species and stocks utilizing Grays Harbor and adjacent marine areas.

Quinault weavers have gathered materials from the Grays Harbor area for many generations. Sweetgrass, cattail, and other grasses and willow gathered from the Bowerman Basin are used by the Quinault as a material in the traditional weaving of baskets and mats, and for ceremonial purposes. Weaving is as integral to contemporary Indian culture as it was in the past. For more detail, *see* K. James and V. Martino, *Grays Harbor and Native Americans* (1986), prepared for the U.S. Army Corps of Engineers (Contract #DACQ67-85-M-0093).

Bowerman Basin, located in Grays Harbor to the north of the proposed Imperium project, is one of the two major areas remaining in Washington with large sweetgrass populations. Sweetgrass is a key component, and participant, in the highly complex estuarine ecosystem processes. Its loss due to a potential oil spill would significantly impact juvenile salmonid and bird habitats, and estuary function, having huge negative implications for the Quinault.

The Quinault Indian Nation has an obvious and keen interest in protecting the fish and fish habitat that it relies on in Grays Harbor to exercise its federally-guaranteed treaty fishing rights, as well as the traditional areas used for gathering plants for traditional cultural use. Additionally, the Quinault Nation's treaty fishing right includes a right of access to its traditional fishing areas and any impact to that right is an unconstitutional taking of a property right. These collective federally-protected treaty rights must be considered and addressed—the State of Washington cannot take actions that impinge the Quinault Indian Nation's treaty rights.

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[3] *See, generally* Jacqueline M. Strom, Land of the Quinault (1990).

II. THE PROJECT'S SEPA ANALYSIS IS FATALLY FLAWED.

On May 2, 2013, the City of Hoquiam and Washington Department of Ecology (co-lead agencies for SEPA) announced that they had made a mitigated finding of non-significance for Imperium's proposal to build nine new storage tanks at the Port of Grays Harbor, a decision that exempts the proposal from full review under SEPA. At Imperium's request, the comment period was extended to June 3, 2013. The MDNS is deeply flawed in multiple respects and will not withstand review in an appeal. A decision to authorize the storage, shipping, and handling of millions of barrels of crude oil each year will have a number of critically important environmental impacts that must be fully evaluated in an environmental impact statement, along with a complete analysis of different alternatives and potential mitigation possibilities, if any.

A. Legal Requirements

SEPA requires an environmental impact statement ("EIS") for any action that has a "probable significant, adverse environmental impact." RCW 43.21C.031(1). Significance means a reasonable likelihood of more than a moderate adverse impact on environmental quality." WAC 197-11-794. To assist in determining whether an EIS is required, agencies conduct a "threshold determination." RCW 43.21C.033. If, in reviewing the project, the agency concludes that the project will not have a significant adverse environmental impact, it may issue a "determination of non-significance" and proceed without further review. Similarly, if significant adverse environmental impacts can be mitigated to reduce them to insignificance, a "mitigated determination of non-significance" is permissible. In contrast, if the threshold determination concludes that significant environmental impacts will result, the agency needs to conduct a full EIS that evaluates all of the environmental impacts, alternatives to the proposed action, and potential mitigation. SEPA authorizes, but does not require, the mitigation of adverse environmental impacts.

B. The MDNS Failed to Consider Cumulative Impacts From Three Crude-By-Rail Proposals.

The MDNS review was limited to the immediate environmental impacts of the construction work and operating the facility. It did, however, recognize one of the other two crude-by-rail terminal proposals (Westway) as having similar transportation pathways and timeframes; this led to a chart of aggregate transportation impacts from two projects only. The MDNS, however, limited most of its analysis to only the Imperium proposal. Where Westway was considered, it was only for its transportation (rail and marine vessel) impacts, but not others, including greenhouse gas emissions, impacts of marine life, impacts to Quinault treaty rights, or risks of oil spills.

There is no explanation why the third proposal (Grays Harbor Rail Terminal, a subsidiary of U.S. Development Group) was not considered. Like Imperium and Westway, U.S.

Development Group is proposing a crude-by-rail facility, with similar types of impacts from rail and vessel transportation, greenhouse gas emissions, impacts of marine life, impacts to Quinault treaty rights, and risks of oil spills. Although this proposal has not yet submitted its permit application, it is clearly foreseeable and being proposed in the same time frame. Information about the proposal is available on the Port of Grays Harbor website, and the Port recently granted a subsidiary of Grays Harbor Terminals a lease option.[4]

"Proposals are similar if, when viewed with other reasonably foreseeable actions, they have common aspects that provide a basis for evaluating their environmental consequences together, such as common timing, types of impacts, alternatives, or geography." WAC 197-11-060(3)(c)(i). Because the MDNS did not fully consider the indirect and cumulative impacts of the three crude-by-rail proposals for Grays Harbor, WAC 197-11-792, there are probable significant adverse cumulative environmental impacts associated with this project that require review in an environmental impact statement.

C. <u>The MDNS Fails to Consider Direct, Indirect, and Cumulative Impacts of This Project on Water Quality and Aquatic Life.</u>

The MDNS failed to adequately consider and mitigate the impacts of this project on streams, wetlands, fishing areas, shellfish beds, water quality, aquatic life, and migratory bird habitats, and the probable adverse impacts from this proposal on these marine and aquatic resources are simply too significant for an MDNS. Fry Creek lies on the north and west boundaries of the site; the Chehalis River borders the southwest side of the site. Fry Creek supports coho salmon and cutthroat trout; the Chehalis River is home to several fish species protected under the federal Endangered Species Act, 16 U.S.C. § 1531 *et seq.*, including bull trout, green sturgeon, and Pacific eulachon. Chinook, coho, and chum salmon and steelhead are found in Grays Harbor,[5] and the harbor is an important nursery and adult refuge for Dungeness Crab. Snowy plover (threatened) have critical habitat at Damon Point, due west of the Imperium site. Steller sea lions and bald eagles also live in the area.

Juvenile salmon, which use near shore environments for migration and rearing, may also be disrupted by increased vessel traffic. With the increase of vessel traffic, turbidity and suspended sediments could increase, interfering with fish feeding capabilities. The use of the area by Pacific eulachon or smelt for near shore movement, schooling, and spawning will be

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[4] *See* http://www.thenewstribune.com/2013/04/10/2551234/port-of-grays-harbor-open-to-oil.html.

[5] Coho and chinook salmon originating from Grays Harbor and its tributaries are heavily harvested by the ocean salmon fisheries from Oregon up to Southeast Alaska. The status of Grays Harbor coho and chinook salmon are important components of United States-Canada Treaty considerations. *See* http://www.psc.org/pubs/Treaty/Treaty.pdf.

harmed. During terminal operations, noise and artificial light will harm all the fish that use the near shore environment. Protection of near-shore estuary areas is vital for the survival and recovery of juvenile chinook and coho salmon. "En route to the ocean the juveniles may spend from a few days to several weeks in the estuary, depending on the species. The highly productive estuarine environment is an important feeding and acclimation area for juveniles preparing to enter marine waters." Endangered and Threatened Species: Final Listing Determinations for 16 ESUs of West Coast Salmon, 70 Fed. Reg. 37,160, 37,161 (June 28, 2005).

Gray whales are also often seen in Grays Harbor. The National Marine Fisheries Service notes that current threats to gray whales includes collisions with vessels, impacts for commercial development, and local catastrophic events.[6] The MDNS assessed none of these impacts on gray whales.

The Grays Harbor National Wildlife Refuge is also at risk from this proposal. From late April through early May, hundreds of thousands of shorebirds concentrate on the muddy tideflats of Grays Harbor estuary—one of four major staging areas for shorebirds in North America and one of the largest concentrations of shorebirds on the west coast, south of Alaska. Shorebirds gather here in the spring to feed, store up fat reserves, and rest for the non-stop flight to their northern breeding grounds. From June through October, shorebirds return to the estuary in lesser concentrations on their way south during the longer fall migration period. Thousands of shorebirds stay for the winter.

The potential for the introduction of invasive species, including through ballast water, was not assessed, even though tens of thousands of cubic meters of ballast water per visit will be discharged by the shipping vessels. Hull fouling presents a similar danger of invasive species introduction.

Probable, significant impacts to the marine and fresh-water aquatic environment from operation of the facility include oil spills (discussed further below), polluted runoff, and the impacts of the new pollutant loads on aquatic life.

The proposed project and its cumulative effects to connected upstream freshwater habitat have also been omitted. In the unfortunate event that a crude oil spill or leak did happen via storage tanks or rail, the impacts could cumulatively affect fresh water habitat. The Chehalis, Humptulips, Wishkah, Johns, Elk, and Hoquiam rivers are tidally influenced by Grays Harbor. Water moves from Grays Harbor into these drainages and periodically creates a back water effect into its tributaries. Pollutants would make their way into freshwater systems and disperse in the same manner as saltwater.[7] These rivers provide vital habitat for all life stages of salmonids and

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[6] *See* http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/graywhale.htm.

[7] Beverage, J. & Swecker, M., Estuarine Studies in Grays Harbor Washington (1969).

other fish; the effects to fish habitat from a crude spill could be irreversible. Local, state, federal, and tribal entities contribute millions of dollars a year to protect and restore declining estuarine and freshwater habitat, yet the cumulative effects over time by this project could directly compromise these efforts.

D. The MDNS Does Not Adequately Address, Let Alone Mitigate for, the Risk of an Oil Spill From Rail Cars or Marine Vessels.

Crude oil spills into marine and fresh waters can destroy salmon, eulachon, sturgeon, Dungeness crab, and bivalve shellfish habitat. Importantly, oil spill response plans were not provided before issuance of the MDNS and are not required until prior to operation—after construction of the facility. Without those plans, the true impact of an oil spill is impossible to assess. For example, there is no information provided in the MDNS or SEPA checklist about wind, tide, or current modeling with respect to clean up of an oil spill.

The MDNS also fails to evaluate or mitigate for spill threats and responses along the entire rail line; its mitigation measures simply call for an already required spill response plan and ensuring that equipment caches are positioned near as-yet-to-be-determined sensitive areas. MDNS at 9. As the rail line crosses fish-bearing streams numerous times, an oil spill into non-marine waters poses a significant environmental risk.

Generally, the MDNS relies on the existence of federal and state emergency spill response plans to mitigate for a possible oil spill. But mitigation that is merely "compliance with applicable law" can only be adequate for a MDNS where there is an actual analysis of whether those laws are actually sufficient to mitigate the identified risk. There is no actual analysis of applicable law in this MDNS. Moreover, at least three admitted major factors exist that cannot be addressed by this "paper" mitigation, leaving probable significant adverse environmental impacts unaddressed. First, oil spill response tugs in Neah Bay and the Columbia River will take time to arrive in Grays Harbor if response is necessary. As the MDNS admits, "response tugs at Neah Bay and Columbia River could provide assistance, however, response times will depend on tug availability and weather conditions." MDNS at 9. Second, the necessary oil spill response programs may not be sufficiently funded in the future. Third, this project is proposed within a tsunami hazard zone,[8] yet potential tsunami risks are only mentioned as "covered" by the Grays Harbor County evacuation planning and risk management plan. MDNS at 8.

The MDNS analyzes rail traffic from the Washington/Idaho border and significant vessel traffic out of Grays Harbor, giving the impression that most, if not all, of the petroleum product

[8] *See, e.g.*, http://www.emd.wa.gov/hazards/documents/haz_TFS_Hoquiam.pdf; http://www.co.grays-harbor.wa.us/info/dem/index.asp.

passing through the facility will be crude oil coming from the Bakken play in North Dakota.[9] Crude oil is a serious pernicious toxin, and when released into air, water, and soil, it has devastating effects on fish, the aquatic environment, and wildlife.[10] Crude oil spills are more difficult to clean-up than refined oil products. Crude oil is heavier and thicker; it lasts longer in the environment, coating vegetation, debris, and wildlife. Crude oil can also get trapped in sediments, rocks, and other debris, which allows the oil to be remobilized into the environment days, weeks, and even months after a spill incident.[11] A spill of crude oil[12] would wreak devastating harm on Grays Harbor's estuaries, fish populations, and aquatic ecosystem.[13]

E. Increased Marine Vessel Impacts Pose a Probable Risk of Significant Environmental Impact and Will Disrupt Tribal Fisheries.

The Quinault actively fish in Grays Harbor and the Chehalis River, including in the waters adjacent to the Imperium site. Quinault fishermen will be directly impacted by increased vessel traffic associated from this project. The Quinault Nation is particularly concerned about the potential for catastrophic impacts to fish and shellfish habitat if an oil spill were to occur in or near the waters of their usual and accustomed fishing areas. Increased large vessel traffic will impact Pacific eulachon by harming larval fish that have recently been confirmed in the waters

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[9] Appendix D to Imperium's SEPA Checklist reproduces the Material Safety Data Sheets for B100 Biodiesel, vegetable oil, used cooking oil, extra fancy tallow, ethanol, methanol, Bakken crude oil, jet fuel, kerosene, petroleum naphtha, unleaded gasoline, No. 2 diesel fuel, No. 6 fuel oil, and vacuum gas oil.

[10] *See, generally* http://www.epa.gov/hpv/pubs/summaries/crdoilct/c14858ca.pdf.

[11] *See* http://okaloosa.ifas.ufl.edu/MS/OilSpillFactSheetAlaska.pdf; http://dujs.dartmouth.edu/winter-2012/oil-spills-severity-and-consequences-to-our-ecosystem#.UWgvDy7n_ug.

[12] Alberta tar sands crude—diluted bitumen—is even more difficult to clean up, especially in an aquatic environment, as it is heavier and can sink to the bottom. Unlike Westway, Imperium has not stated that its crude oil might come from Alberta, Canada. Alberta tar sands oil is very different from other crude oil, as it is "a highly corrosive, acidic, and potentially unstable blend of thick raw bitumen and volatile natural gas liquid condensate. *See* http://www.nrdc.org/energy/tarsandssafetyrisks.asp; http://cahr.uvic.ca/nearbc/documents/2009/Alberta-Tar-Sands-Industry-Pollute.pdf; http://www.pnas.org/content/106/52/22346.full.pdf. Alberta tar sands oil is also heavier, making it much harder to clean up after a spill.

[13] *See generally* http://pipeupagainstenbridge.ca/images/uploads/resources/pipelines-and-salmon-in-northern-bc-report.pdf.

of the lower Chehalis River.[14] Larval eulachon will inevitably suffer mortalities from large propellers associated with tankers and tugs that are part of this proposed project.

The increased use of the pier with boats and tugs will have shading impacts, which in turn affects marine vegetation like eel grass and macro algae. Marine vegetation is vital to the marine species found in Grays Harbor for spawning, forage, and refuge habitat.[15]

The increased shipping traffic brings with it an increased risk of collisions, groundings, spills, discharges, and accidents during vessel fueling. Increased vessel traffic in Grays Harbor and the surrounding waters will disturb native populations and salmon and eulachon. One mitigation measure calls for a Vessel Traffic Impact Analysis to determine "the potential for impacts that may result from changes or increases in vessel traffic in Grays Harbor." MDNS at 12. However, this analysis is only required prior to the applicant receiving a certificate of occupancy. The City and Ecology should have required this analysis up-front, in order to review and evaluate the probable, significant risks to the environment caused by increased vessel traffic.

Although the MDNS avers that fishing access will not be affected, the additional rail and vessel traffic make this assumption unlikely. The MDNS's mitigation measure of required tug escort for outbound make it more likely that fisheries will be disturbed and negatively impacted. If a U.S. Coast Guard security zone is eventually required, such a zone would have an even greater negative impact on fishing access and the tribal fishery.

F. <u>The MDNS Fails to Consider Archeological and Cultural Impacts.</u>

The checklist submitted by Imperium on February 22, 2013 incorrectly states there are no historically significant sites near the project location. *[Text containing sensitive information was removed].* The Quinault have a deep interest in protecting and preserving historic archeological sites.

The Quinault also exercise their treaty gathering rights in the Grays Harbor area, including Bowerman Basin and the Grass Creek area to the north, to collect grasses, reeds, and

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[14] U.S. Army Corps of Eng'rs/Quinault Indian Nation joint study of eulachon habitat and distribution in Grays Harbor, 2012-continuing.

[15] Parametrix, Port of Grays Harbor Industrial Development District Property #1—Eelgrass/Macro Algae Survey (2006).

willows for traditional cultural uses. An oil spill in Grays Harbor would devastate this culturally significant area. *See* discussion above at section I.C. The MDNS fails to disclose or discuss any impacts to these treaty gathering rights.

G. The MDNS Fails to Adequately Address Impacts to Public Safety and Local Economics From Increased Rail Traffic.

The impacts to public safety run the gamut from increased train traffic and vehicle accidents, increased derailments and concomitant emergency response, travel time delays at specific intersections (including the economic impacts of those delays, and impacts to/delay of emergency services (fire, police, EMT).

Threats from frequent long trains at rail crossings all along the route from North Dakota/Alberta and near the project area will mean delayed emergency medical service response times; and increased accidents, traumatic injury and death. A 105-unit train is almost a mile long, and this proposal would significantly increase the daily number of trains along the rail route. These trains will bisect multiple communities along the route, leading to significant traffic delays and potential safety issues at grade-crossings. The delay of only a few minutes for an emergency response vehicle can mean the difference between life and death for citizens in these rural communities.

The MDNS (at 11) contains a chart that sets out the number of vessel and train transits per year expected from the Imperium and Westway proposals. This chart is incomplete, as it is missing the Grays Harbor Terminal proposal increases. Yet the MDNS fails to use this incomplete chart when assessing rail traffic. On the next page, the "Rail Traffic" discussion focuses on two additional unit trains every day (the Imperium estimates), with no discussion or even acknowledgment of the additional rail traffic from any of the other projects. Even without the Grays Harbor Terminal numbers, there will be an estimated 18 additional trains a week (nine loaded and unloaded)—much more than the Freight Rail Plan 2013 that "identifies infrastructure enhancements for an increase of three to seven loaded trains per week." MDNS at 11.

One mitigation measure calls for a Rail Transportation Impact Analysis to determine "the potential for impacts directly caused by changes and increases in rail traffic on local vehicular traffic and other rail commodities." MDNS at 12. However, this analysis is only required prior to the applicant receiving a certificate of occupancy. The City and Ecology should have required this analysis up-front, in order to review and evaluate the probable, significant risks to the environment caused by increased rail traffic. As with the Vessel Traffic Impact Analysis, the requirement that a rail impact analysis be prepared after permits are approved cannot serve SEPA's goal of analyzing and understanding project impacts before projects are fully built.

In addition, the MDNS fails to examine or even require post-approval examination of the rail impacts from all three crude-by-rail proposals combined with anticipated rail impacts from proposed coal export terminals.

Unless mitigated with significant capacity additions, the addition of the massive increases of crude oil and coal train traffic is likely to present significant adverse impacts on other users of the rail line, including grain and fruit shippers, intermodal users, ports, industries, aircraft manufacturers and passenger rail—all of who are critically dependent on timely and affordable access to the rail system.[16] Existing state studies indicate that coal rail traffic alone is already having a significant negative impact on the ability of Washington shippers to access markets where coal traffic from the Powder River Basin is dominating the rail lines. These reports also confirm that the railroad prioritizes unit trains, such as crude oil trains, over other shippers. The MDNS fails to analyze any impacts on northwest shippers if inbound and outbound freight traffic is diverted or eliminated due to the competition with crude-by-rail trains.

The economic impacts of the increased rail traffic associated with this project must also be reviewed. Issues here include the impact of dramatic increases in train traffic on real estate values and damage to property from oil leaks, diesel emissions, vibration, and noise. There are also serious concerns relating to the impact of such a massive increase in rail traffic on other non-oil shippers of freight by rail, including ports and shippers of agricultural products. These same issues may dramatically affect passenger rail interests. These significant rail traffic increases are likely to create major impacts on communities affected by vehicle traffic problems related to delays at non-grade separated railway crossings, which will affect non-rail freight mobility, access to ports, retailers, tourist centers, and employers.[17]

H. <u>The MDNS Fails to Fully Disclose and Consider All Climate Impacts From Greenhouse Gas Emissions.</u>

SEPA and its implementing regulations explicitly require consideration of direct and indirect climate impacts. *See* RCW 43.21C.030(f) (directing agencies to "recognize the world-wide and long-range character of environmental problem); WAC 197-11-444 (listing "climate" among elements of the environment that must be considered in SEPA review). SEPA regulations also explicitly direct that environmental impacts outside the jurisdiction of the deciding agency should be considered. WAC 197-11-060(c). Crucially, agencies are required to assess both the direct and indirect impacts of the proposal.

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[16] *Heavy Traffic Ahead*, http://www.heavytrafficahead.org/.

[17] Freight rail congestion has become an important issue with respect to coal trains; an increase in crude-by-rail traffic would cause the same choke-points, but the MDNS did not address this issue. *See* http://earthfix.opb.org/communities/article/northwest-railroads-already-congested/.

In recent years, state and federal agencies have made efforts to better define how climate analysis should be performed, and to provide tools to enable agencies to meaningfully assess and mitigate the greenhouse gas contribution of proposed projects. For example, in late 2008, Ecology and the State's Department of Community, Trade and Economic Development (CTED) issued a "comprehensive plan to address the challenges and opportunities of climate change." (2008 Climate Plan).[18] That plan recognized the increasing pressure on local governments to better identify climate impacts in their SEPA analyses, and noted that SEPA analysis provided an opportunity to evaluate climate impacts of government decisions and to identify changes to proposals to reduce or mitigate those impacts. *Id.* at 50.

Also in 2008, a governor-appointed working group provided a list of recommendations on how to ensure that climate change is considered in meeting SEPA's directives.[19] Notably, those recommendations identified the following categories of greenhouse gas emissions to be considered pursuant to SEPA: a) off-site mining of materials purchased for the project; b) transportation of raw materials to the project, and transport of the final product offsite; c) use of products sold by proponent to consumers or industry, including "emissions generated from combustion of fuels manufactured or distributed by the facility." *Id.* at App. D.

Ecology recently issued SEPA guidance for its own consideration of greenhouse gas emissions.[20] Accordingly, that Guidance makes clear that SEPA requires climate to be considered in its environmental analysis. Ecology's Guidance proposes that SEPA documents consider whether the proposal will significantly contribute to greenhouse gas concentrations, and states that "[i]f the emissions are proximately caused by the project, they should be disclosed regardless of their location." *Id.* at 4. The Guidance proposes that projects qualitatively disclose greenhouse gas emissions of at least 10,000 metric tons/year and quantitatively disclose greenhouse gas emissions for projects expected to produce an average of 25,000 tons/year of CO_2 equivalent.

Ecology has also provided a "table of tools" that can be used to calculate emissions from projects.[21] That Table, in turn, lists various sources of emissions from projects, methods to calculate those emissions, and options to mitigate them. Direct "Scope 1" emissions include trains and boats. *Id.* at 1. Scope 3 emissions include "emissions from the future combustion of fossil fuels," which are defined to include "emissions that will result from the combustion of fossil fuels transported, distributed or imported as a result of the project (*e.g.*, natural gas pipeline)." *Id.* at 2.

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[18] *Available at* http://www.ecy.wa.gov/pubs/0801025.pdf.

[19] *Available at* http://www.ecy.wa.gov/climatechange/2008CATdocs/IWG/sepa/103008_sepa_iwg_report.pdf.

[20] *Available at* http://www.ecy.wa.gov/climatechange/sepa.htm.

[21] *Available at* http://www.ecy.wa.gov/climatechange/sepa.htm.

Here, Imperium reviewed its greenhouse gas emissions in its SEPA Checklist at pages 7-9 to arrive at a total greenhouse gas emission estimate of 45,211 metric tons CO_{2e} annually. However, Imperium began and ended its greenhouse gas emission analysis at Washington's state borders. However, "[i]n assessing the significance of an impact, a lead agency shall not limit its consideration of a proposal's impacts only to those aspects within its jurisdiction, including local or state boundaries." WAC 197-11-060(4)(b).

Imperium's failure to calculate and consider the full rail greenhouse gas emissions violates SEPA. "For projects with ongoing operations that include transporting products from outside the state, such as a port, a more thorough and perhaps more defensible analysis would include the transportation emissions from the source location outside of Washington to the final destination if either is known and the extent to which either is known." Guidance for Ecology at 4. Because the rail emissions will have a significant environmental impact, the MDNS is invalid.

On the outbound marine vessel side of the equation, Imperium's SEPA Checklist again uses the state border (here the nautical three mile boundary). Clearly, the transportation of the crude oil to a refinery in Washington or California will be a much longer journey and will emit many more tons of CO_{2e} per year.

The MDNS also fails to calculate the greenhouse gas emissions of drilling, pumping refining the crude oil, and ultimately burning the refined product. A life-cycle analysis (well to wheel) was not done.

Because the MDNS fails to account for the actual greenhouse gas emissions from the Imperium proposal, and because those emissions will have a significant and detrimental environmental impact, the MDNS is invalid.

I. The MDNS Failed to Address Climate Change Impacts, Including Ocean Acidification.

In February 2012, Washington Governor Christine Gregoire convened the Washington State Blue Ribbon Panel on Ocean Acidification to chart a course for addressing the causes and consequences of acidification. The Governor charged the Panel to:

- Review and summarize the current state of scientific knowledge of ocean acidification,
- Identify the research and monitoring needed to increase scientific understanding and improve resource management,
- Develop recommendations to respond to ocean acidification and reduce its harmful causes and effects, and
- Identify opportunities to improve coordination and partnerships and to enhance public awareness and understanding of ocean acidification and how to address it.

The Panel released its report and recommendations in the document Washington State Blue Ribbon Panel on Ocean Acidification (2012): Ocean Acidification: From Knowledge to Action, Washington State's Strategic Response, H. Adelsman and L. Whitely Binder (eds). Washington Department of Ecology, Olympia, Washington.[22]

In November 2012, Governor Christine Gregoire issued an Executive Order[23] acknowledging the particular harm that ocean acidification, caused by increased emissions of greenhouse gases into the atmosphere, inflicts on Washington. "[I]t is critical to our economic and environmental future that effective and immediate actions be implemented in a well-coordinated way and that we work collaboratively with federal, tribal, state, and local governments, universities, the shellfish industry, businesses, the agricultural sector, and the conservation/environmental community to address this emerging threat. The Executive Order specifically directs "[t]he Office of the Governor and the cabinet agencies that report to the Governor to advocate for reductions in emissions of carbon dioxide at a global, national, and regional level." Despite this directive, the MDNS fails to address any impacts of this proposal for crude oil shipping on ocean acidification.

J. <u>The MDNS Should Not Segment Connected Actions Into Separate Analyses.</u>

SEPA prohibits agencies and project proponents from segmenting a single project into multiple separate decisions in order to avoid a comprehensive analysis. WAC 197-11-060(3)(b) ("Proposals or parts of proposals that are related to each other closely enough to be, in effect, a single course of action shall be evaluated in the same environmental document."). Imperium may be segmenting its action here.

First, Imperium has proposed no in-water work on its dock at this time. Given the significant expansion of Imperium's operation, the different requirements for loading crude oil onto barges and ships, and the company's own estimates of up to two outbound vessels (Panamax class with 350,000 barrel capacity) and two outbound barges (25,000 to 150,000 barrel capacity), it seems likely that Imperium will need to upgrade its dock in the future. In-water dock work would require separate, federal permits. If likely dock repair or upgrade associated with this project is foreseeable, it should be included here, and not segmented into a separate, later analysis.

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[22] *Available at* https://fortress.wa.gov/ecy/publications/SummaryPages/1201015.html. The technical summary (Feely, R.A., T. Klinger, J.A. Newton, and M. Chadsey (2012): Scientific Summary of Ocean Acidification in Washington State Marine Waters. NOAA OAR Special Report) is *available at* https://fortress.wa.gov/ecy/publications/SummaryPages/1201016.html.

[23] *Available at* http://www.governor.wa.gov/execorders/eo_12-07.pdf.

Second, completion of this project involves a number of other agencies and approval decisions, as listed in the MDNS at pages 3-4. The impacts of these various permits should not be viewed in isolation but rather aggregated in a single, comprehensive environmental impact statement that explores all of the direct, indirect, and cumulative impacts of the Imperium proposal to build and operate a crude oil shipping facility.

K. The MDNS Violates RCW 88.40—Transport of Petroleum Products—Financial Responsibility.

Washington State law recognizes that "oil and hazardous substance spills and other forms of incremental pollution present serious danger to the fragile marine environment of Washington state." RCW 88.40.005. Because of this significant environmental danger, RCW 88.40.025 requires that Imperium "shall demonstrate financial responsibility in an amount determined by [the Department of Ecology] as necessary to compensate the state and affected counties and cities for damages that might occur during a reasonable worst case spill of oil from that facility…." The financial responsibility calculations must include the amount of oil that could be spilled, cost of cleaning up the spill, frequency of operations at the facility, and damages that could result from a spill. *Id.* The MDNS contains no such discussion, analysis, or evidence.

L. The MDNS Violates the Ocean Resources Management Act, RCW 43.143.

The Washington legislature has also found that "Washington's coastal waters, seabed, and shorelines are among the most valuable and fragile of its natural resources," and that some uses of Washington's coastal waters, seabed, and shorelines "may pose unacceptable environmental or social risk at certain times." RCW 43.143.005. Grays Harbor is among the particular portions of Washington's coast called out for special protection from oil or gas exploration, development, or production. RCW 43.143.010. RCW 43.143.030 sets forth specific planning and project review criteria for projects along Washington's coast, and calls for "special protection provided for the marine life and resources of … Grays Harbor estuaries," *id.* at 43.143.030(2)(d), as well as all reasonable steps to avoid and minimize impacts on tribal fishing, *id.* at 43.142.030(2)(e). The MDNS fails to mention, discuss, or follow the Ocean Resources Management Act.

M. City of Hoquiam Should Transfer Lead SEPA Authority to the State, and a Complete EIS Should Be Prepared.

For the reasons discussed above, this project needs a "time out" for further evaluation and analysis, public input, appropriate dialogue among all stakeholders, and consultation with the Quinault Indian Nation. SEPA explicitly prohibits the City of Hoquiam from allowing any action which would either have an adverse environmental impact or that would limit the choice of alternatives while a valid EIS is being prepared. WAC 197-11-070(1). We ask that you

withdraw the MDNS and hold off from issuing any permits related to this project until SEPA is fully satisfied.

The Imperium project requires a complete EIS that fully evaluates the environmental impacts of the crude-by-rail project, reasonable alternatives to that project, and mitigation options. The EIS should encompass all related portions of the project and should include other agency permitting actions related to the project. The EIS should also consider the indirect and cumulative impacts of the other two proposed crude-by-rail projects; alternatively, the Department of Ecology could review these projects as similar actions under WAC 197-11-060(3)(c). The EIS should do an emissions analysis of transporting oil via rail and marine vessel and also include emissions from drilling, pumping, refining, and burning—a true life-cycle analysis of greenhouse gas emissions as well as other air toxics like mercury.

III. IMPERIUM'S PROPOSAL MUST BE REVIEWED AND APPROVED BY THE WASHINGTON UTILITY TRANSPORTATION COMMISSION UNDER RCW 80.50.

The State of Washington, through the passage of RCW 80.50, assigned the selection, review, and development of energy facility sites to the Energy Facility Site Evaluation Council ("EFSEC"). The stated policy of this law is "to recognize the pressing need for increased energy facilities, and to ensure through available and reasonable methods, that the location and operation of such facilities will produce minimal adverse effects on the environment, ecology of the land and its wildlife, and the ecology of state waters and their aquatic life." RCW 80.50.010.

EFSEC has jurisdiction over facilities that have "the capacity to receive more than an average of fifty thousand barrels per day of crude or refined petroleum … which has been or will be transported over marine waters…." RCW 80.50.020(12)(d). Imperium's proposal, with a 720,000 barrel capacity, meets this definition of a covered facility.

Imperium's position is that this proposal does not trigger EFSEC jurisdiction because it is an expansion that would yield a net increase in receiving capacity of less than 50,000 barrels per day. "A unit train typically has 105 tank cars, each of which can carry up to 743 barrels for a total of 78,000 barrels per unit train. Currently we have 64 spots for unloading rail cars, yielding a capacity to receive 47,500 barrels per day. The expansion would add capacity to unload up to an additional 41 rail cars per day (i.e., an entire unit train of 105 cars), thus adding an incremental capacity to receive approximately 30,500 barrels daily." Letter from John Plaza, Imperium, to Stephen Posner, EFSEC (March 19, 2013).

Imperium's position misreads Washington law. In order to trigger EFSEC jurisdiction, a facility must have the capacity to receive an average of 50,000 barrels of crude a day, not a lower expectation based on unit train length. Plans can change, yet there will be no further state review if Imperium begins to receive more crude oil. Additionally, Imperium's proposed storage capacity is 14 times greater than the jurisdictional threshold set in RCW 80.50.020(12)(d); this

proposal, even though it is an expansion, should be proceeding under the EFSEC's jurisdiction, procedures, and environmental review requirements.

* * * * *

Thank you for the opportunity to comment. We would be pleased to meet with you and discuss these comments further if such a discussion can help avoid appeals and litigation on this project's permits and SEPA review.

Sincerely,

Kristen L. Boyles
Attorney for the Quinault Indian Nation

cc: Governor Jay Inslee
Dr. Mary Alice Heuschel, Chief of Staff
Governor's Office
(via U.S. Mail)

Ted Sturdevant
Governor's Office
ted.sturdevant@gov.wa.gov

Keith Phillips
Governor's Office
keith.phillips@gov.wa.gov

Maia Bellon, Director
Washington Department of Ecology
maia.bellon@ecy.wa.gov

Tom Laurie, Senior Advisor, Tribal and Environmental Affairs
Washington Department of Ecology
tom.laurie@ecy.wa.gov

Dale Jensen, Program Manager, Spill Prevention, Preparedness, and Response
Washington Department of Ecology
djen461@ecy.wa.gov

Gordon White, Program Manager, Shorelines and Environmental Assistance
Washington Department of Ecology
gwhi461@ecy.wa.gov

Paula Ehlers
Washington Department of Ecology
pehl461@ecy.wa.gov

Phil Anderson, Director
Washington Department of Fish and Wildlife
director@dfw.wa.gov

Stephen Posner, Interim EFSEC Manager
Energy Facility Site Evaluation Council
sposner@utc.wa.gov

Jim LaSpina, Siting Specialist
Energy Facility Site Evaluation Council
jlaspina@utc.wa.gov

Allyson Brooks, Ph.D.
State Historic Preservation Officer
Allyson.Brooks@dahp.wa.gov

Grays Harbor National Wildlife Refuge
nisqually@fws.gov

Michael Tehan, Habitat Conservation Ass't Regional Administrator
National Marine Fisheries Service
mike.tehan@noaa.gov

Steve Landino, Washington State Habitat Office
National Marine Fisheries Service
steven.landino@noaa.gov

Ken Berg, Western WA Office Manager
Western Washington Fish and Wildlife Office
US Fish and Wildlife Service
Ken_Berg@fws.gov

Doug Zimmer, Supervisor, External Affairs
Western Washington Fish and Wildlife Office
US Fish and Wildlife Service
Douglas_Zimmer@fws.gov

Gary Nelson, Executive Director
Port of Grays Harbor
gnelson@portgrays.org

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

April 7, 2014

The Honorable David Burnett
Chehalis Confederated Tribes
420 Howanut Road
Oakville, WA 98568

Dear Chairperson Burnett:

The Washington State Department of Ecology (Ecology) is a co-lead agency with the City of Hoquiam for the environmental reviews of the Imperium Bulk Liquid Facility Project (Imperium) and Westway Terminal Tank Farm Expansion Project (Westway) proposals in Grays Harbor under the State Environmental Policy Act (SEPA). The City of Hoquiam is the nominal lead for the SEPA process, which means the City's processes and procedures are being used for the public notice, comment periods, and appeals.

As you will recall, these two projects were previously considered by the co-lead agencies in earlier SEPA and permitting processes. The permits were issued and then both SEPA and the local shoreline permits were appealed by the Quinault Indian Nation and other organizations. Those permits were vacated by the Shorelines Hearing Board in November 2013. The companies re-applied in January 2014, and asked the co-lead agencies to conduct Environmental Impact Statement (EIS) processes prior to consideration of permits. The co-lead agencies are now beginning those new environmental review processes for each proposal.

Ecology and Hoquiam are holding a joint scoping period for these EISs, with a 47 day expanded scoping period beginning April 10, 2014, and ending May 27, 2014. We invite you to provide comments on what the EISs should analyze. In addition to the opportunities for providing comments as described below, direct government-to-government consultation can be arranged if requested.

Imperium and Westway are proposing expansions of their existing facilities at the Port of Grays Harbor. If built, the Westway terminal expansion would receive, store and ship crude oil with a maximum throughput of 17,855,000 barrels per year. The Imperium terminal, if built, would receive, store and ship additional oils, including crude oil and biodiesel, with a maximum throughput of 30,000,000 barrels per year. The company's environmental checklists with details on the proposals are on the project website at
http://www.ecy.wa.gov/geographic/graysharbor/terminals.html.

The co-lead agencies will consider all comments regarding the scope of the EISs, and determine what should be included in each scope. The co-lead agencies have the responsibility to ensure that these proposals receive objective and thorough review in the EIS process, consistent with the requirements of SEPA and its related regulations.

Scoping is an important step. It is during the scoping process that tribal governments, other agencies and organizations, and the public are invited to comment on what should be covered in the EIS document and in what detail, to include: reasonable range of alternatives; potentially affected resources (e.g., stormwater, wetlands, air emissions, marine waters, noise, traffic) and the extent of analysis for those resources; significant unavoidable adverse impacts; and measures to avoid, minimize and/or mitigate effects of the proposals.

As mentioned earlier, the expanded 47 day scoping period begins April 10, 2014, and ends on May 27, 2014. Scoping comments will be accepted by the methods below:

Oral Comments: Oral comments will be accepted during two public scoping meetings:

1. Hoquiam: April 24, 2014, at Hoquiam High School Commons, 501 W. Emerson Avenue, Hoquiam WA. The meeting will start at 5 p.m. and end at 9 p.m. The public comment period will start at 6 p.m. and end at 9 p.m.

2. Centralia: April 29, 2014, Centralia High School Commons, 813 Eshom Road, Centralia WA. The meeting will start at 5 p.m. and end at 9 p.m. The public comment period will start at 6 p.m. and end at 9 p.m.

Electronic Written Comments: Electronic written comments will be accepted through 5 p.m. Pacific Daylight time until May 27, 2014, via a web form at https://public.commentworks.com/cwx/westwayimperiumcommentform.

Other Written Comments: Other written comments will be accepted through May 27, 2014, via US Mail at the following address:

Imperium and Westway EISs
c/o ICF International,
710 Second Avenue, Suite 550
Seattle, WA 98104

Written scoping comments will also be accepted at scoping meetings listed above.

Additional information is available on Ecology's website at: http://www.ecy.wa.gov/geographic/graysharbor/terminals.html. Following scoping, a draft EIS will be prepared by a contractor under the direction of the co-lead agencies. The purpose of an EIS is to provide the public and agency decision makers with information on likely adverse effects of the proposed project, as well as reasonable measures to reduce those effects.

A draft EIS may take months to prepare. When available, it will be broadly announced and circulated so that tribes, other agencies, and the public have an opportunity to comment on its content, analysis, and accuracy. Public hearings will also occur during the public review of the draft EIS. The co-lead agencies will consider and respond to public comments in the final EIS.

If you have any questions or would like to arrange government-to-government consultation, please contact Sally Toteff, Ecology Southwest Regional Director at (360) 407-6307 or by email at sally.toteff@ecy.wa.gov.

Sincerely,

Maia D. Bellon

Maia D. Bellon
Director

cc: Glen Connelly, Natural Resources Director, Chehalis Confederated Tribes
Sally Toteff, Southwest Regional Director, Ecology
Tom Laurie, Executive Advisor for Tribal & Environmental Affairs, Ecology

Quinault Indian Nation
POST OFFICE BOX 189 □ TAHOLAH, WASHINGTON 98587 □ TELEPHONE (360) 276 - 8211

RECEIVED
JUN 16 2014
DEPARTMENT OF ECOLOGY
OFFICE OF DIRECTOR

June 10, 2014

Maia Bellon, Director
Washington State Department of Ecology
PO Box 47600
Olympia, WA 98504-7600

Dear Director Bellon:

By this letter I request formal government-to-government consultation with you regarding the various aspects of the crude-by-rail proposals in Grays Harbor necessitating reviews or regulatory action by the Washington State Department of Ecology (DOE). As you are aware, the Quinault Indian Nation ("QIN") has federally-protected treaty rights in the Grays Harbor area and adjacent marine waters of the Pacific Ocean. These rights are jeopardized by the proposed storage and rail and vessel transport of crude oil.

Specifically, I wish to discuss the anticipated scope and timing of the EIS for Imperium and Westway, as well as potential permits and SEPA review for the proposed crude oil storage facility by U.S. Development Corp. Additionally, I request a response to the QIN's scoping comments submitted by Earthjustice on May 27, 2014 (Attached). Finally, I request to discuss DOE's response to the QIN's comments regarding the Grays Harbor Navigation Improvement Project Clean Water Act 401 certification and CZMA consistency (Attached).

Please contact my Executive Assistant, Rose Enos-Weedmark, at your earliest convenience, renos@quinault.org or 360.276.8215 ext. 333, to schedule a mutually agreeable time and location for consultation.

Thank you for your prompt attention to this request. I look forward to meeting with you soon.

Sincerely,

Fawn R. Sharp, President
Quinault Indian Nation

Enc.: QIN letter of June 4, 2014
Earthjustice Scoping Comments May 27, 2014

Quinault Indian Nation
POST OFFICE BOX 189 • TAHOLAH, WASHINGTON 98587 • TELEPHONE (360) 276-8211

September 16, 2014

Diane Butorac, Regional Planner
Southwest Region, Department of Ecology
300 Desmond Drive
Lacey, WA 98503-1274

Sent via email: dbut461@ECY.WA.GOV

Dear Ms. Butorac:

This letter is in follow-up to the government-to-government meeting on July 18, 2014, between Department of Ecology (Ecology) staff and the Quinault Indian Nation (QIN). At that meeting, Ecology offered to consider comments by the QIN on the Scope of Work for the EIS development by ICF International for the Westway and Imperium Renewables Expansion Projects, and we take this opportunity to provide our thoughts.

As you know, the QIN is represented by Earthjustice in its ongoing appeals of the Shoreline Substantial Development Permits and underlying Mitigated Determinations of Significance (MDNSs) for these projects. The Shoreline Hearings Board (SHB) granted the QIN summary judgment on the inadequacy of the MDNSs to consider the direct, indirect, and cumulative impacts of three proposed crude-by-rail projects in Grays Harbor. Earthjustice subsequently submitted extensive EIS scoping comments on QIN's behalf, many of which appear to have been ignored in the Scope of Work.

In its Summary Judgment Order, the SHB stated, "[T]he Co-leads should have considered the cumulative impacts from the USD project along with the cumulative impacts from Westway and Imperium in making their threshold determination. Their failure to do so makes the MDNS clearly erroneous." Amended Order on Summary Judgment, December 9, 2013, p. 26. Given this conclusion, the QIN is surprised the Scope of Work fails to include any analysis of cumulative impacts of the U.S. Development (USD) (now Grays Harbor Rail Terminal)

proposal. The QIN is also surprised at the utter absence of recognition and analysis of impacts to tribal treaty fishing and gathering rights, which we specifically address below.

Additional deficiencies include:

- The geographic scope of the analysis is limited to rail impacts between Centralia and Grays Harbor rather than from the source of crude oil to Grays Harbor, as we argued, and as is being analyzed by Ecology for the Gateway Pacific Terminal Project, or even Washington State borders, as originally analyzed in the checklists submitted by Imperium and Westway. Similarly, vessel impacts are only being analyzed three nautical miles away from Washington coast rather than the geographic extent of the ultimate destination, which QIN believes is more appropriate.

- Analysis of greenhouse gas emission impacts does not address or include consideration of NEPA guidance or Ecology SEPA guidance, or incorporate and address the commitments by the State of Washington to reduce emissions and increase the availability of low-carbon energy alternatives.

- Analysis of potential oil spills is limited to risk rather than analyzing the magnitude of potential impacts to plants/wildlife/economies from a potential oil spill.

- There is no analysis included that considers the unique properties of the crude oil proposed to be stored and transported for health risks, spill clean-up, and climate impacts.

Aside from these more global comments, we offer the following more specific comments by page number:

p. 11 EARTH

The Scope of Work states: "Project site soil data will be based on the available geotechnical reports. Natural Resources Conservation Service (NRCS) soil mapping and soil series information is not expected to be relevant as the project sites are on fill materials. Therefore, this soils information will not be collected and addressed unless **relevant**." (Emphasis added).

> **COMMENT**: There is no question that soils information **is** relevant because soils are mostly comprised of fill in the area of facilities. Furthermore, there is no contractual mechanism that addresses how this issue of relevancy is determined.

p. 13 AIR

COMMENT: The QIN believes analysis relating to hazardous air pollutants should be quantitative in addition to qualitative. Addressing these issues without quantitative studies or analysis is unreasonable given the magnitude and significance of the impacts.

Canada's largest oil-by-rail terminal in St. John, New Brunswick, has seen escalating air quality problems even though the operator Irving Oil Ltd. assured regulators it was unlikely to affect the environment. Data show that emissions of volatile organic compounds have spiked since the terminal was approved in 2012, impacting residents who reported odors from rail cars powerful enough to burn their eyes. A qualitative discussion of air quality impacts is critical for context and comparison with similar situations and for decision makers to properly address impacts.

p. 15 WATER

COMMENTS: The QIN believes analysis relating to water quality impacts should be quantitative in addition to qualitative. Addressing these issues without quantitative studies or analysis is unreasonable given the magnitude and significance of the impacts.

QIN disagrees that "No hydraulic modeling is required to support the floodplain assessment." Modeling is critical to understanding floodplain impacts from tsunamis in relation to the proposed projects.

p. 15-16 PLANTS

COMMENTS: The scoping document for the EIS inappropriately lacks discussion of spill impacts to plants, which are critical to the QIN's treaty gathering right. This should be analyzed in the EIS.

There is no direction for analysis of impacts to plants from carbon emissions and we recommend this be added.

p. 16-17 ANIMALS

COMMENTS: The scoping document for the EIS inappropriately lacks discussion of potential spill impacts to fish/marine mammals as well as analysis of impacts to animals from carbon emissions.

Most critically, there is no acknowledgement of fish being a treaty resource or that QIN and the State of Washington co-manage fish resources in Grays Harbor.

p. 17 ANIMALS

COMMENT: Analysis of wildlife impacts should not be limited to water river crossings. The analysis should be throughout the corridor. Deer and elk cross the tracks in many locations.

p. 20 NOISE

COMMENT: The QIN believes analysis relating to noise should be quantitative in addition to qualitative. Addressing these issues without quantitative studies or analysis is unreasonable given the magnitude and significance of the impacts.

p. 23 RECREATION

COMMENT: There is vague reference to areas "near" the proposed project sites, but no specific mention of Bowerman Basin, which is a National Wildlife Refuge and significant bird watching site.

pp. 23-25 HISTORIC & CULTURAL PRESERVATION

COMMENTS: This section inappropriately lacks recognition of and analysis of treaty rights and impacts to access of QIN fishers and harvesters of grasses from vessel traffic or spills, as well as consideration and analysis of fish as cultural resource. Consultation with tribes is contemplated the by co-lead agencies, but there is no inclusion of analysis of the information gathered from such consultation in the Scope of Work.

The analysis appears limited to existing data, which is inappropriate and short-sighted.

The Scope of Work assumes no archeological sites in the study area, which is likely false based on QIN information and experience.

pp. 26-30 RAIL TRAFFIC AND SAFETY

COMMENTS: Based on comments made by BNSF and PS&P employees and union representatives at public meetings, QIN recommends an anonymous survey of BNSF and PS&P railway workers to request additional information about railway use/management/ maintenance, etc. to independently verify existing data.

The assumption that "Estimated increased grade crossing delay from each project will not be large enough to warrant quantitative analysis of potential impacts on neighboring roadway intersections" inappropriately affirms an outcome rather than requests analysis to determine an outcome. Additionally, this assumption seems false in light of many public comments about concerns about delays at the Walmart/Gateway Mall entrances from increased traffic.

p. 41 COST-BENEFIT ANALYSIS

COMMENTS: The focus is geographically narrowed to the City of Hoquiam, which contradicts reliance on ECONorthwest Cost Benefit Analysis and review of information at County and State level per pp. 40-41.

There is no inclusion or consideration of the information raised in the cost benefit analysis prepared for Earthjustice by Natural Resource Economics in January 2014. More specifically, the Scope of Work inappropriately lacks analysis of economic or social impacts to QIN treaty rights from increased vessel traffic and limitations on fishing opportunity, and potential losses from oil spills.

Thank you for consideration of these comments. If you would like to discuss these comments or have any questions, please contact our attorney, Karen Allston, at (206) 713-8223 or kallston@quinault.org.

Sincerely,

Fawn R. Sharp, President
Quinault Indian Nation

cc: Allyson Brooks, SHPO

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47600 · Olympia, Washington 98504-7600 · (360) 407-6000
711 for Washington Relay Service · Persons with a speech disability can call 877-833-6341

October 16, 2014

The Honorable Fawn Sharp
Quinault Indian Nation
PO Box 189
Taholah, WA 98587

Dear President Sharp:

Thank you for your letter of September 16, 2014, with your comments and thoughts about the scope of work for the environmental impact statements (EISs) being developed for the expansion projects at Westway Terminal and Imperium Renewables in Hoquiam.

As a co-lead agency with the City of Hoquiam for these environmental reviews, the Department of Ecology (Ecology) is committed to thorough, transparent and impartial reviews of the significant environmental impacts of these proposals. We are following the State Environmental Policy Act (SEPA) and agency guidance. As you may know, the City of Hoquiam is the nominal lead for the SEPA processes, which means the City's procedures are being used to hire ICF International to assist in preparation of the draft EISs.

The scope of work is broadly worded and identifies tasks such as initial research and analyses necessary for the draft EISs. The scope of work is not intended to provide in-depth evaluations nor detailed information. Rather, it is a mechanism providing direction to our consulting firm. The co-lead agencies are in the early stage of preparing the draft EISs, and anticipate issuing them for review and comment in the first quarter of 2015.

Your letter expresses concern about the level of detail in the scope of work as well as highlighting aspects of the Shorelines Hearings Board decision. In particular, you question why the scope of work does not provide more specifics about analyses of cumulative impacts and of tribal fishing and gathering rights. Ecology is aware of the Shorelines Hearings Board conclusion in this matter and we intend to make every effort to prepare draft EISs that comply with it.

In regard to your inquiry about the U.S. Development proposal, the co-lead agencies intend to include it in the draft EIS cumulative impact analyses. The scope of work purposefully did not list projects to be analyzed. Rather, the scope of work directs consultants to carefully research and then identify all appropriate projects to be included in the analyses.

Another concern raised in the letter is about evaluating impacts to tribal rights. As mentioned earlier, the scope of work is broadly worded; the in-depth analyses will come later in the draft EISs. The scope of work calls for research into "resource areas" that are defined in the SEPA regulations. Because SEPA does not identify tribal treaty fishing and gathering rights as a

"resource area", the scope of work does not call these out as individual areas of study. Nonetheless, the scope of work acknowledges and refers multiple times to tribal fishing areas and fisheries, tribal lands, culturally significant resources and historic and cultural resources (see pages 17, 20, 21, 24, 25, 36 and 40). The draft EISs will include descriptions of tribal treaty rights and significant impacts will be identified within the resource area discussions.

To your inquiry about how the greenhouse gas impacts will be evaluated, the co-lead agencies will consult existing SEPA and National Environmental Policy Act regulations and guidance.

In response to concerns about how potential oil spills and risk will be analyzed, our consultants will model numerous spill scenarios. The scenarios will be used to identify potential impacts and where appropriate, to identify mitigation. Additionally, the draft EISs will evaluate the potential of increased exposure to hazardous materials, risk of fire or explosion, or risk of spills at the proposed project sites and during rail and vessel transport. Hazardous material exposure will be further discussed in other sections of the draft EISs. Chemical properties of all the proposed commodities being transported will be explained in the draft EISs. This includes crude oil, hazardous materials, and other commodities.

I appreciate your early feedback and look forward to further discussing these issues at our October 20 meeting. For additional technical communication, the co-lead agencies would like to meet with members of your staff and tribe to learn and gather additional information specific to the Quinault Indian Nation's interests. Ecology's project manager, Diane Butorac, is coordinating with your Natural Resource Director, Dave Bingaman, to schedule these meetings.

One final note, in your letter you reference a cost benefit analysis prepared for Earthjustice by Natural Resource Economics. I would appreciate receiving a link or a copy of this document for evaluation as part of our environmental review.

If you have additional questions during the environmental processes, please contact me at (360) 407-6307 or Paula Ehlers at (360) 407-0271.

Best Regards,

Sally Toteff

Sally Toteff
Southwest and Olympic Regional Director

cc: Maia Bellon, Director, Ecology
Dave Bingaman, Natural Resources Director, Quinault Indian Nation
Allyson Brooks, DAHP
Brian Shay, City Manager, City of Hoquiam
Tom Young, Attorney General's Office
Diane Butorac, Project Manager, Ecology
Paula Ehlers, Section Manager-SEA, Ecology
Tom Laurie, Executive Advisor for Tribal & Environmental Affairs, Ecology

Quinault Indian Nation

POST OFFICE BOX 189 • TAHOLAH, WASHINGTON 98587 • TELEPHONE (360) 276-8211

December 10, 2014

Maia Bellon, Director
Washington State Department of Ecology **Sent by email to**: maia.bellon@ecy.wa.gov

Dear Director Bellon:

In light of a technical call between our respective staff on November 24th, by which the Department of Ecology (Ecology) and ICF representatives attempted to informally gather information about the Quinault Indian Nation's (QIN) treaty and cultural interests in Grays Harbor, I take this opportunity to explain how QIN will coordinate with Ecology in your EIS process related to the crude-by-rail facilities proposed in Grays Harbor.

First, I reiterate that the basis of our interest in cultural resources in Grays Harbor, including plants, fish, shellfish and their habitats, stems from our federally-guaranteed treaty rights as a signatory to the Treaty of Olympia (1856). The exercise of our reserved rights under that Treaty—fishing, shellfishing, hunting, and gathering—define us as Quinault people.

Treaties are the highest law of the land. Accordingly, we expect Ecology to respect and honor our rights and interests. It was in this spirit that QIN and the State of Washington committed to meaningful government-to-government consultation in the "Centennial Accord between the Federally Recognized Indian Tribes in Washington State and the State of Washington," August 4, 1989. The Accord was further memorialized in the "New Millenium Agreement" in 1999, by which we committed to: "Striving to coordinate and cooperate as we seek to enhance economic and infrastructure opportunities, protect natural resources and provide the educational opportunities and social and community services that meet the needs of all our citizens." It is under these frameworks that we intend to assist you in the collection of information to inform the EISs for Westway, Imperium, and U.S. Development's proposed crude storage facilities.

We recently worked with the Washington Department of Transportation (WSDOT) on an EIS for the 520 Pontoon Project, which entailed building pontoons in Grays Harbor and floating them out of the Chehalis River and Grays Harbor. This project resulted in impacts to treaty fishing rights. Those impacts were addressed by a Memorandum of Agreement between WSDOT and QIN, which was negotiated after several community and government-to-government meetings by which WSDOT gathered information to inform its EIS process and develop an appropriate mitigation package. I direct you to WSDOT's Model Tribal Consultation Process for NEPA as an example of a respectful way to conduct EIS analysis involving tribal rights:

http://www.wsdot.wa.gov/NR/rdonlyres/BF49CED8-B7C7-46A4-BA89-93153AB70FF3/0/TribalManual.pdf

As I have indicated to you in our prior government-to-government meetings, we expect meaningful engagement on an ongoing basis throughout the EIS process. In that spirit, we have provided extensive scoping comments that give you an indication of what impacts we believe these projects will have on our rights and interests. Continued dialogue and engagement will allow you, as an EIS co-lead agency, to focus on understanding and properly characterizing the impacts we have identified to date. To that end, meaningful engagement should occur at three levels: with our elected officials, our community, and our staff. We have 2,936 enrolled Quinault tribal members. Each and every one of them has a right to fish, harvest shellfish, and gather plants for cultural use.

It is highly appropriate for you to conduct community meetings on the Reservation to hear from those who exercise treaty rights in Grays Harbor. Those meetings should be coordinated through my assistant, Rose Enos (renos@quinault.org). Further coordination with QIN staff can now take place through our Director of Natural Resources, Dave Bingaman, who has returned to work after taking medical leave. Mr. Bingaman can coordinate meetings to ensure proper staff are present to answer specific questions. We expect agendas for those meetings to be jointly developed and we expect to understand the specific types of information and the level of detail you seek in advance of those meetings, rather than to be asked broad questions such as "tell us what cultural resources should be included in our analysis." We expect our scoping comments to inform your questions. Our cultural resources, which include plants, fish, shellfish and their habitats are in current, living and ongoing use by our Tribal members, which elevates their significance far beyond a checking of a box as "described" in an EIS. Please use this letter as guidance to gathering the information needed for a meaningful characterization and analysis of the impacts under discussion between the Quinault Nation and the State of Washington.

In the spirit of the Centennial Accord, we are committed to meaningful government-to-government consultation with Ecology through this EIS process. I look forward to further discussing this matter at our upcoming meeting on December 15, 2014.

Sincerely,

Fawn R. Sharp, President
Quinault Indian Nation

Cc: Sally Toteff, Regional Director, SWRO
Diane Butorac, Regional Planner, Southwest Region
Gordon White, Program Manager, Shorelands and Environmental Assistance
Tom Laurie, Tribal Liaison
Allyson Brooks, State Historic Preservation Officer
Lance Wollwage, DAHP

Attachment B

Historic Property Inventory Forms

Historic Inventory Report

Location

Field Site No.

DAHP No.

Historic Name:

Common Name: Paneltech Products Inc.

Property Address: 2999 John Stevens Way, Hoquiam, WA 98550

Comments:

Tax No./Parcel No. 56402300000

Plat/Block/Lot

Acreage

Supplemental Map(s)

Township/Range/EW	Section	1/4 Sec	1/4 1/4 Sec	County	Quadrangle
T17R09W	07			Grays Harbor	ABERDEEN

Coordinate Reference

Easting: 803131

Northing: 614511

Projection: Washington State Plane South

Datum: HARN (feet)

Identification

Survey Name: Westway-Imperium CR Survey

Date Recorded: 04/21/2015

Field Recorder: Hetzel, Christopher

Owner's Name: Paneltech Products, Inc.

Owner Address: 2999 John Stevens Way

City: Hoquiam **State:** WA **Zip:** 98550

Classification: Building

Resource Status: Survey/Inventory

Comments:

Within a District? No

Contributing? No

National Register:

Local District:

National Register District/Thematic Nomination Name:

Eligibility Status: Not Determined - SHPO

Determination Date: 1/1/0001

Determination Comments:

Description

Historic Use: Industry/Processing/Extraction - Manufacturing Facility

Current Use: Industry/Processing/Extraction - Manufacturing Facility

Plan: Rectangle

Stories: 1

Structural System: Concrete - Reinforced Concrete

Changes to Plan: Slight

Changes to Interior: Unknown

Changes to Original Cladding: Slight

Changes to Windows: Extensive

Changes to Other: Moderate

Other (specify): Addition added to northeast elevation.

Style:	Cladding:	Roof Type:	Roof Material:
Other - Industrial	Concrete - Poured Veneer - Stucco	Flat with Parapet Barrel Vault	Other

Foundation:	Form/Type:
Concrete - Poured	Industrial

Narrative

Study Unit	Other
Manufacturing/Industry Architecture/Landscape Architecture	

Date of Construction: 1945 Built Date

Builder:

Engineer:

Architect:

Property appears to meet criteria for the National Register of Historic Places: No

Property is located in a potential historic district (National and/or local): No

Property potentially contributes to a historic district (National and/or local): No

Statement of Significance:

The existing warehouse building at 2999 John Stevens Way (APN: 56402300000) was evaluated at a reconnaissance level during a cultural resources study conducted for the City of Hoquiam and the Washington State Department of Ecology in association with two proposed development projects at the Port of Grays Harbor. The building was originally constructed in the mid-1940s, sometime before 1948. It appears to have been one of the first industrial manufacturing facilities built adjacent to the Port of Grays Harbor's Marine Terminal Number 1, following a boom in development in the vicinity in the postwar period and through the 1950s. A large rectangular addition was added to the building's northeast elevation circa 1970. In the early 1980s, the building was known as Port of Grays Harbor Warehouse 5-5. The building is currently occupied by Paneltech Products, Inc., which is a manufacturer of medium and high density phenolic overlays used in the production of wood panels.

ICF evaluated the warehouse building to determine its eligibility for listing in the National Register of Historic Places (NRHP). Based on NRHP evaluation criteria (36 CFR 60.4), the building is recommended as not eligible for listing in the NRHP. No evidence was found to suggest that the building is associated with events that have made a significant contribution to the broad patterns of history, nor with the lives of persons significant in the community. It was not the first industrial facility to be constructed in the vicinity, and its construction appears to be of a style and type typical of industrial manufacturing and distribution facilities from the 1950s that did not involve significant change or innovation. The building exhibits an industrial utilitarian design with a modernist elements, but does not appear to embody characteristics or a method of construction that would warrant special recognition. Furthermore, there is no evidence to suggest that the property is associated with a significant designer or craftsman. The building is not considered to have the potential to be a principal source of historical information based on its common construction and building type.

Description of Physical Appearance:

The property consists of a large industrial warehouse building, originally constructed in the mid-1940s. The building has a long rectangular plan with a northeast-southwest orientation, situated on a parcel between John Stevens Way and Ingram Street. A railroad spur at one time ran along Ingram Street immediately adjacent to the building's northwest elevation and the existing paved area southeast of the building was known as Murphy Street in the 1980s.

The building is one-story high and constructed of board-formed reinforced poured concrete. Its rectangular plan is comprised of two sections. The building's original massing is located to the southwest, while a large addition extends the building's length to the northeast. The addition was built at the northeast elevation sometime in the 1960s or early 1970s. It equals the building's original dimensions in height and width. The original massing has a barrel vault roof that has four sections. The addition has a flat roof. Both roofs feature low parapet walls and are clad with modern composite roofing. The exterior walls consist of finished board-formed concrete at the original massing and stucco cladding at the addition.

The southeast and northwest elevations of the building's original massing are each equally divided into 12 bays. The bays are delineated by simple concrete pilasters that extend the building's full height. Most of the bays on the southeast elevation feature groups of three and four rectangular window openings set in a two-over-two or two-over-one configuration. The window openings are interspersed by smaller pedestrian doors and three large overhead freight doors occupy three of the bays. The building's original upper windows have been replaced with non-original single-light fixed windows and the lower windows with tripartite sashes from the same manufacturer. The doors have also been replaced, and several door and window openings enclosed. Similarly configured windows characterize the building's northwest elevation, but with only one freight door opening. The addition is five bays wide and characterized by large two-over-two industrial windows in the three northernmost bays.

Major Bibliographic References:

Grays Harbor County Tax Assessor Records.

Jones Photo Historical Collection. http://www.jonesphotocollection.com/.

Photos

Southeast Elevation, Looking North
2015

Southeast Elevation, Looking North
2015

Southeast Elevation, Looking North
2015

Historic Inventory Report

Location

Field Site No.

DAHP No.

Historic Name:

Common Name: Westway Terminal Company/Warehouse E

Property Address: 3128 Port Industrial Rd, Hoquiam, WA 98550

Comments:

Tax No./Parcel No.

Plat/Block/Lot

Acreage

Supplemental Map(s)

Township/Range/EW	Section	1/4 Sec	1/4 1/4 Sec	County	Quadrangle
T17R09W	07			Grays Harbor	ABERDEEN

Coordinate Reference

Easting: 803182

Northing: 613590

Projection: Washington State Plane South

Datum: HARN (feet)

Identification

Survey Name: Westway-Imperium CR Survey

Date Recorded: 04/21/2015

Field Recorder: Hetzel, Christopher

Owner's Name: Westway Terminals

Owner Address: 365 Canal Street, Suite 2900

City: New Orleans **State:** LA **Zip:** 70130

Classification: Building

Resource Status: Survey/Inventory

Comments:

Within a District? No

Contributing? No

National Register:

Local District:

National Register District/Thematic Nomination Name:

Eligibility Status: Not Determined - SHPO

Determination Date: 1/1/0001

Determination Comments:

Description

Historic Use: Industry/Processing/Extraction - Industrial Storage

Current Use: Industry/Processing/Extraction - Industrial Storage

Plan: Rectangle

Stories: 1

Structural System: Platform Frame

Changes to Plan: Extensive

Changes to Interior: Intact

Changes to Original Cladding: Extensive

Changes to Windows: Extensive

Changes to Other: Extensive

Other (specify): Half of the original building has been removed.

Style:	Cladding:	Roof Type:	Roof Material:
Other - Industrial	Wood - Plywood Metal - Corrugated	Barrel Vault	Asphalt / Composition

Foundation:	Form/Type:
Concrete - Poured	Industrial

Narrative

Study Unit	Other
Manufacturing/Industry Architecture/Landscape Architecture	

Date of Construction:

1962 Built Date
1982 Addition
1976 Remodel
2009 Remodel

Builder:

Engineer:

Architect:

Property appears to meet criteria for the National Register of Historic Places: No

Property is located in a potential historic district (National and/or local): No

Property potentially contributes to a historic district (National and/or local): No

Statement of Significance:

The existing building at 3128 Port Industrial Road (APN: 56402300000), known as Warehouse E, was evaluated at a reconnaissance level during a cultural resources study conducted for the City of Hoquiam and the Washington State Department of Ecology in association with two proposed development projects at the Port of Grays Harbor. The warehouse was originally constructed in 1962 by the Port of Grays Harbor at the Port's Marine Terminal 1. The building appears to have replaced or been constructed as an addition to older warehouse buildings that existed at the terminal at that time. Between 1976 and 1979, the structure was relocated a short distance northeast of its current location. Subsequent to this move, its length was extended with the construction of a large addition in the early 1980s, prior to 1984. During this period it was used for "transit storage" by the Port of Grays Harbor. In 2009, the building's length was again changed when it's northern half was removed to accommodate construction of the existing Westway Terminals facility. The warehouse is currently vacant.

ICF evaluated Warehouse E to determine its eligibility for listing in the National Register of Historic Places (NRHP). Based on NRHP evaluation criteria (36 CFR 60.4), the building is recommended as not eligible for listing in the NRHP. No evidence was found to suggest that the building is associated with events that have made a significant contribution to the broad patterns of history, nor with the lives of persons significant in the community. It has suffered extensive alterations that have substantially impacted its integrity and does not appear to embody characteristics or a method of construction that would warrant special recognition. Furthermore, there is no evidence to suggest that the property is associated with a significant designer or craftsman. The building is not considered to have the potential to be a principal source of historical information based on its common construction and building type.

Description of Physical Appearance:

The property consists of a large industrial warehouse building, originally constructed in 1962 and subsequently altered. The warehouse has a long rectangular plan with a northeast-southwest orientation. It is a tall one-story high and consists of braced frame wood construction set on a concrete slab foundation. The building has a tall barrel vault roof clad with modern composite roofing. Its exterior walls were previously clad with non-original, vertical corrugated metal siding. The siding remains intact on the building's southwest elevation. However, it has been removed from the northwest and southeast elevations, exposing a sheathing of plywood panels that now serves as the wall cladding in these locations. The warehouse's northeast elevation remains open from when the building's northern half was removed. The elevation is partially enclosed by a framed internal wall partition that is set back from the opening. Large freight door openings punctuate each of the warehouse's northeast, southeast, and southwest elevations. Each door opening is fit with a large industrial sliding door. A line of regularly spaced window openings, located under the eaves, characterizes the warehouses southeast and northwest elevations. The original windows have been removed and replaced with non-original two-light fixed windows.

Major Bibliographic References:

Grays Harbor County Tax Assessor Records.

Jones Photo Historical Collection. http://www.jonesphotocollection.com/.

Photos

Southwest Elevation, Looking Northeast
2015

Southwest and Southeast Elevations, Looking North
2015

Southeast Elevation, Looking North
2015

Southeast Elevation, Looking West
2015

Southeast Elevation, Looking West
2015

Southeast and Northeast Elevations, Looking West
2015

Interior, Looking West
2015

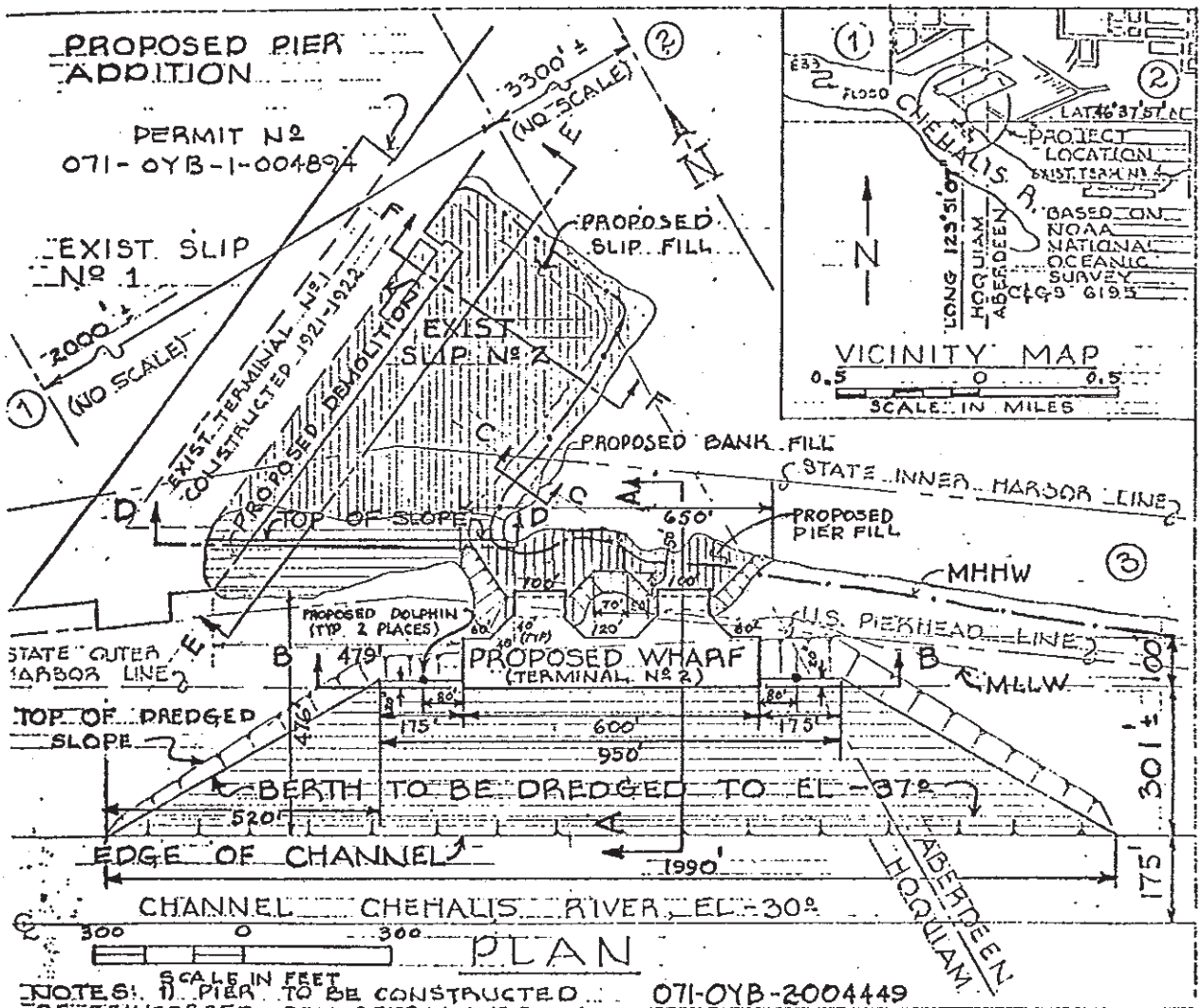
Attachment C

Cascadia Study of Westway Project Site

Attachment contains sensitive information and has been removed.

Attachment D

1978 Engineering Drawings for Terminal 2 Project



NOTES: 1) PIER TO BE CONSTRUCTED OF REINFORCED CONCRETE OVER STEEL AND CONCRETE PILING.
2) FOR DISPOSAL SITE OF DREDGED MATERIAL, SEE SHEET 5 of 5
3) ADJACENT PROPERTY OWNERS:
① ITT RAYONIER, P.O. BOX 299 HOQUIAM, WA. 98550
② BOISE CASCADE CORP. P.O. BOX 1120 ABERDEEN, WA. 98520
③ STATE OF WASHINGTON (DNR)
4) DATUM: MLLW = 0º

071-OYB-2004449

PROPOSED TERMINAL 2 PROJECT
IN CHEHALIS RIVER AT HOQUIAM/ABERDEEN, COUNTY OF GRAYS HARBOR STATE of WASHINGTON
APPLICATION BY PORT OF GRAYS HARBOR

REV. 8-4-78
SHT. 1 OF 5 DATE 10-28-77

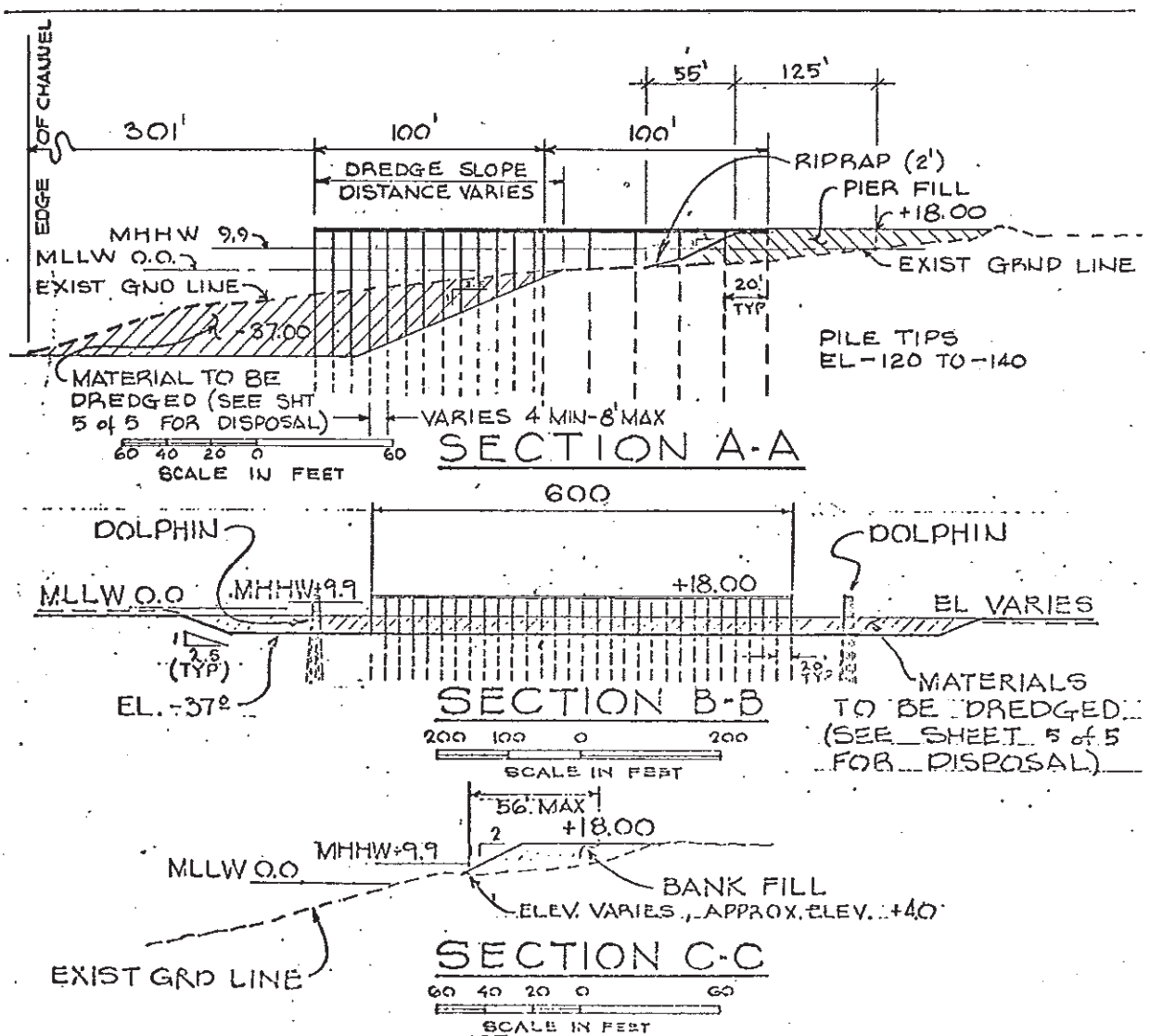
ITEM	FILL SOURCE	TYPE OF FILL	CU YDS	METHOD OF HANDLING
PIER FILL	REHANDLED DREDGED GRANULAR MATERIAL FROM NAVIGATIONAL FACILITIES ADJACENT TO TERMINAL Nº 4	CLEAN SANDY GRAVEL	31,000	COMBINATION OF BARGE, DUMP TRUCK & CLAMSHELL
BANK FILL	DO (DITTO)	DO	3,000	CLAMSHELL & DUMPTRUCK
DIKE FILL (STAGE I)	DO	DO	30,000	COMBINATION OF BARGE, DUMP TRUCK & CLAMSHELL
DIKE FILL (STAGE II)	DO	DO	30,000	CLAMSHELL & DUMPTRUCK
SLIP NO 2	DO, & INORGANIC, NON-POLLUTING MATERIALS SUCH AS BROKEN CONCRETE SLAB & ASPHALT PAVING FROM ON-SITE DEMOLITION		250,000	CLAMSHELL & DUMP TRUCK
SLOPE PROTECTION (RIP-RAP)	QUARRY	FRACTURED BASALT	15,600*	CLAMSHELL & DUMPTRUCK

ITEM	DISPOSAL	TYPE OF MATERIAL	CU YDS	METHOD OF HANDLING
BERTH DREDGING	SOUTH SHORE DISPOSAL SITE, SEE SHEET 5 of 5	SANDY SILT	250,000	HYDRAULIC DREDGE

071-OYB-2-004449

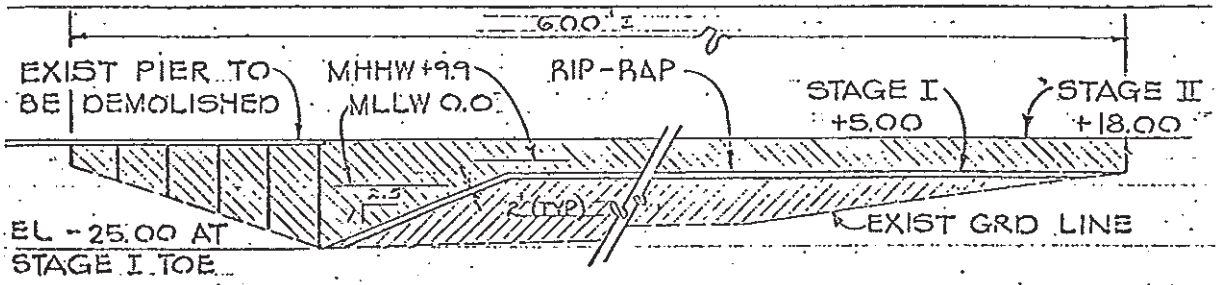
*
PIER FILL = 3,600 CY
DIKE STAGE I = 8,000 CY
DIKE STAGE II = 4,000 CY

PROPOSED TERMINAL 2 PROJECT
IN CHEHALIS RIVER AT
HOQUIAM/ABERDEEN
COUNTY OF GRAYS HARBOR
STATE OF WASHINGTON
APPLICATION BY PORT OF GRAYS HARBOR REV 8·4·78
SHT 2 of 5 DATE 10·28·77



071-OYB-2-004440

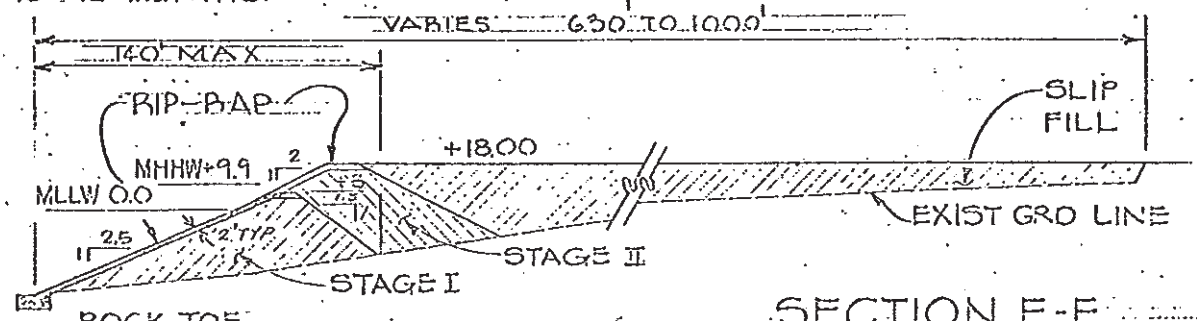
PROPOSED TERMINAL 2 PROJECT
IN CHEHALIS RIVER AT
HOQUIAM/ABERDEEN
COUNTY OF GRAYS HARBOR
STATE OF WASHINGTON
APPLICATION BY: PORT OF GRAYS HARBOR
REV. 8·4·78
SHT 3 OF 5 DATE 10:28:77



DIKE IS STAGED CONSTRUCTION (STAGE I & STAGE II), TIME INTERVAL BETWEEN STAGES IS 12 MONTHS.

SECTION D-D

60 40 20 0 60
SCALE IN FEET



TIME INTERVAL BETWEEN STAGE II & SLIP FILL IS 0-6 MONTHS.

SECTION E-E

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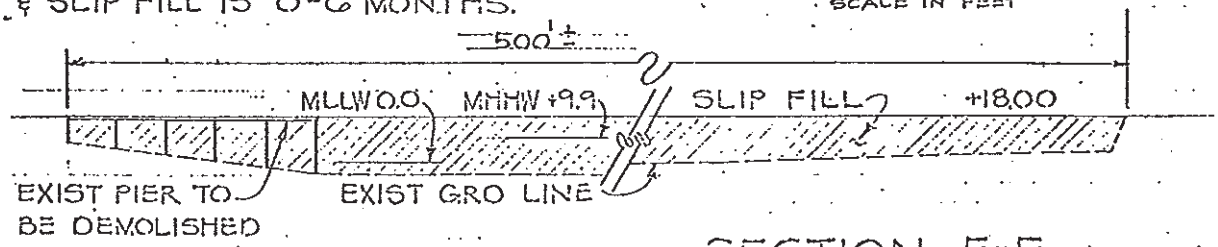
SCALE IN FEET



SECTION F-F

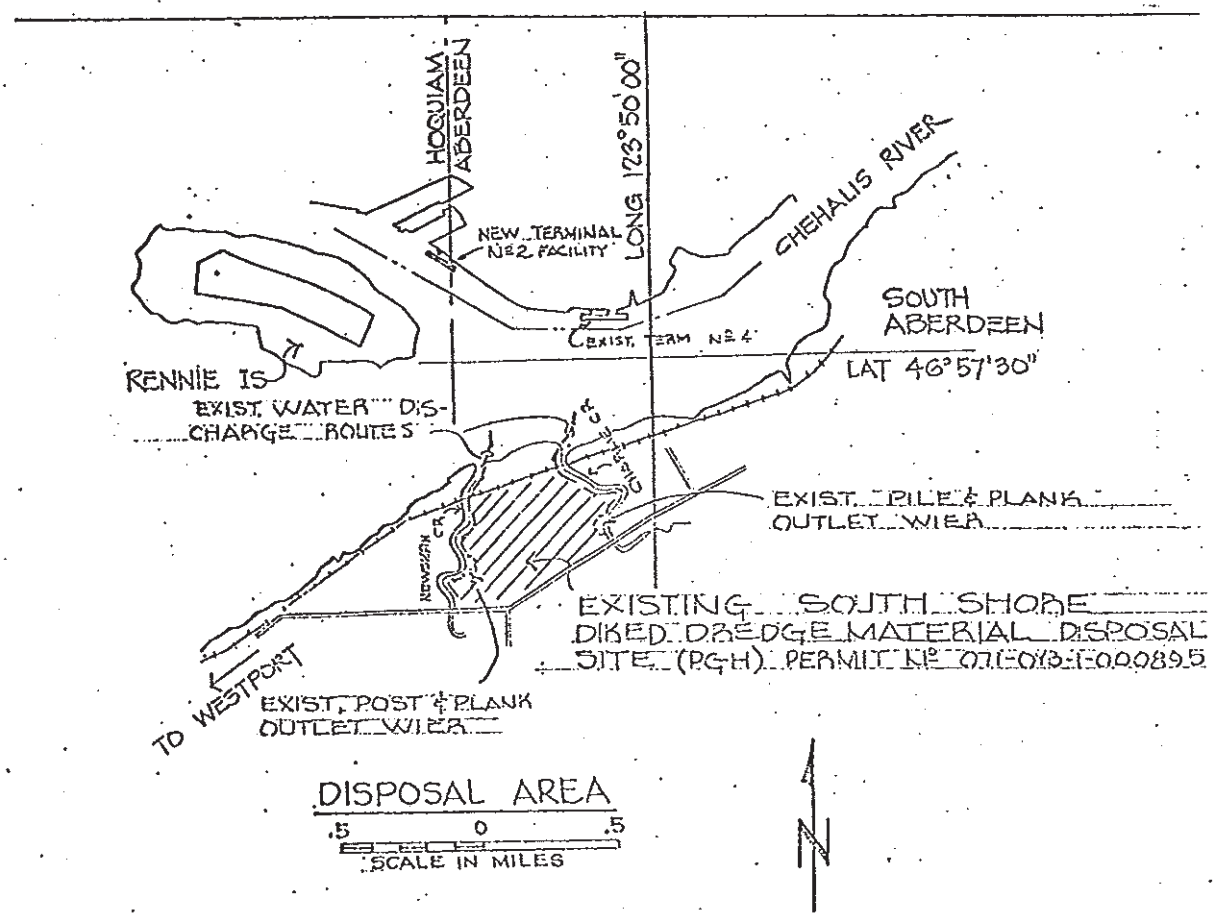
60 40 20 0 60
SCALE IN FEET

071-OYS-2-004449

PROPOSED TERMINAL 2 PROJECT IN CHEHALIS RIVER
AT ABERDEEN/HOQUIAM
COUNTY OF GRAYS HARBOR
STATE OF WASHINGTON
APPLICATION BY: PORT OF GRAYS HARBOR

SHT 4 OF 5

REV. 8·4·78
DATE 10·28·77



071-0YB-2-00 4449
PROPOSED TERMINAL 2 PROJECT
IN CHEHALIS RIVER
AT HOQUIAM / ABERDEEN
COUNTY OF GRAYS HARBOR
STATE WASH
APPLICATION BY
PORT OF GRAYS HARBOR
SHEET 5 OF 5 DATE 10·28·77
REV 8·4·78

Attachment E

Cowan Study of Imperium Project Site

Attachment contains sensitive information and has been removed.

Attachment F

Subsurface Archaeological Investigations Plan

Westway and Imperium Terminals Services Expansion Projects
Subsurface Archaeological Investigations Plan
April 3, 2015

Goals

The goals of the subsurface archaeological investigations are as follows:

1. To assess the depth of previous dredging activities along the margins of the ship's slips that previously inhabited the area of potential effects (APE).
2. To assess the potential for encountering archaeological deposits if pre-development landforms are encountered during subsurface investigations.

Approach

To achieve the goals of the archaeological investigation, the following approach to fieldwork will be followed:

1. Twenty-four subsurface investigation units (twelve in each portion of the APE) will be excavated in the APE. Subsurface investigation units will include both mechanical trenches and geoarchaeological borings. The specific methods that will be used to perform each of the subsurface investigation types are summarized below.
    a. **Mechanical Trenches:** Mechanical trenches will be excavated in unpaved areas where buried utilities are unlikely to be encountered. It is anticipated that mechanical trenches will be primarily used in the Imperium portion of the APE because of widespread paved surfaces in the Westway portion of the APE. Mechanical trenches will be excavated to the maximum vertical reach of the excavator arm (24 feet) or until the sidewalls of the trench slump and the trench infills faster than it can be excavated. Trench dimensions will vary depending on local logistical factors, but will typically be around 20 feet long and 6 feet wide. When possible, all trenches will be excavated in successive shallow lifts.

    Two archaeologists will be present during the excavation of mechanical trenches; one will oversee excavations and inspect trench profile walls and the other will carefully inspect the spoils pile. A metal rake will be used to break-up any large peds to inspect them for archaeological materials. In instances where sediments appear to have contents that warrant additional inspection, a sample of the sediments in question will be screened through 0.25-inch hardware cloth.

    Once each excavation is completed, the mechanical trench will be photographed and plotted using a handheld global positioning system (GPS) unit. Trench contents, stratigraphy, depth to undisturbed native landforms, and other relevant information will be recorded on a standard trench summary form. All mechanical trenches will be backfilled and compacted to a level that is considered to be appropriate by the landowner.

b. **Geoarchaeological Borings:** Geoarchaeological borings will be used in paved areas and to supplement mechanical trenching. Therefore, it is anticipated that the majority of the geoarchaeological borings will be excavated in the Westway portion of the APE. Geoarchaeological borings will be excavated to a minimum depth of 40 feet below the ground surface unless impassible obstructions are encountered. Sediment samples will be continuously collected via the rotosonic or direct push sample collection method, and the internal diameter of the sampler tube will be no less than 2 inches.

   Archaeologists will perform a detailed analysis of each sediment sample. Sample attributes – such as color, grain size, gravel angularity, structure, interface, compaction, and notable inclusions, will be recorded and used to determine depositional context. Sample attributes will be analyzed at no less than two points for each sediment sample. If stratigraphic contacts are present, sediments will be analyzed at two additional points per contact – directly above and below each contact. This information will be recorded on a standardized bore log form. In the event that a more detailed analysis of sediment sample contents is needed, archaeologists will collect sub-samples for post-field analysis. The need for, and selection of, sub-samples will be determined by the principal investigator in the field.

   Upon completion of the analysis, each sediment sample will be photographed and the entire of the contents of the screened through 0.25-inc mesh. Upon completion, all borings will be mapped with a handheld GPS unit and refilled using a structurally appropriate substrate as directed by the landowner.

2. Subsurface investigations will be spaced at approximately 100-foot intervals along the northern central and southern margins of the APE where subsurface project-related ground disturbance is anticipated. To the extent possible, subsurface investigation units will be placed along the margin of the ship's slips that previously inhabited the APE.

3. In the event that possible archaeological deposits are encountered, ICF archaeologists may excavate additional subsurface investigations in the vicinity of the discovery in order to adequately assess and characterize the discovery. The nature and extent of the additional subsurface investigations would be determined by the principal investigator in the field. If the discovery is determined to not be archaeological, observations about the discovery will be recorded and the archaeological investigation will continue. If the discovery is determined to be an archaeological site, excavations will cease in the vicinity of the discovery until consultation with the State Historic Preservation Officer has occurred.

   If human remains are encountered, archaeological investigations will be halted at the location of the discovery and the Grays Harbor County sheriff and coroner will be contacted immediately. The remains will be protected in place by the archaeologist until the sheriff or coroner take

jurisdiction over them. If the remains are determined to be non-forensic by the sheriff or coroner, DAHP will take jurisdiction over the remains to determine whether they are Native American or non-Native American. If the remains are determined to be Native American, DAHP will identify the affected tribes and consult to determine the next steps for the treatment of the remains.

4. The results of the archaeological investigations will be integrated into the project's cultural resources discipline report. The report will summarize survey methods, findings, interpretations, and provide technical recommendations. The discipline report will be provided to DAHP upon completion of the project's draft Environmental Impact Statement.

Attachment G

Radiocarbon Analysis Tables

Designation	Depth (ft) Below MSL	Beta #	14C YBP	Error	Material Type	Source
AB-1a	1.4	263288	Modern	0	Organic	Phipps 2010
D-3	0.4	229689	80	40	Plant	Phipps 2008
L-6	9.6	229682	200	40	Twig	Phipps 2008
AB-1a	0.7	263289	250	40	Organic	Phipps 2010
15-03	6.6	20296	330	100	Wood	Peterson and Phipps 1992
B-2	2.2	229686	400	40	Twig	Phipps 2008
07-01	4.9	20308	620	70	Wood	Peterson and Phipps 1992
L-6	22.7	229683	620	40	Conifer Cone	Phipps 2008
04-01	3.3	20293	830	60	Peat	Peterson and Phipps 1992
AB-4	27.1	264293	1000	40	Organic	Phipps 2010
AB-2	20	263291	1130	40	Organic	Phipps 2010
02-04	16.4	20279	1360	70	Shell	Peterson and Phipps 1992
L-6	22.8	229684	1380	50	Wood Debris	Phipps 2008
AB-5	16.8	263295	1660	40	Organic	Phipps 2010
D-14	14.7	229681	2470	40	Conifer Cone	Phipps 2008
15-06	21.3	20297	3190	230	Wood	Peterson and Phipps 1992
05-06	16.4	20309	3380	80	Peaty	Peterson and Phipps 1992
03-11	47.6	20287	3570	80	Shell	Peterson and Phipps 1992
01-09	37.3	20957	4020	120	Shell	Peterson and Phipps 1992
17-04	9.8	20529	4120	80	Peat	Peterson and Phipps 1992
J-14	27	229688	4410	40	Wood Debris/Shell	Phipps 2008
08-02	41	20301	4740	100	Shell	Peterson and Phipps 1992
AB-1b	28.2	263290	4950	40	Organic	Phipps 2010
L-6	53.9	229685	5040	50	Wood Debris	Phipps 2008
06-03	41	20528	5080	90	Shell	Peterson and Phipps 1992
17-07	36	20530	5540	80	Peaty	Peterson and Phipps 1992
15-10	39.4	20527	5770	140	Peaty	Peterson and Phipps 1992
01-22	101.7	20284	6040	90	Shell	Peterson and Phipps 1992
03-14	62.3	20288	6170	80	Wood	Peterson and Phipps 1992
06-06	68.9	20306	6440	110	Shell	Peterson and Phipps 1992
AM-1	0.9	263298	7130	50	Organic	Phipps 2010

Designation	Depth (ft) Below MSL	Beta #	14C YBP	Error	Material Type	Source
03-16	72.2	20291	7320	390	Shell	Peterson and Phipps 1992
15-14	44.3	20299	7340	140	Peaty	Peterson and Phipps 1992
03-21	96.8	20289	7350	110	Shell	Peterson and Phipps 1992
17-12	65.6	20531	7530	80	Peaty	Peterson and Phipps 1992
AM-4	85.8	263300	7690	50	Organic	Phipps 2010
F-6	75.6	229676	7700	50	Wood Debris	Phipps 2008
AB-4	85.9	263294	7710	50	Organic	Phipps 2010
AM-2	87	263297	7720	50	Organic	Phipps 2010
AM-1b	93	263296	7780	50	Organic	Phipps 2010
17-16	95.1	20532	7930	120	Peaty	Peterson and Phipps 1992
02-20	96.8	20280	7990	90	Shell	Peterson and Phipps 1992
15-24	111.5	20300	8050	110	Wood	Peterson and Phipps 1992
D-6	79	229675	8060	50	Peat	Phipps 2008
F-6	85.1	229677	8250	50	Organic Sediment	Phipps 2008
F-6	100	229678	8380	60	Organic Sediment	Phipps 2008
03-30	141	20290	8730	100	Shell	Peterson and Phipps 1992
AB-3	114	263292	8860	50	Organic	Phipps 2010
H-6	70.3	229680	8870	60	Peat	Phipps 2008
B-2	119.4	229687	8890	60	Wood Debris	Phipps 2008
02-25	121.4	20281	8940	100	Shell	Peterson and Phipps 1992
AM-3b	127.6	263299	9150	50	Organic	Phipps 2010
F-6	119.8	229679	9160	80	Twig	Phipps 2008
02-35	172.2	20282	9700	130	Shell	Peterson and Phipps 1992
08-14	155.8	20304	10110	270	Shell	Peterson and Phipps 1992
01-39	187	20286	10760	90	Wood	Peterson and Phipps 1992
WW-9	72.5	411881	8840	30	Organic Sediment	current study

Designation	Depth (ft) Below MSL	Beta #	14C YBP	Error	Material Type	Source
AB-1a	1.4	263288	Modern	0	Organic	Phipps 2010
D-3	0.4	229689	80	40	Plant	Phipps 2008
L-6	9.6	229682	200	40	Twig	Phipps 2008
AB-1a	0.7	263289	250	40	Organic	Phipps 2010
15-03	6.6	20296	330	100	Wood	Peterson and Phipps 1992
B-2	2.2	229686	400	40	Twig	Phipps 2008
07-01	4.9	20308	620	70	Wood	Peterson and Phipps 1992
L-6	22.7	229683	620	40	Conifer Cone	Phipps 2008
04-01	3.3	20293	830	60	Peat	Peterson and Phipps 1992
AB-4	27.1	264293	1000	40	Organic	Phipps 2010
AB-2	20	263291	1130	40	Organic	Phipps 2010
02-04	16.4	20279	1360	70	Shell	Peterson and Phipps 1992
L-6	22.8	229684	1380	50	Wood Debris	Phipps 2008
AB-5	16.8	263295	1660	40	Organic	Phipps 2010
D-14	14.7	229681	2470	40	Conifer Cone	Phipps 2008
15-06	21.3	20297	3190	230	Wood	Peterson and Phipps 1992
05-06	16.4	20309	3380	80	Peaty	Peterson and Phipps 1992
03-11	47.6	20287	3570	80	Shell	Peterson and Phipps 1992
01-09	37.3	20957	4020	120	Shell	Peterson and Phipps 1992
17-04	9.8	20529	4120	80	Peat	Peterson and Phipps 1992
J-14	27	229688	4410	40	Wood Debris/Shell	Phipps 2008
08-02	41	20301	4740	100	Shell	Peterson and Phipps 1992
AB-1b	28.2	263290	4950	40	Organic	Phipps 2010
L-6	53.9	229685	5040	50	Wood Debris	Phipps 2008
06-03	41	20528	5080	90	Shell	Peterson and Phipps 1992
17-07	36	20530	5540	80	Peaty	Peterson and Phipps 1992
15-10	39.4	20527	5770	140	Peaty	Peterson and Phipps 1992
01-22	101.7	20284	6040	90	Shell	Peterson and Phipps 1992
03-14	62.3	20288	6170	80	Wood	Peterson and Phipps 1992
06-06	68.9	20306	6440	110	Shell	Peterson and Phipps 1992
AM-1	0.9	263298	7130	50	Organic	Phipps 2010

Designation	Depth (ft) Below MSL	Beta #	14C YBP	Error	Material Type	Source
03-16	72.2	20291	7320	390	Shell	Peterson and Phipps 1992
15-14	44.3	20299	7340	140	Peaty	Peterson and Phipps 1992
03-21	96.8	20289	7350	110	Shell	Peterson and Phipps 1992
17-12	65.6	20531	7530	80	Peaty	Peterson and Phipps 1992
AM-4	85.8	263300	7690	50	Organic	Phipps 2010
F-6	75.6	229676	7700	50	Wood Debris	Phipps 2008
AB-4	85.9	263294	7710	50	Organic	Phipps 2010
AM-2	87	263297	7720	50	Organic	Phipps 2010
AM-1b	93	263296	7780	50	Organic	Phipps 2010
17-16	95.1	20532	7930	120	Peaty	Peterson and Phipps 1992
02-20	96.8	20280	7990	90	Shell	Peterson and Phipps 1992
15-24	111.5	20300	8050	110	Wood	Peterson and Phipps 1992
D-6	79	229675	8060	50	Peat	Phipps 2008
F-6	85.1	229677	8250	50	Organic Sediment	Phipps 2008
F-6	100	229678	8380	60	Organic Sediment	Phipps 2008
03-30	141	20290	8730	100	Shell	Peterson and Phipps 1992
AB-3	114	263292	8860	50	Organic	Phipps 2010
H-6	70.3	229680	8870	60	Peat	Phipps 2008
B-2	119.4	229687	8890	60	Wood Debris	Phipps 2008
02-25	121.4	20281	8940	100	Shell	Peterson and Phipps 1992
AM-3b	127.6	263299	9150	50	Organic	Phipps 2010
F-6	119.8	229679	9160	80	Twig	Phipps 2008
02-35	172.2	20282	9700	130	Shell	Peterson and Phipps 1992
08-14	155.8	20304	10110	270	Shell	Peterson and Phipps 1992
01-39	187	20286	10760	90	Wood	Peterson and Phipps 1992
WW-9	72.5	411881	8840	30	Organic Sediment	current study

Appendix K

Rail Traffic Technical Information

Section K.1 Rail Characteristics and Operations: A Primer

Section K.2 Stringlines and Data Tables

Section K.3 Proposed Switching Operations

Section K.4 Poynor Yard Switching Operations for Rail Car Inspections

Section K.5 Doubling and Clearing

Section K.1

Rail Characteristics and Operations: A Primer

A number of elements dictate how freight trains will operate and function along a rail line. These elements include train personnel, signalization along the tracks, and traffic control.

Train Personnel

The crew of a train generally consists of two people: the conductor and the engineer. The engineer operates the locomotive under the direction of the conductor. The conductor is in charge of the train. Except in emergency situations, instructions from suitable authority, or situations provided for in the operating rules and instructions, the conductor determines when the train should move, whether it should move forward or backward, and when and where the train should stop. The conductor and engineer are stationed in the cab of the leading locomotive. When it is necessary for the conductor to leave the locomotive to operate switches, couple cars, uncouple cars, or other duties, the conductor communicates with the engineer by hand signals or radio.

The train dispatcher (dispatcher) supervises operation on an assigned segment or segments of line. The dispatcher issues instructions to conductors, engineers, and maintenance forces along the line, and issues authority to occupy or travel on the main track.

Signals

Except at very low speed, the stopping distance of a train is often substantially greater than the sight distance of the engineer operating the train. A signal system effectively increases the engineer's sight distance, allowing higher speed than could be allowed without the signal system. The signal system is typically configured with red/yellow/green lights similar to highway traffic signals, on masts along the line. The lights have a slightly different meaning from those of a traffic signal. Red means stop, but yellow means the line is clear of trains to the next signal but the next signal is red. Green means that the line is clear of trains at least to the second signal down the line. The length of track between signals is called a block, and the system of signals is called Automatic Block System (ABS).

Sometimes, a signal may be in place to provide information about the position of a switch. Such signals may be limited to red for stop and green for proceed.

A system known as positive block may be used in lieu of a signal system. In positive block, each train is assigned a segment of line in which no other trains are allowed. The engineer may proceed at the speed limit to the end of the authorized section without worrying about encountering other trains.

Under some circumstances, a method of operation called Restricted Speed is in effect. It may be used in conjunction with permission to pass a red signal or it may be used in lieu of signals. Restricted speed is a maximum of 20 miles per hour, but the train must be able to stop within half the range of vision. Curves, weather, darkness, or other conditions may require the engineer to move the train at

substantially less than the 20 miles per hour definition of Restricted Speed, and/or substantially less than the local speed limit.

Traffic Control

Traffic control is the management of the use of the main track by trains and track maintenance forces. Trains cannot divert whenever they encounter another train or maintenance work on the track. A train delayed when encountering maintenance work on the track may then delay other trains many miles distant. On the other hand, track maintenance work may be delayed waiting for a train to pass, only to have that train stop further down the line to wait for a train in the opposite direction.

The train dispatcher manages the use of the main track by trains and maintenance forces. The dispatcher determines where trains must wait for other trains, whether trains must wait for track maintenance or track maintenance must wait for trains, authorizes trains and maintenance forces to occupy the main track within specific limits for a specific amount of time.

The train dispatcher may issue authority by way of a controlled signal system, known as Centralized Traffic Control (CTC), by written orders, or by voice communication without the use of written orders. CTC is ABS with dispatcher ability to make specific signals red for management of traffic, and typically to route trains through switches to alternate tracks by remote control. CTC implements logic that prevents trains moving in opposite directions from being authorized simultaneously on the same segment of track. Multiple trains may be authorized in the same direction on a segment of track, but all of them except the first one must move at Restricted Speed.

CTC is a proven system that has been in use in the railroad industry for over 80 years. There have been many changes in the specific electronics but the core system operates as it has since inception.

CTC is expensive to install and maintain. In lieu of CTC, traffic control on light traffic lines may be in the form of written orders, generally known as Track Warrant Control (TWC). TWC includes very specific and strict procedures for generating, transmitting, recording, and executing the instructions. The train dispatcher communicates with the conductor and/or engineer of a train or with the foreman in charge of a track maintenance crew, and issues specific instructions including the end points of the authority, the time allowed, and other instructions. The dispatcher generates the authority form on a computer system that checks for overlapping authority, then transmits the instructions by voice radio to the recipient. The recipient must write the instructions (which includes some writing of information and some checking boxes on the form, each relating to a specific preprinted instruction) as they are received. The information must be copied without mistake. Corrections are not allowed. The recipient must read the completed form to the dispatcher, who checks the repeated information against the original form, word for word and number for number. Only when the instructions have been repeated correctly does the dispatcher put the instructions in effect by issuing a time that the instructions on the form are in effect.

The recipient must report to the dispatcher, using a specified procedure, indicating that the line is clear and the authority is no longer in use.

TWC is a proven system that has been in use on US railroads for over 30 years. It is derived from another written order system that was in use for over 100 years, altogether about 150 years of proven safe operation.

In limited local areas in which a substantial amount of yard or industrial switching is conducted, Yard Limit operation is used. In yard limits, all trains must proceed prepared to stop within half the range of vision (Restricted Speed). Further authority is not needed to occupy the main track; however, the dispatcher may give verbal instructions by radio in order to ensure that train movements are not delayed by local switching.

Dispatching

The level of traffic on the Puget Sound & Pacific Railroad (PS&P) rail line does not support the use of CTC for traffic control, nor ABS. Traffic is controlled with TWC, which also provides positive block train separation. Yard Limits operation is used at Centralia, Elma, and Aberdeen/Hoquiam.

Trains and maintenance forces communicate among themselves, with local supervisors, and with the train dispatcher by two-way radio using frequencies assigned for the purpose by the Association of American Railroads, and cell phone.

Following distance is substantial when trains are under TWC control. Since TWC is a positive block system, a train must report clear of a segment of track before it can be occupied by another train. This arrangement can be time-consuming and labor-intensive for the dispatcher. The crew of the lead train must report to the dispatcher that the train has passed an identifiable landmark with all of the cars in the train. There is a procedure for this transaction. The dispatcher must then contact the crew of the second train and issue authority to use the main track between its location and the location that the train has reported passing. The entire process can take five to ten minutes, so a practical following distance is generally close to an hour.

The PS&P dispatcher is located in St. Albans, Vermont . This is a centralized dispatching office used by many of the Genessee and Wyoming subsidiary railroads. The situation is not substantially different from the operation of today's shortline railroads when they were branches of today's Class 1 railroads. One dispatcher was typically assigned one or more branch lines in addition to a segment of main line. Some assignments consisted of several branch lines, sometimes distributed over several states. The arrangement is also similar to the arrangement of the Class 1 railroad operation controlled from centralized control centers that are distant from the area being controlled.

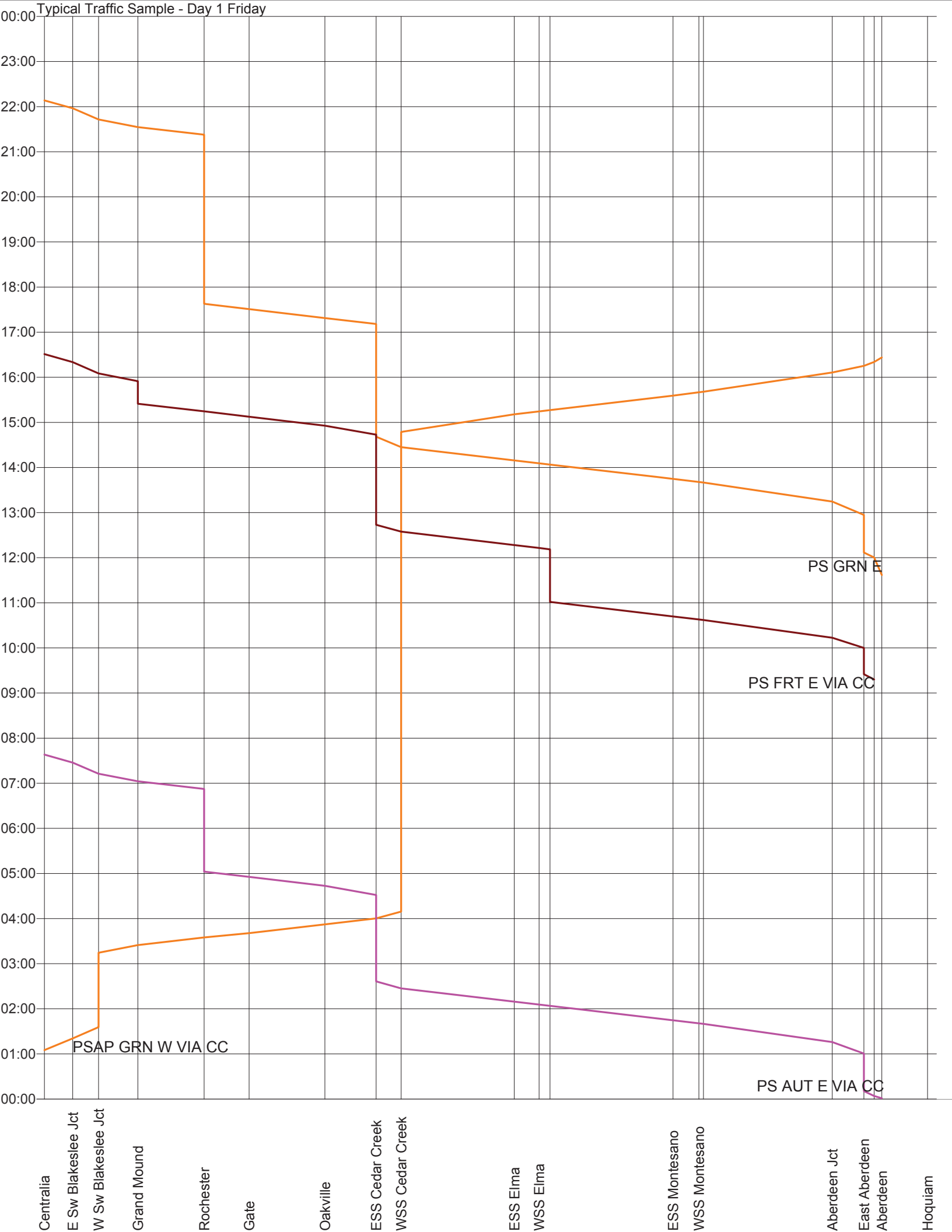
Table 1. Common Railroad Terms and Characteristics

Track Components	What does this mean and why is it important?
Track Structure	Track structure has four elements: rails, ties, ballast and sub-ballast. Rails are made of steel. Even though the steel is very hard, the rail wears out, just as highway pavement wears out. The ties, typically made of wood or concrete, support the rails. Ballast is crushed rock used to support the ties and keep the track in correct alignment. Sub-ballast is a finer grade of crushed rock placed beneath the ballast to divert water from the ballast and distribute the weight of the track to the sub-grade below. The condition of each of these elements dictates the weight and type of equipment that can be used on the track, as well as the speeds allowed on the track.
Number of Tracks and Sidings	The number of tracks affects the capacity of the line. Two tracks (also called double track) have more capacity (the number of trains that can move through the area) than one track (single track). Sidings also increase the capacity of a rail line. Sidings located along the line allow faster trains to overtake slower trains without affecting train traffic on the other track. The capacity of the rail line and the reliability of operation are affected by the time required to move between sidings.
Grade	The steepness of the track dictates the types of trains that can use the rail line. Typical grades for freight trains do not exceed 2%, while grades for passenger trains can be as high as 4%.
Curves	The tightness of the curve dictates the speed that a train can travel. The higher the degree, the tighter the curve, the slower the speed.
Speed Regulations	Train speed limits are generally regulated by the Federal Railroad Administration. The Code of Federal Regulations (CFR) (49 CFR 213, Track Safety Standards) establishes classes of track with associated speed limits and detailed physical requirements for tracks in a given class. In Washington State, speeds may also be restricted by the Washington Utilities and Transportation Commission.
Width (Gage and Track Centers)	The rails of a railroad track are spaced 56.5 inches apart (the gage of track). To allow sufficient clearance between vehicles on adjacent tracks, the tracks are spaced at least fifteen feet apart (the track centers). Recent Federal Railroad Administration Safety Regulations dictate that if rail traffic is to continue while maintenance is performed on an adjacent track, the tracks must be placed at least 25 feet apart from the center of each track. This is often referred to as 25-foot centerline.
Length	Each track that is not a through-route must be long enough to serve the intended purpose. Just as a parking space for a tractor-trailer must be of sufficient length for the vehicle, a railroad track must be long enough to hold even the longest train. Depending on the type of train traffic handled, the length of a typical freight train can be between 7,000 feet and 10,000 feet.
Rail Yard	Series of railroad tracks for storing, sorting, or loading/unloading, railroad cars and/or locomotives. Railroad yards are normally built where there is a need to store cars while they are not being loaded or unloaded, or are waiting to be assembled into trains. Railroad yards have many tracks in parallel for keeping rolling stock stored off the mainline, so that they do not obstruct the flow of traffic. Railroad cars are moved around by specially designed yard switchers, a type of locomotive. Cars

Track Components	What does this mean and why is it important?
	in a railroad yard may be sorted by numerous categories, including railroad company, loaded or unloaded, destination, car type, or whether they need repairs.
Railroad Operations	**What does this mean and why is it important?**
Signals and Traffic Control	Signals help extend the engineer's sight distance and therefore allow greater speeds. Traffic control determines which trains can use which tracks—it increases safety and movement of trains.
Traffic	The number and type of trains along a rail line relate directly to capacity. The more trains that are put on a track, the more the need for additional track signals and controls. Without these signals and controls, the speed and capacity of the rail line would diminish as traffic increases.
Running Time	Running time is the amount of time for a train to travel between two points. Running time is used to determine capacity of the railroad.
Double In	This refers to separating a train or string of cars into more than one track when the tracks will not accommodate the entire string of cars or train. See Section K.5, *Doubling and Clearing*, for illustrations.
Double Out	This refers to aligning rail cars in one track to the cars in another in order to assemble a train or string of cars that will not fit in any of the tracks. See K.5, *Doubling and Clearing*, for illustrations.
Coupling	Coupling is a mechanism used to connect two or more rail cars.
Switching	Switching is a type of operation done within and near the limits of a yard. It generally consists of breaking down and building up trains, storing and classifying cars, serving industries within and near yard limits, and other related purposes.

Section K.2

Stringlines and Data Tables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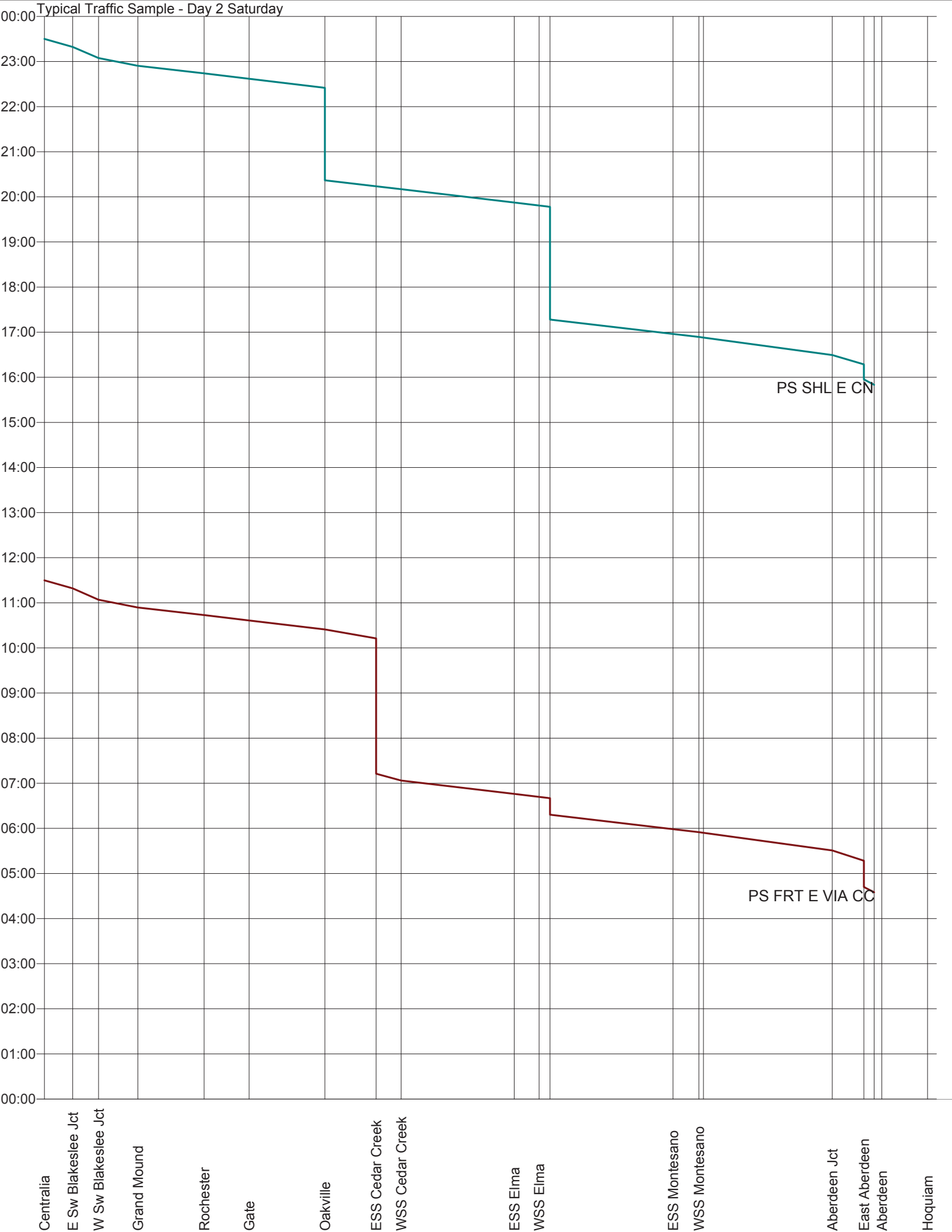
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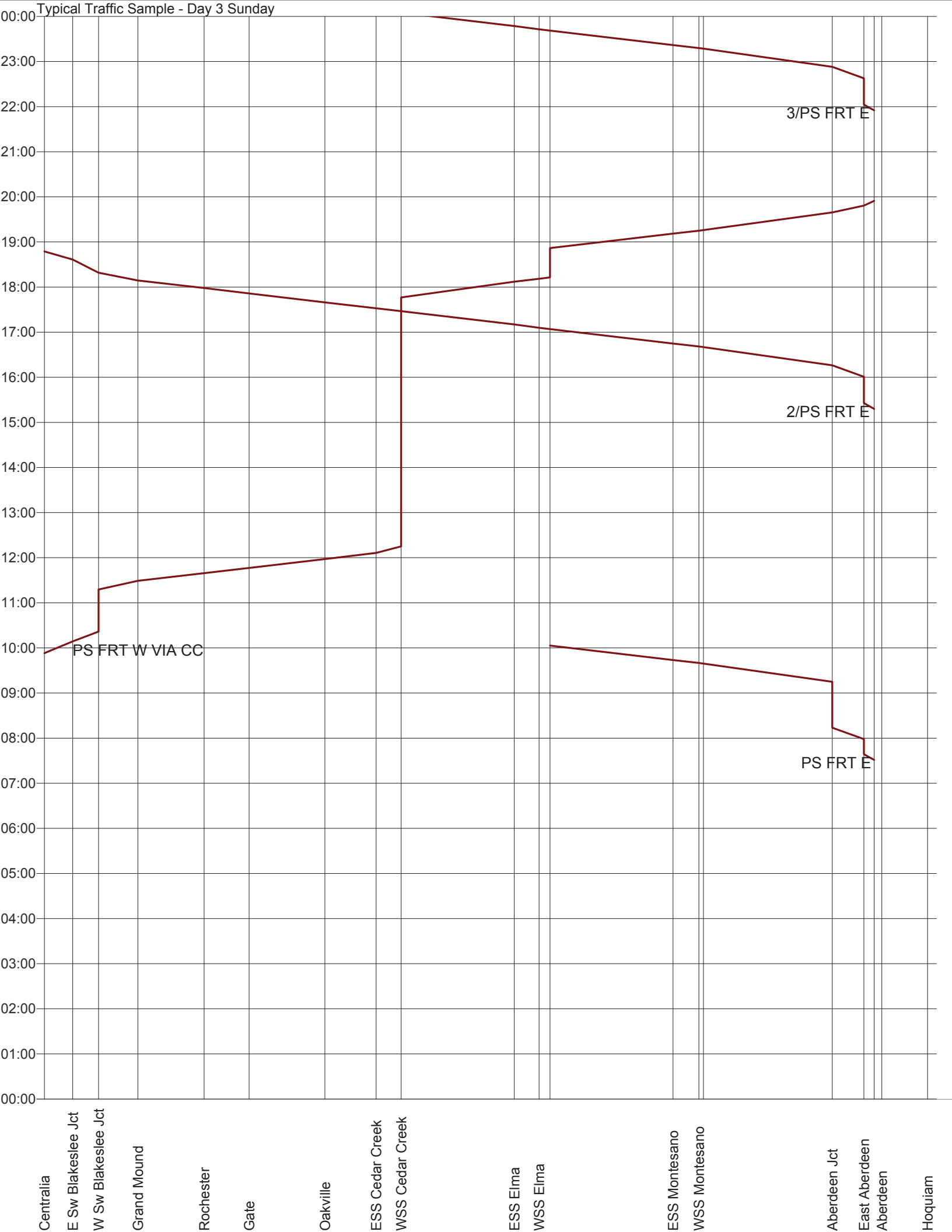
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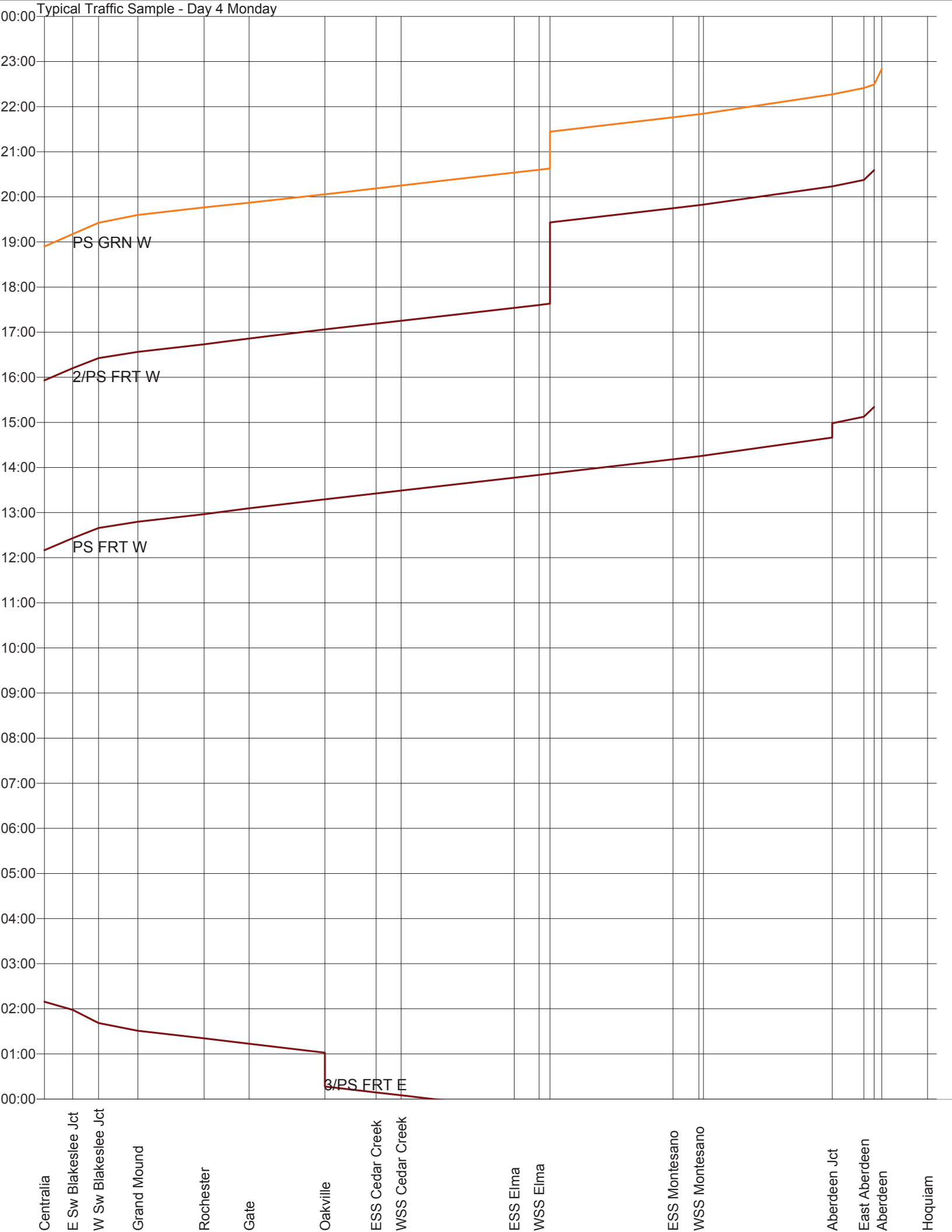
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Grand Mound
Rochester
Gate
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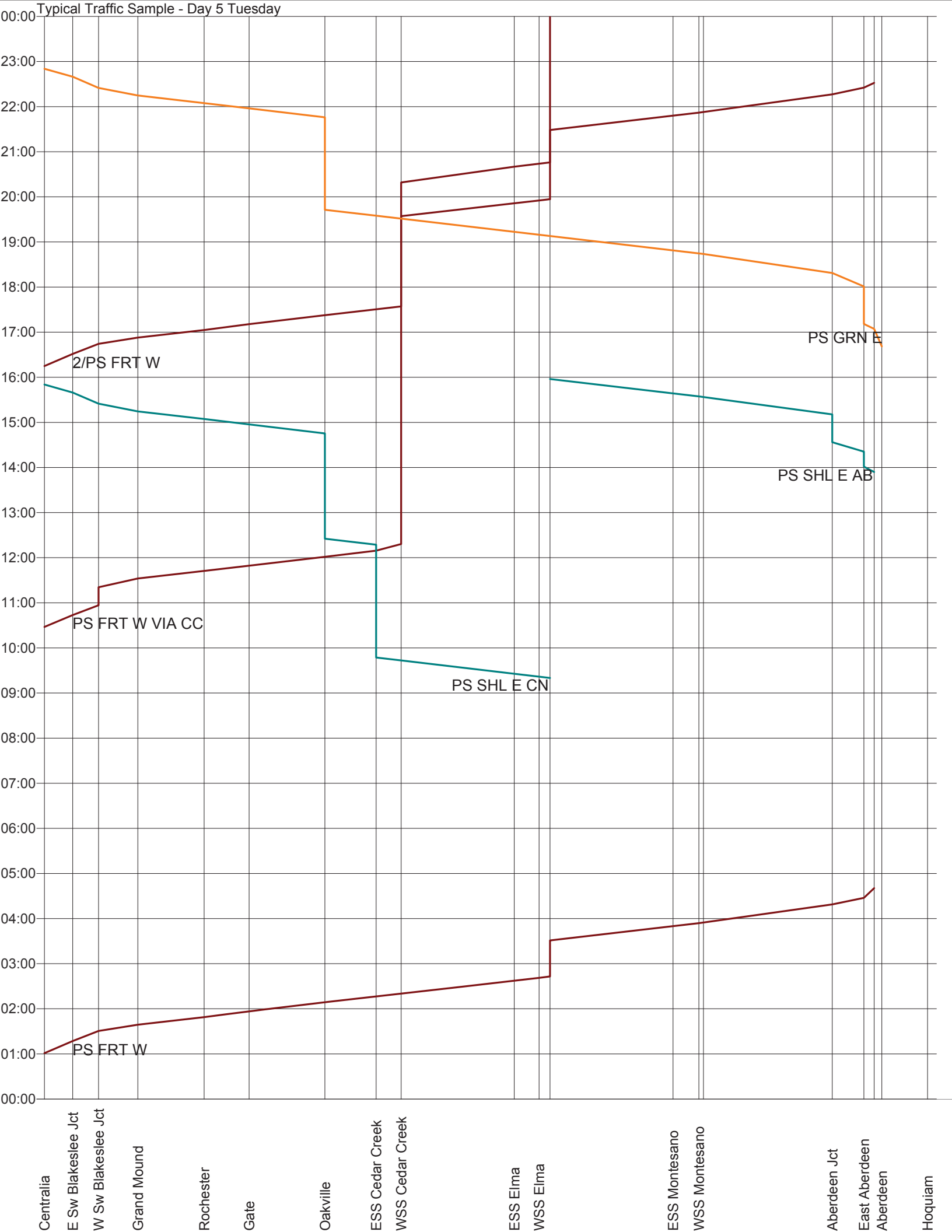
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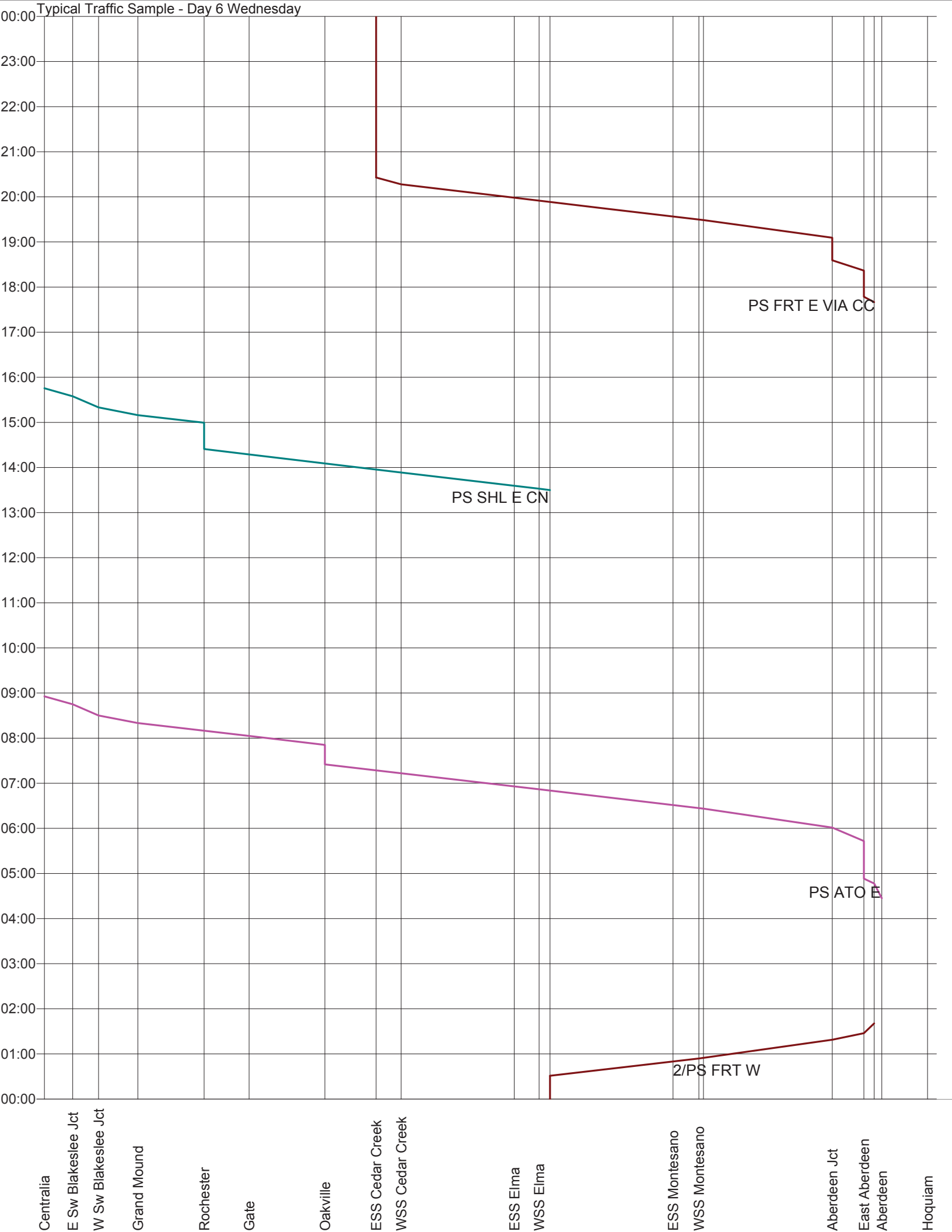
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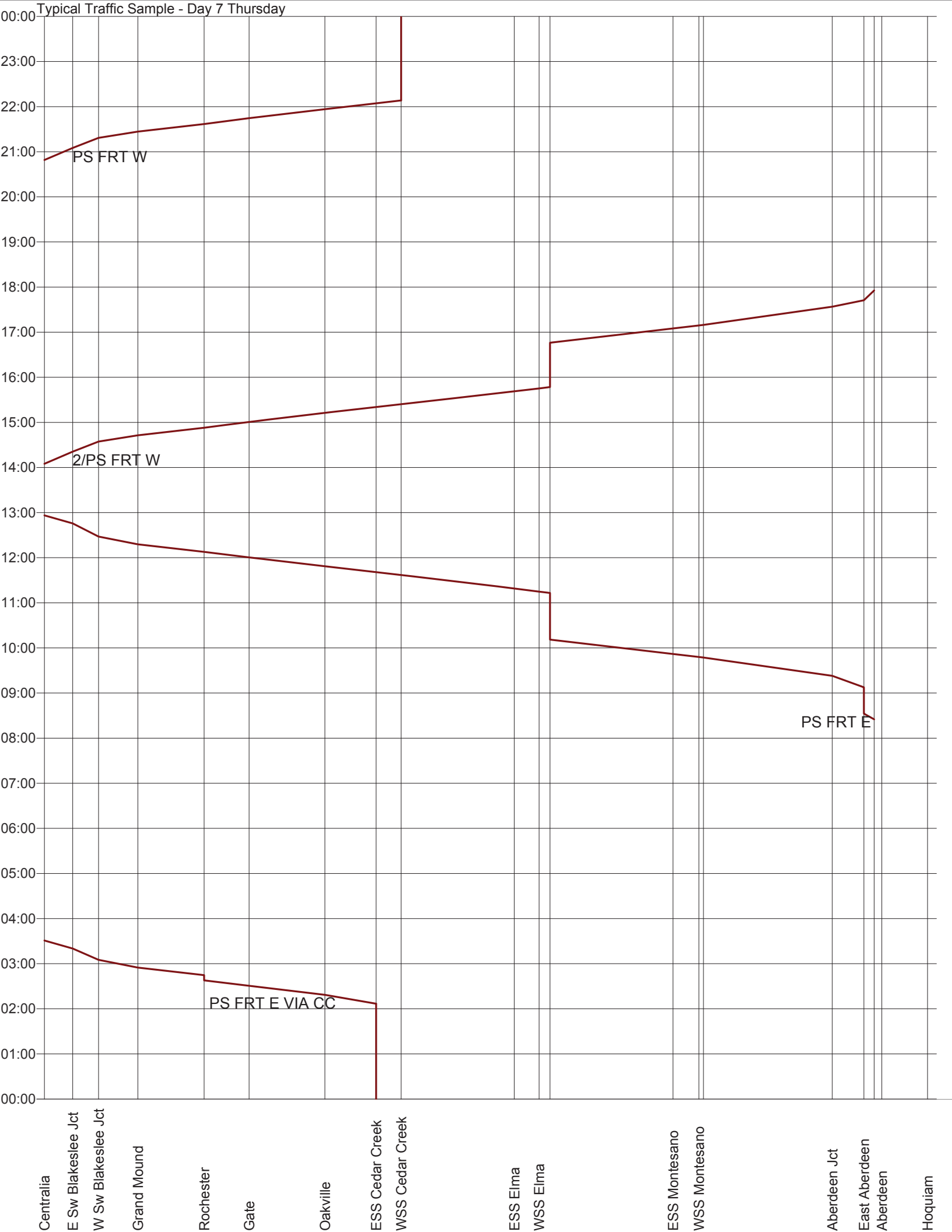
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Gate
Oakville
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East Aberdeen
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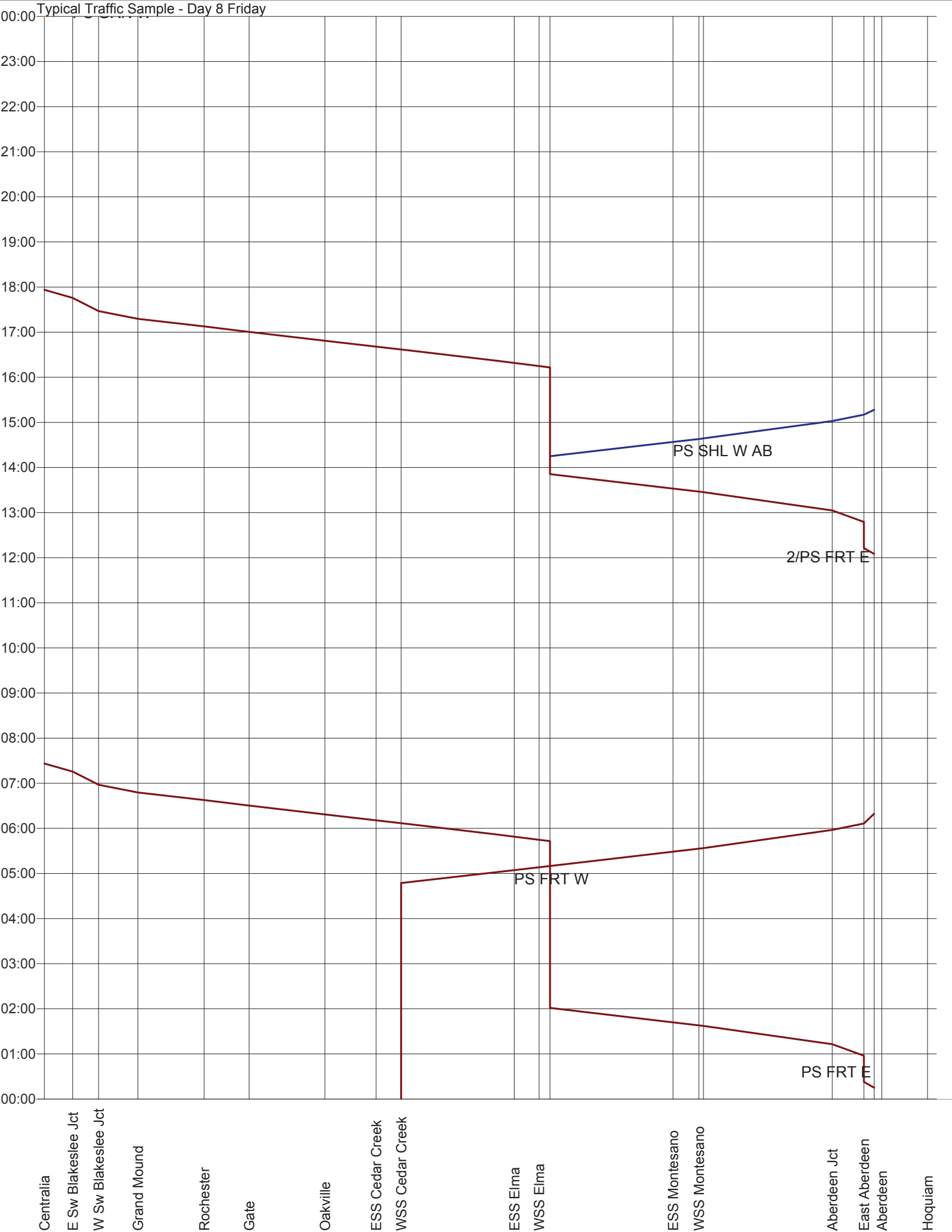

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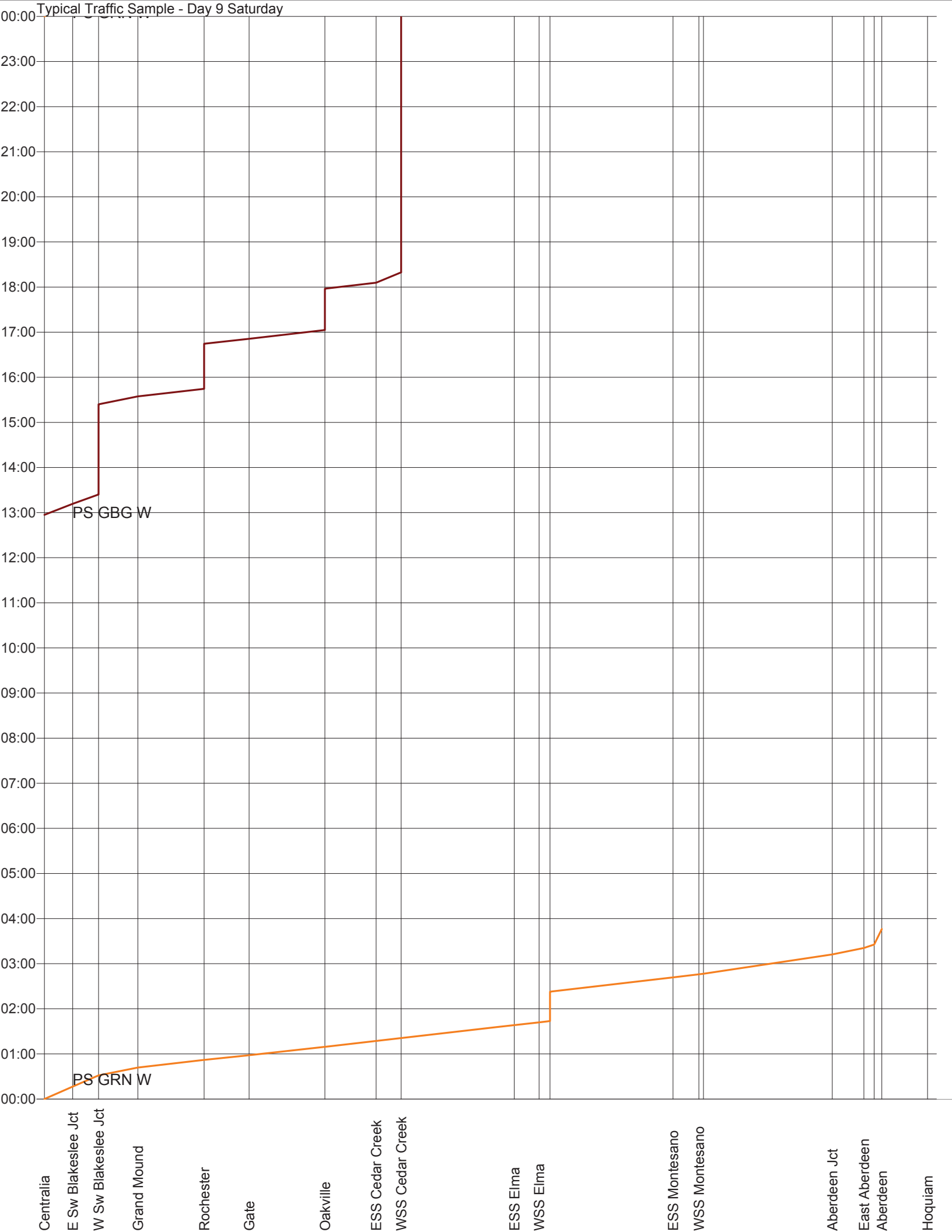

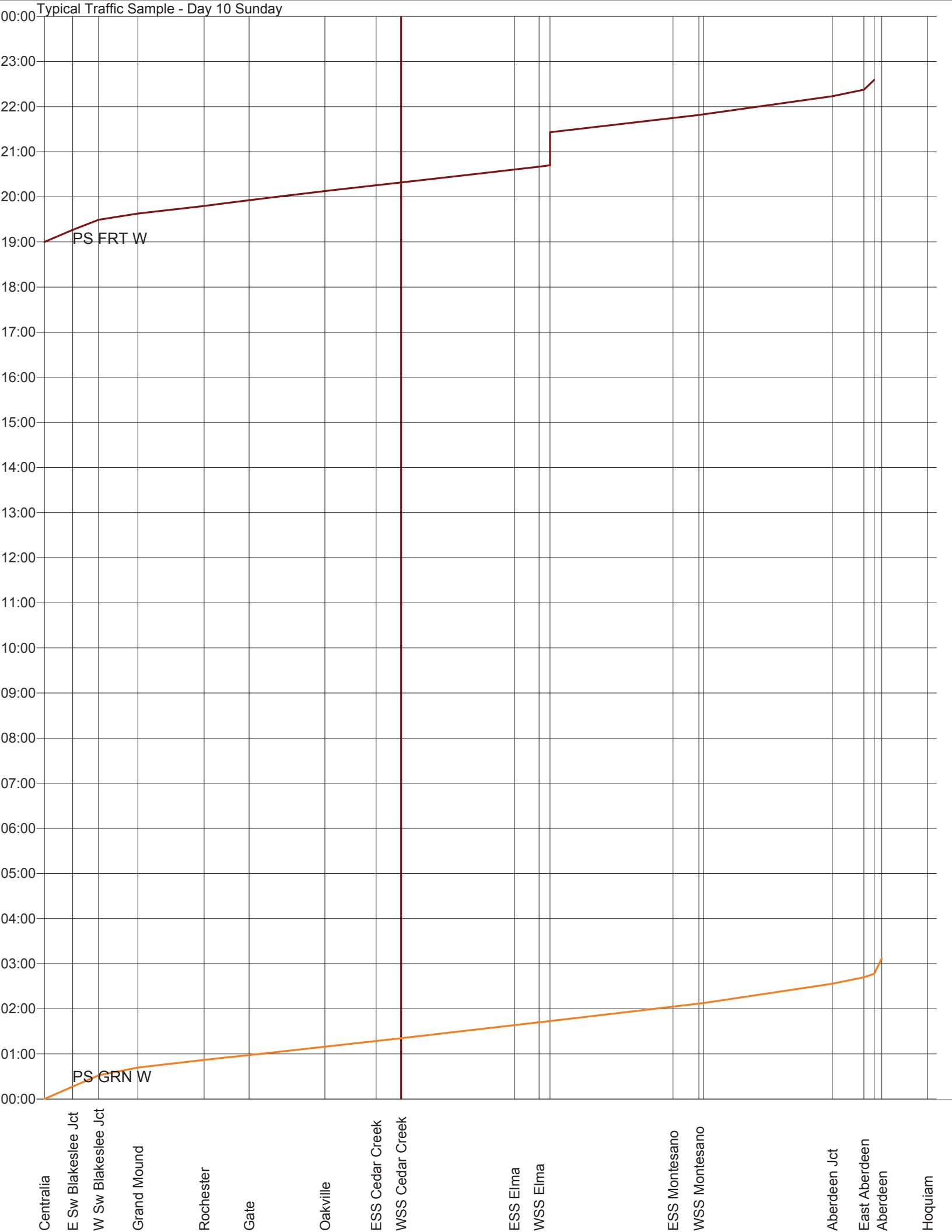
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PS FRT W
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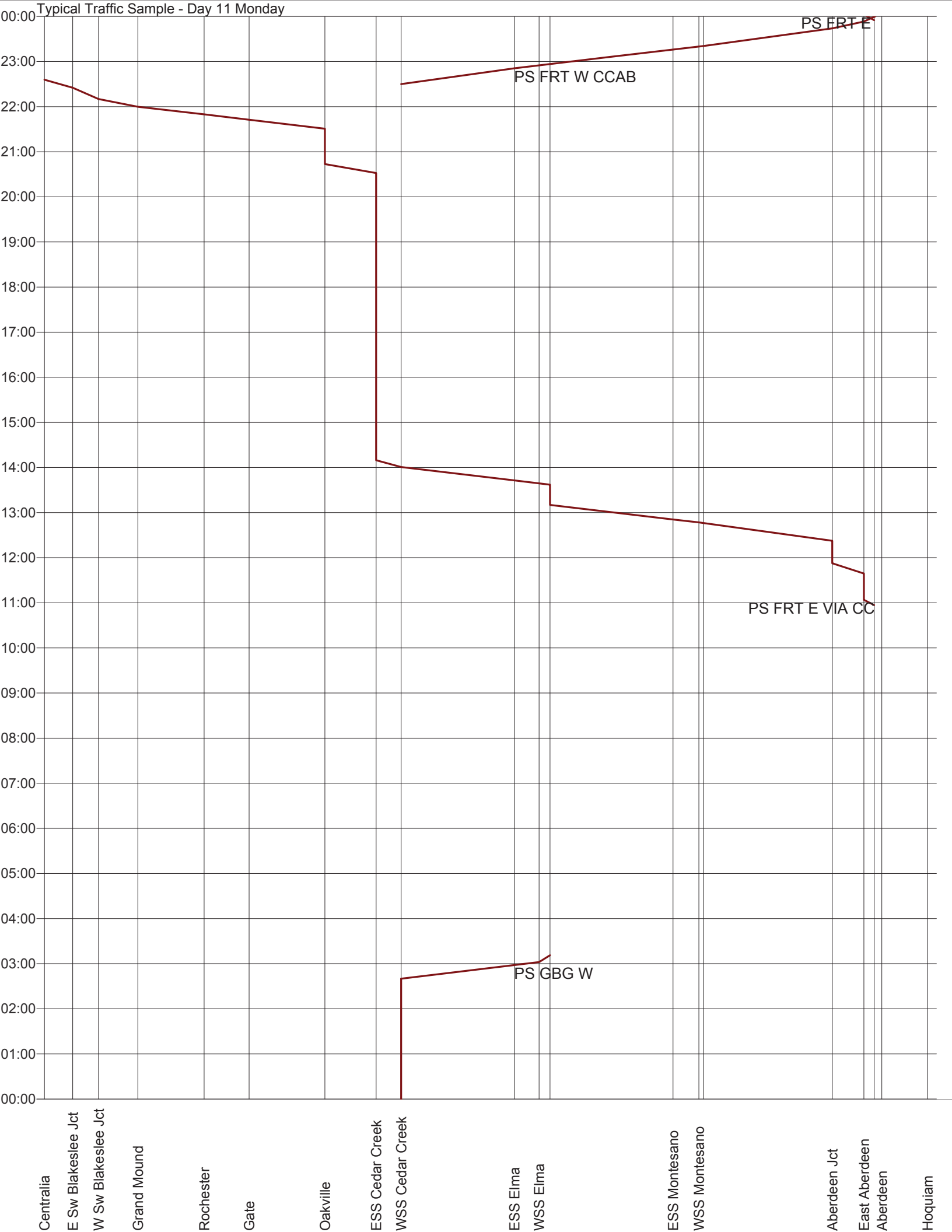
Centralia
E Sw Blakeslee Jct
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 11 Monday
00:00
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PS FRT E
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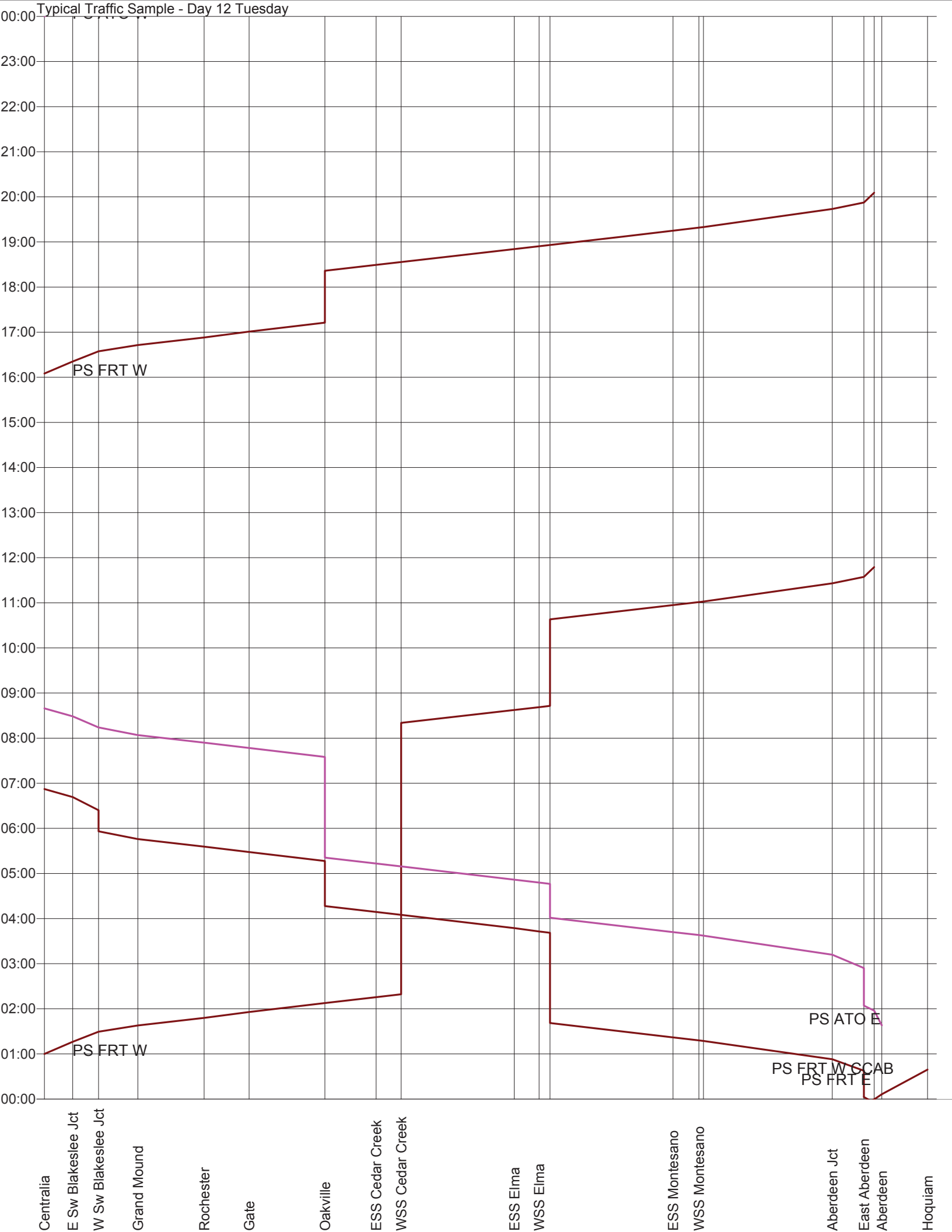
PS GBG W
Centralia
E Sw Blakeslee Jct
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 12 Tuesday
00:00
23:00
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14:00
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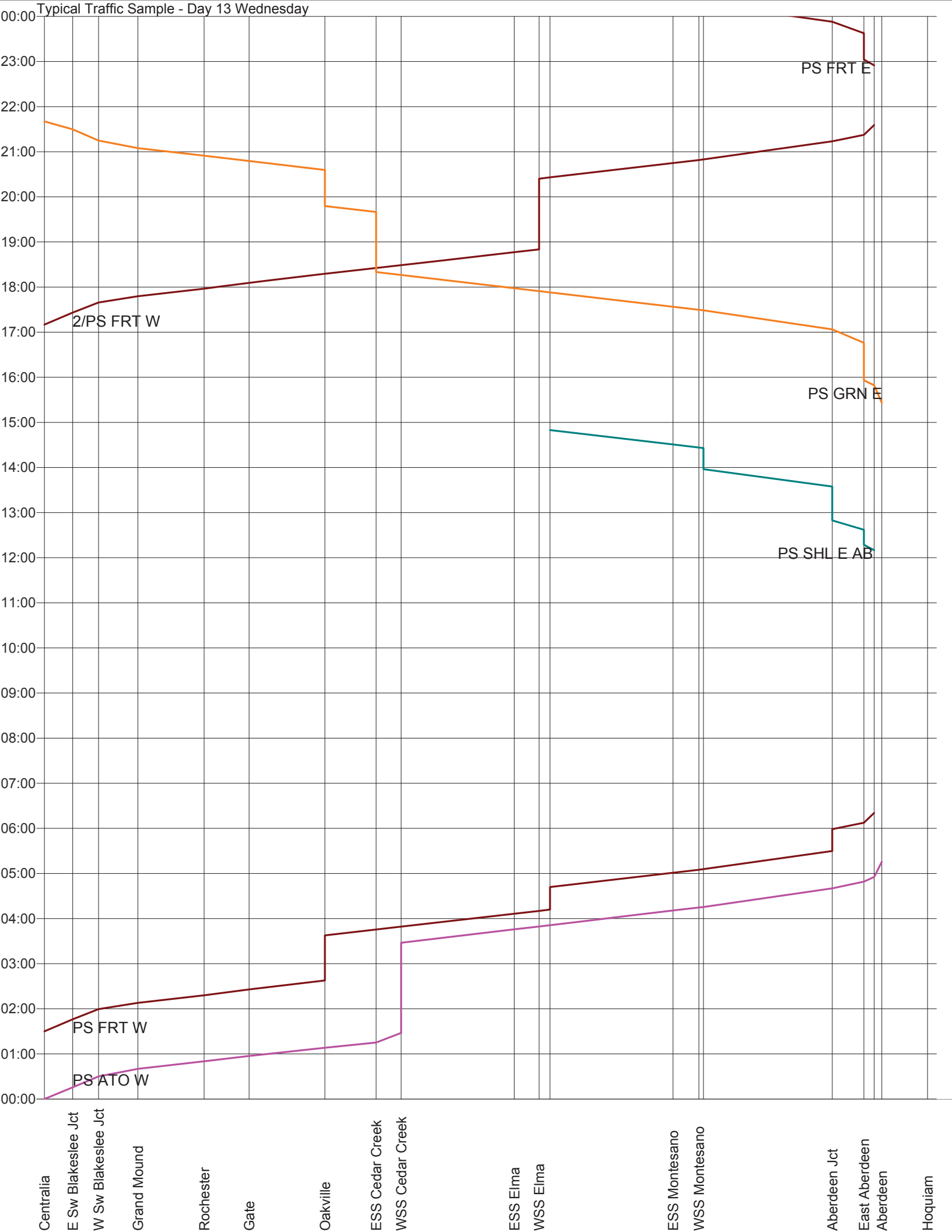
PS FRT W
PS FRT W
PS ATO E
PS FRT W SCAB
PS FRT E
Centralia
E Sw Blakeslee Jct
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 13 Wednesday
00:00
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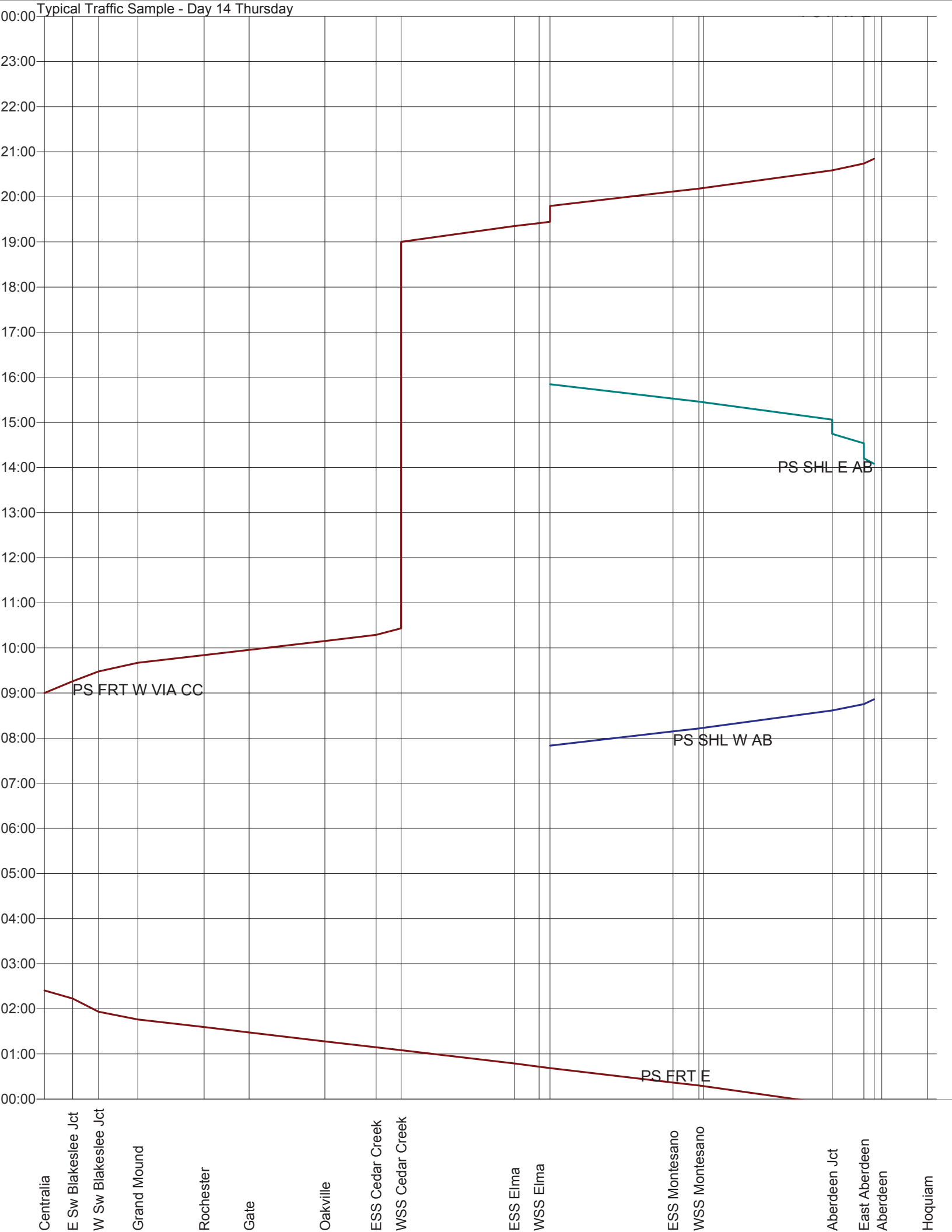
PS GRN E
PS SHL E AB
PS FRT W
PS ATO W
Centralia
E Sw Blakeslee Jct
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 14 Thursday
00:00
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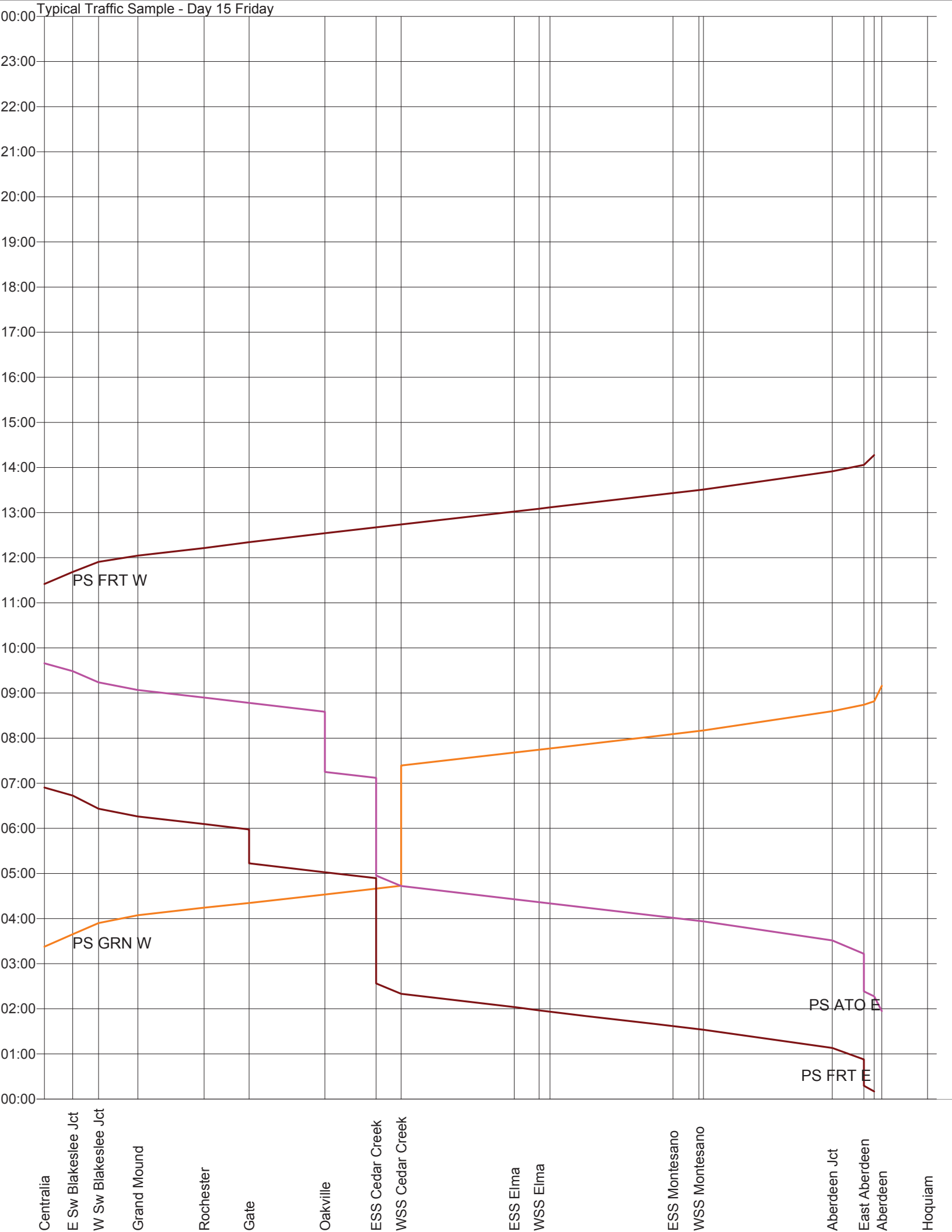
PS FRT W VIA CC
PS SHL E AB
PS SHL W AB
PS FRT E
Centralia
E Sw Blakeslee Jct
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 15 Friday
00:00
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PS FRT W
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Centralia
E Sw Blakeslee Jct
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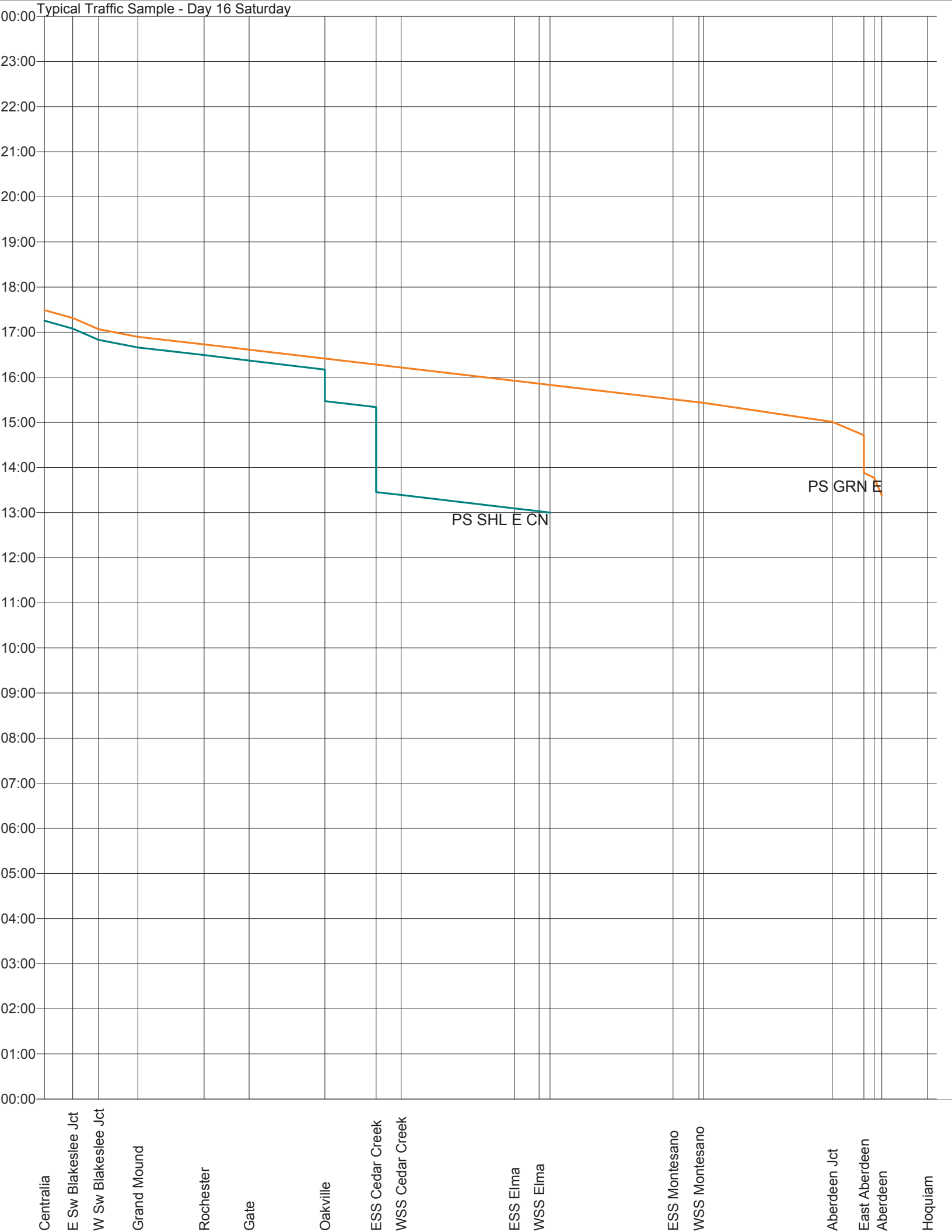
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 16 Saturday
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PS SHL E CN
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Centralia
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W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
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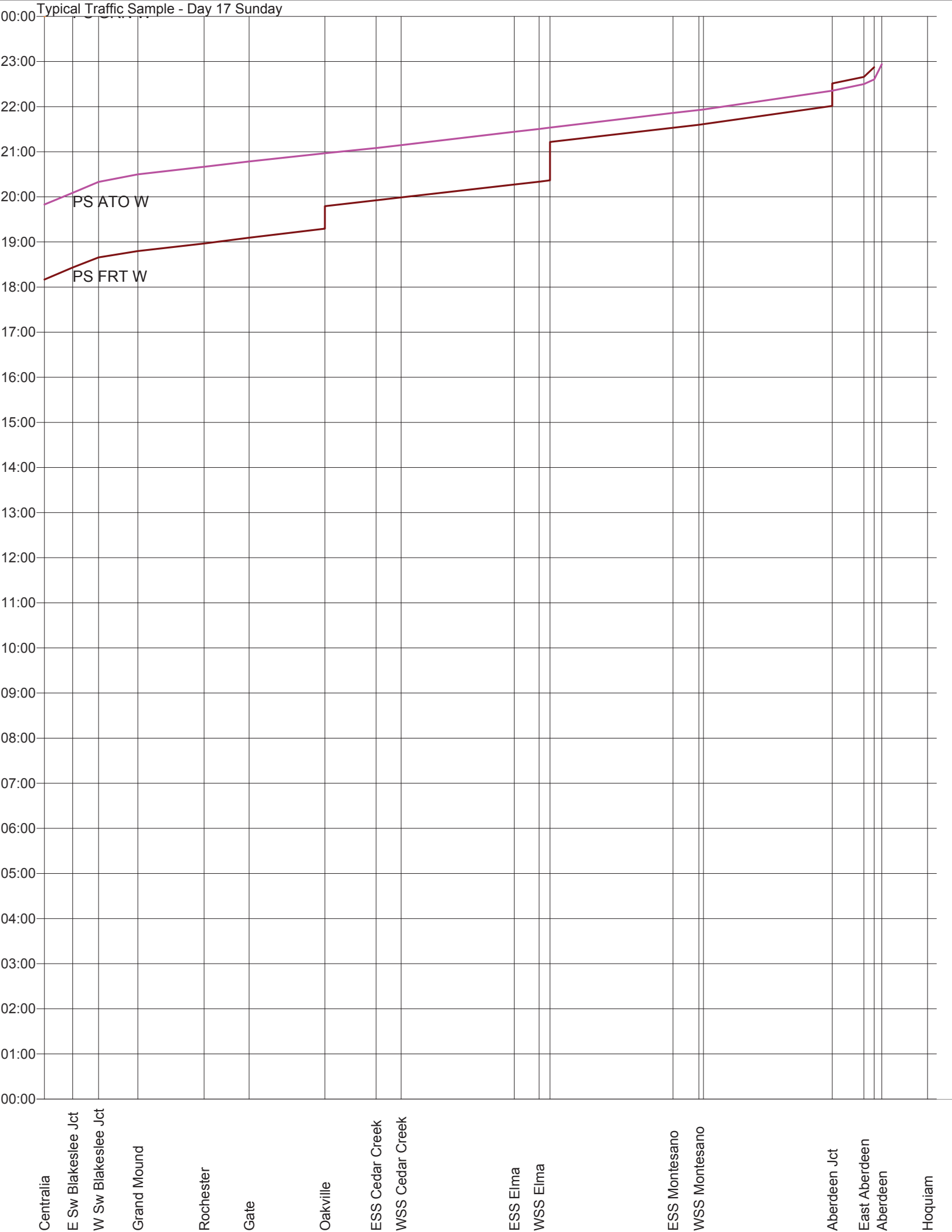
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 17 Sunday
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PS ATO W
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Centralia
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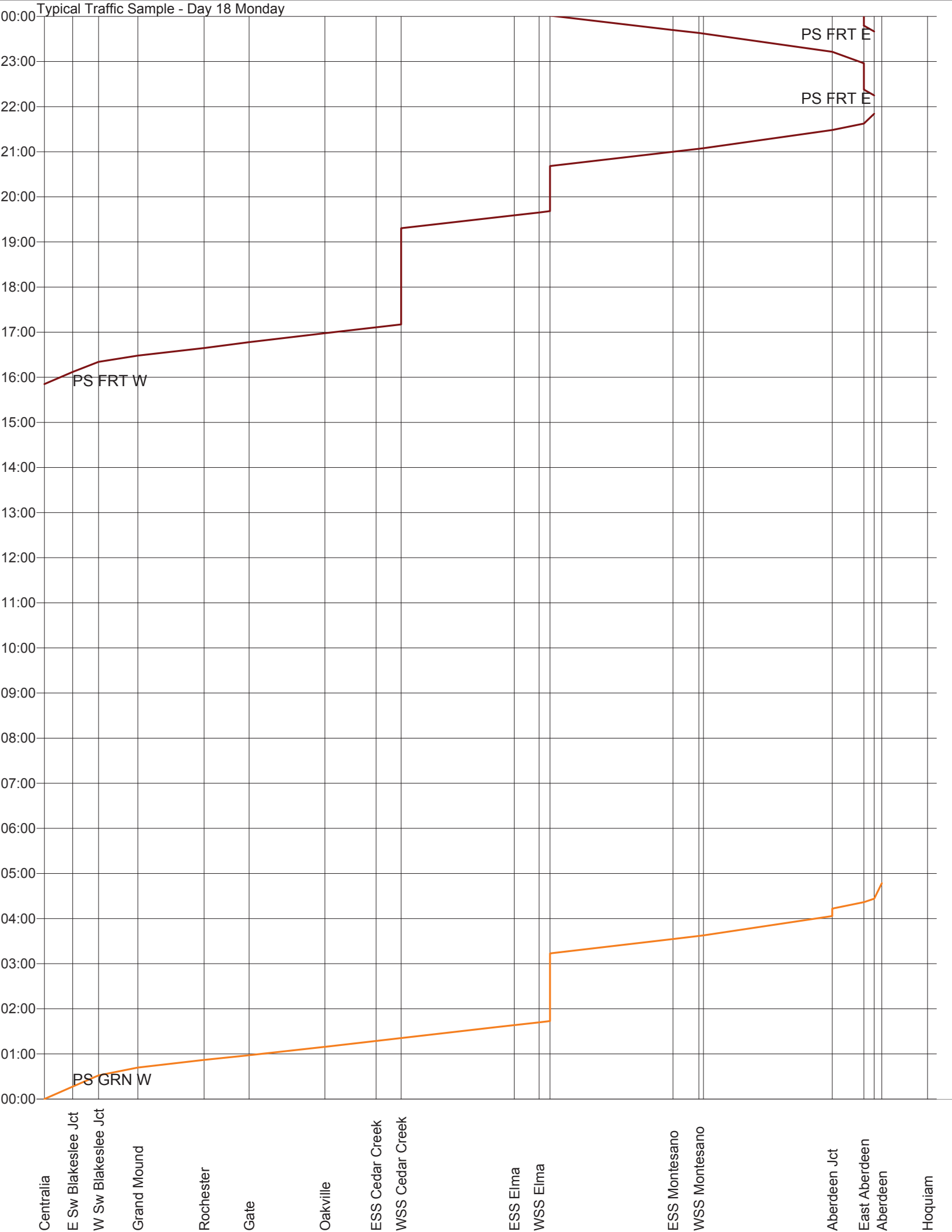
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 18 Monday
00:00
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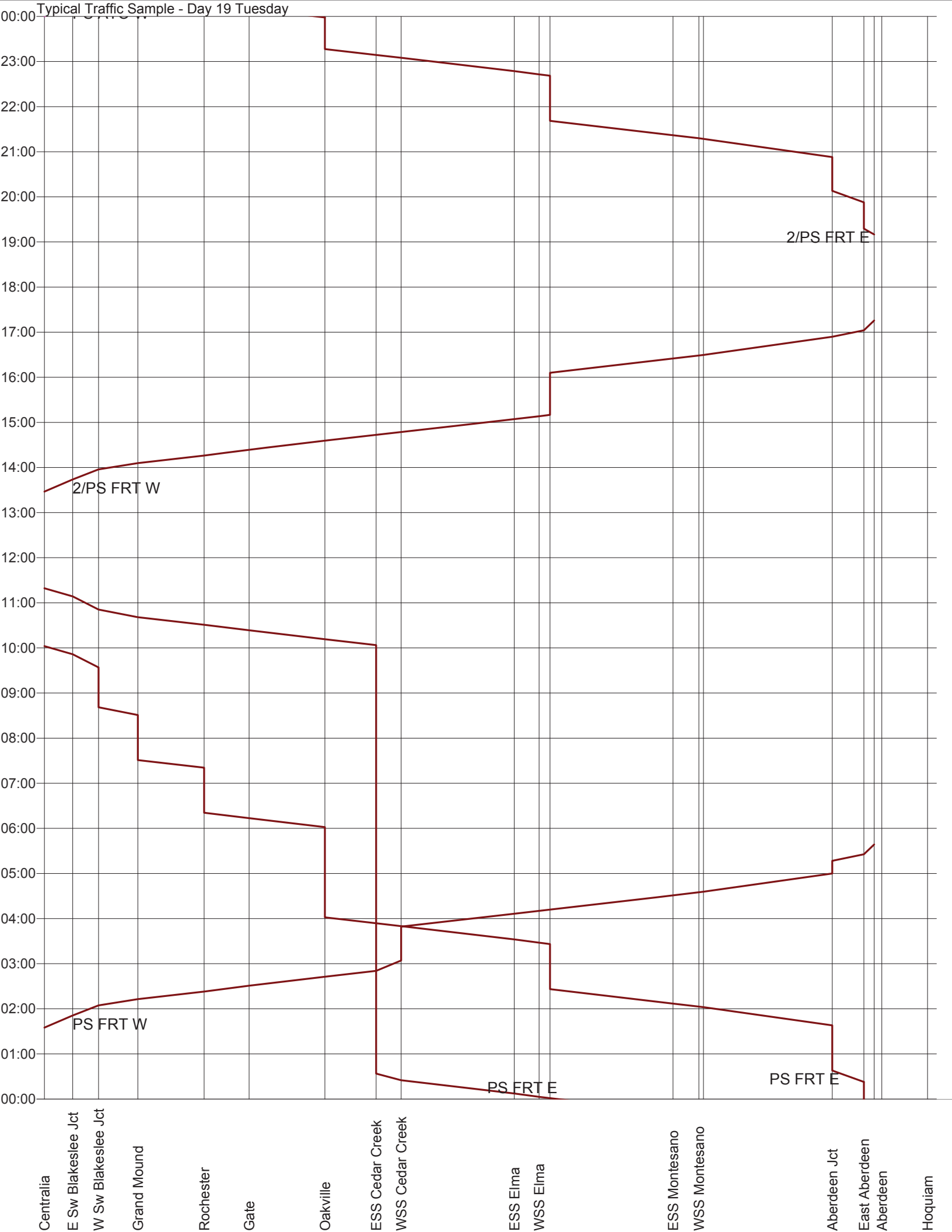
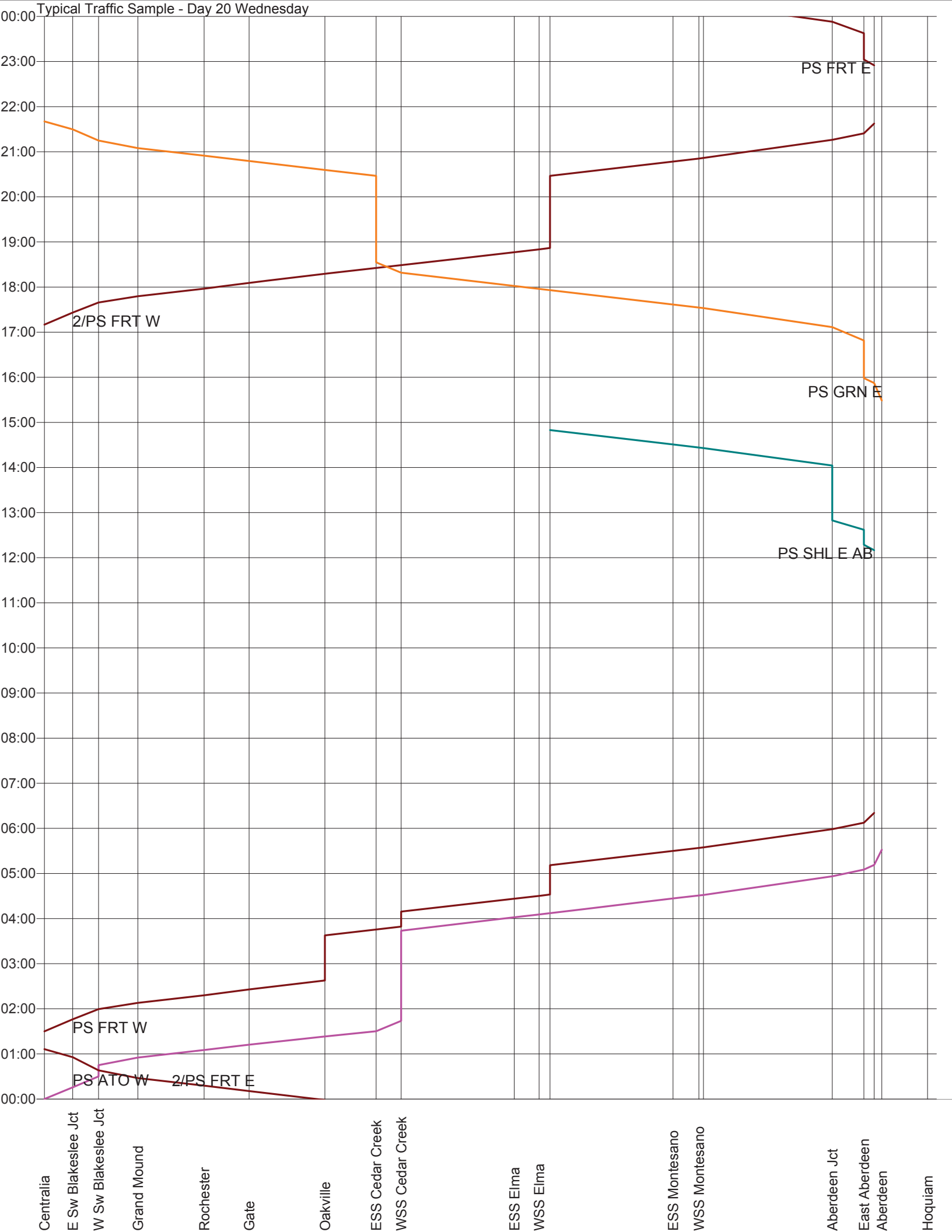
PS FRT E
PS FRT E
PS FRT W
PS GRN W
Centralia
E Sw Blakeslee Jct
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam

Typical Traffic Sample - Day 19 Tuesday




Typical Traffic Sample - Day 20 Wednesday
00:00
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PS FRT E
2/PS FRT W
PS GRN E
PS SHL E AB
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Centralia
E Sw Blakeslee Jct
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
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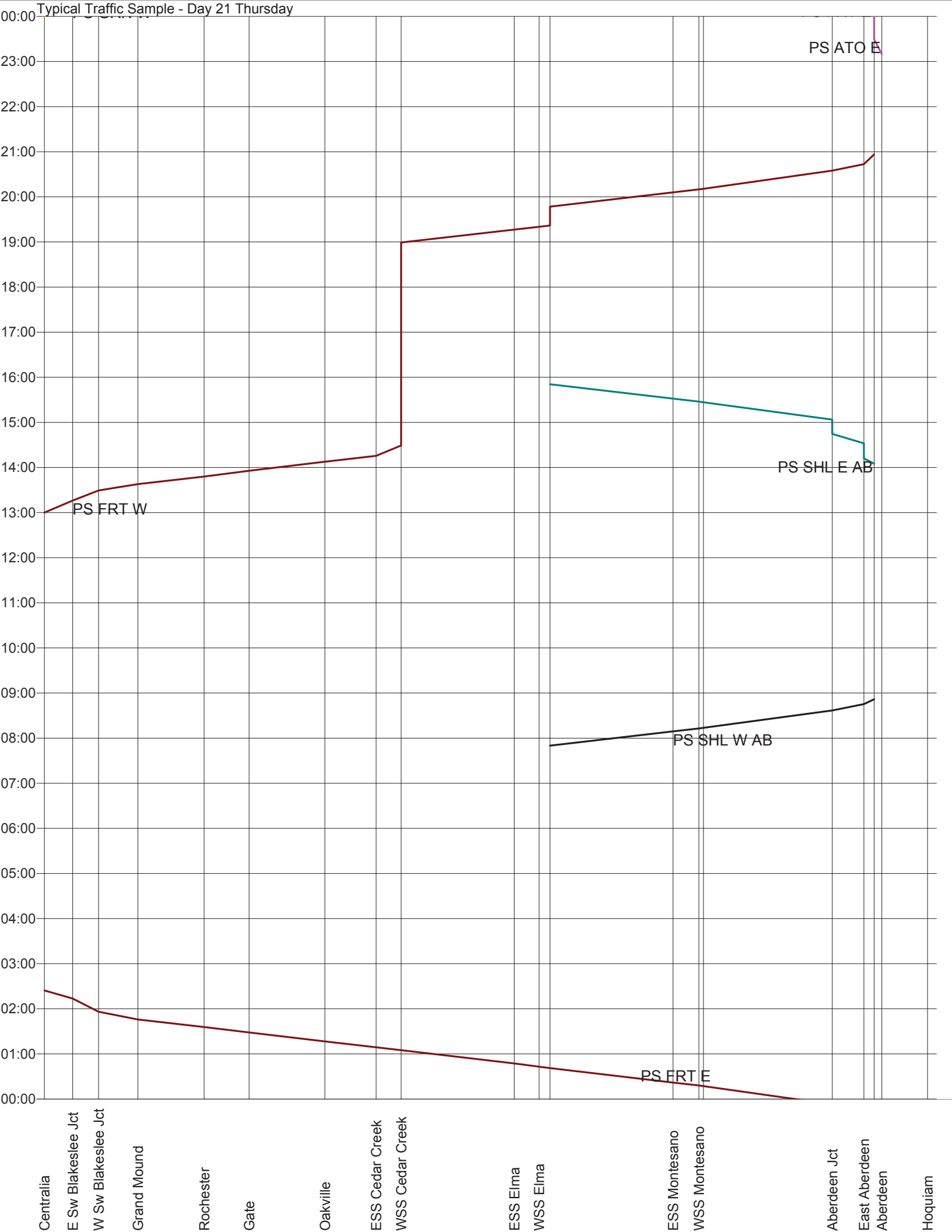
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 21 Thursday
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PS ATO E
PS SHL E AB
PS FRT W
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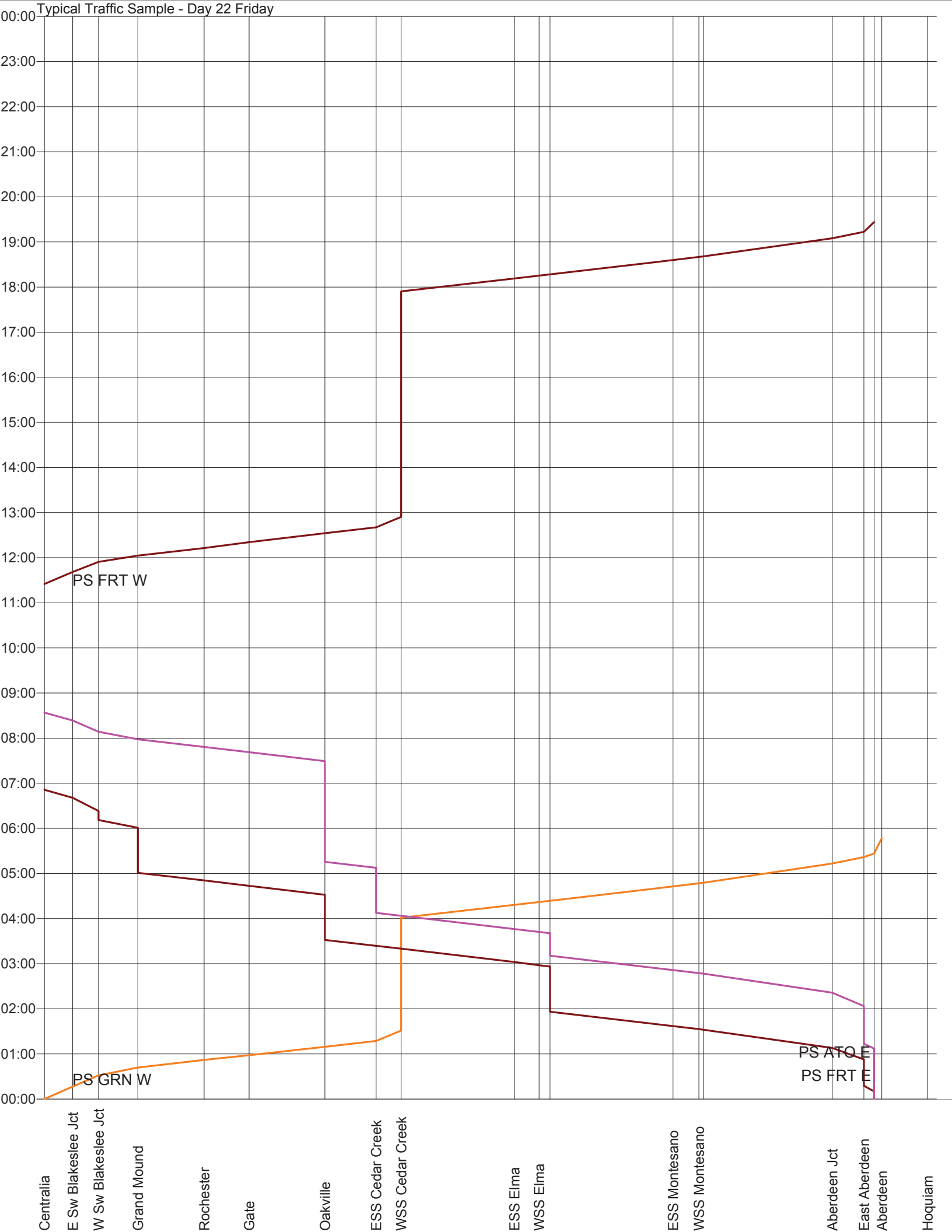
PS FRT E
Centralia
E Sw Blakeslee Jct
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 22 Friday
00:00
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PS FRT W
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Centralia
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Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
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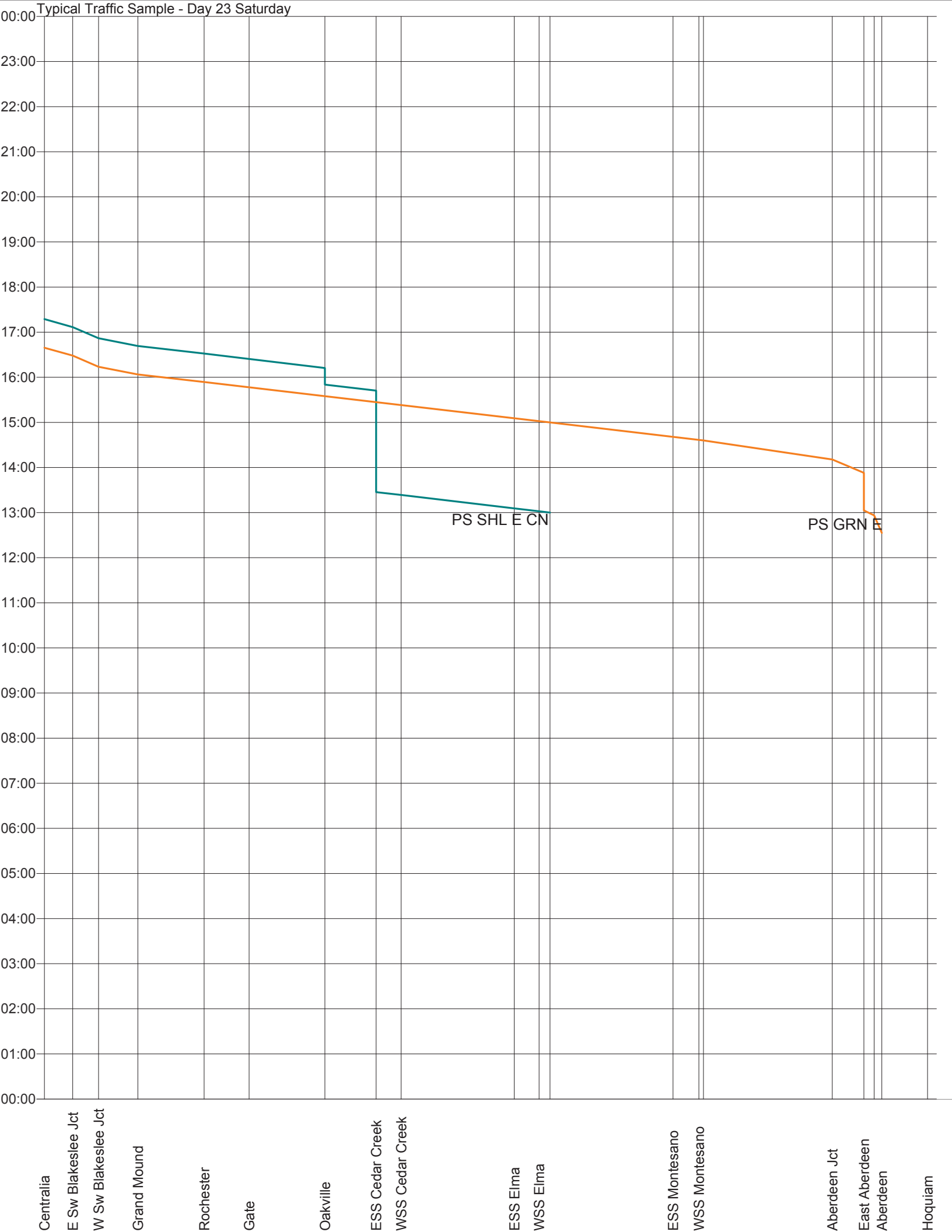
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 23 Saturday
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PS SHL E CN
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Centralia
E Sw Blakeslee Jct
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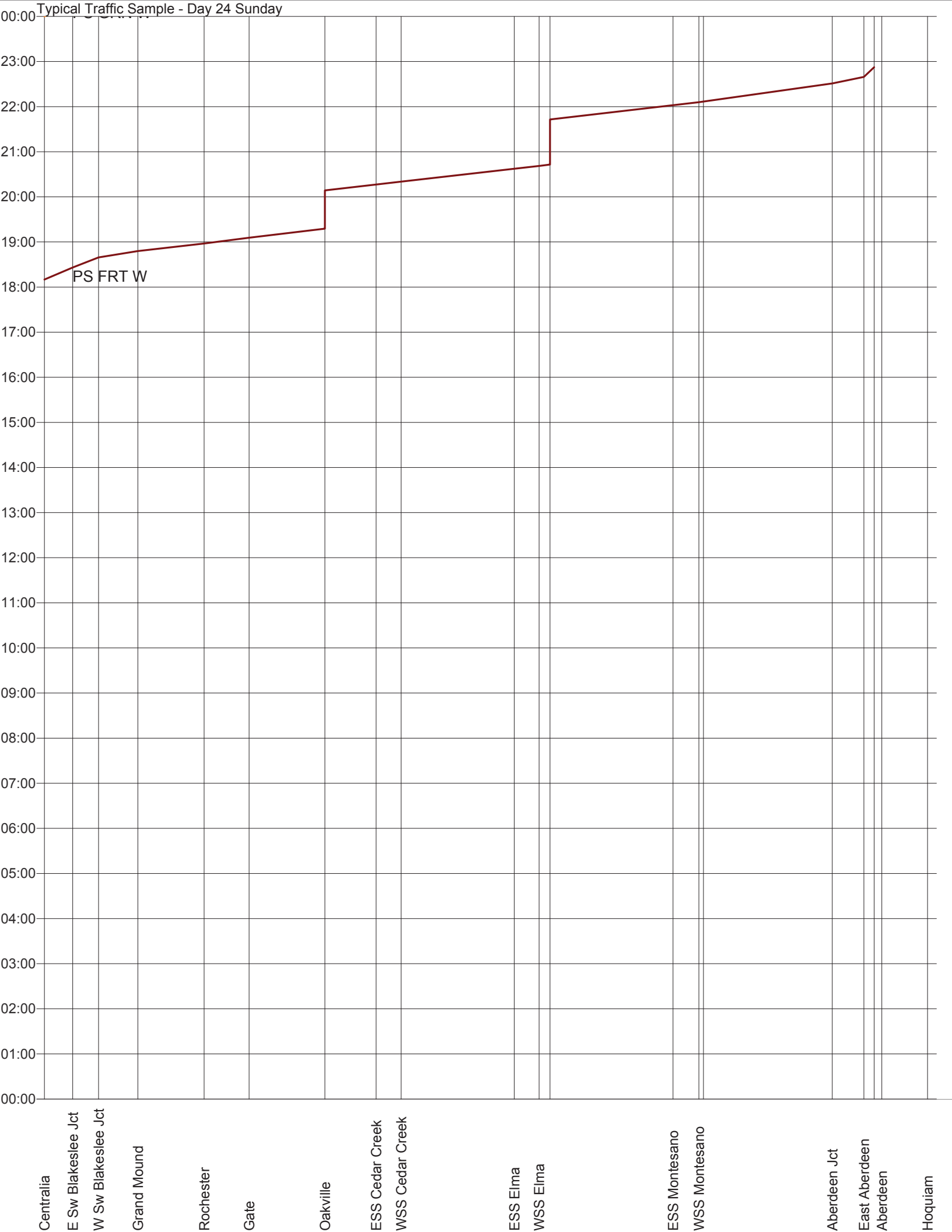
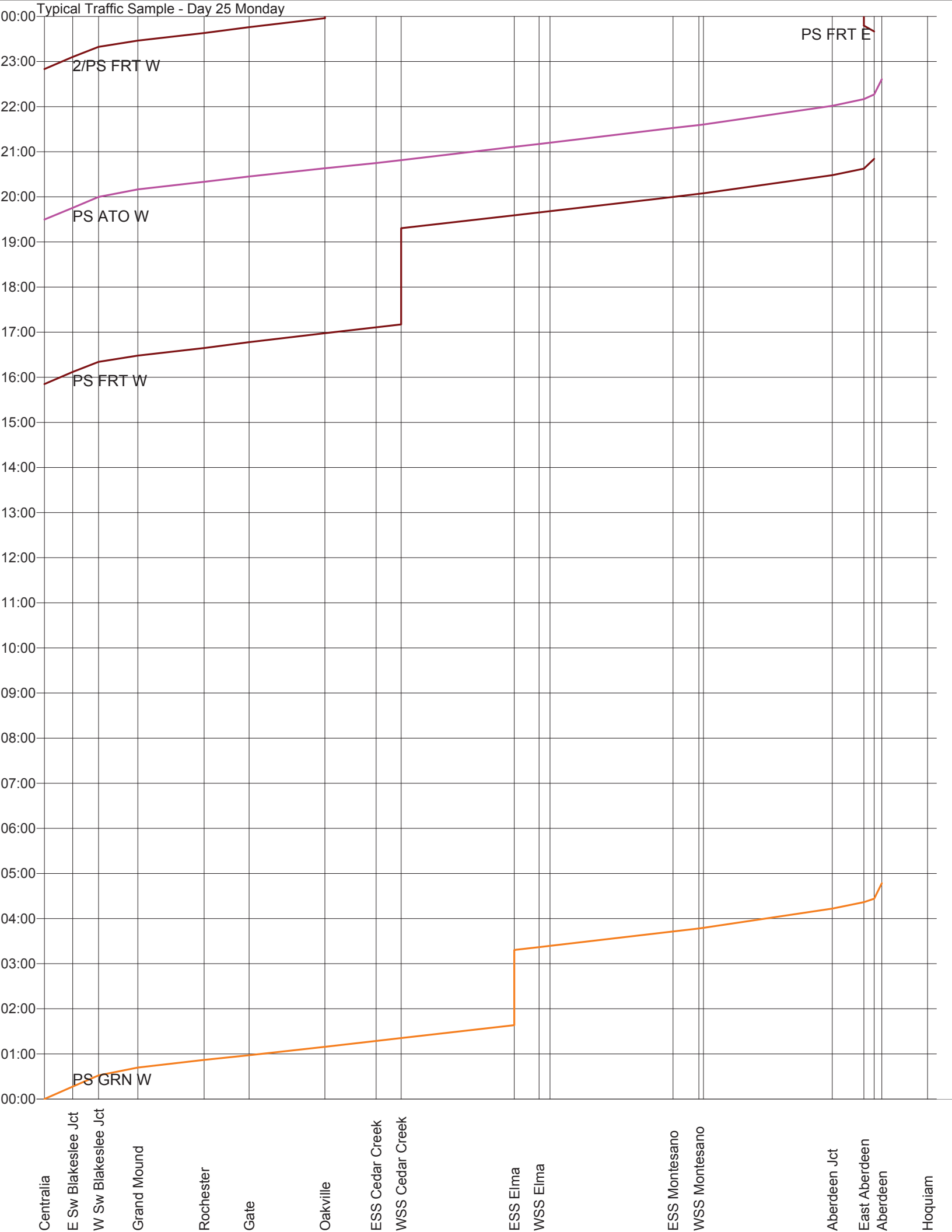
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam

Typical Traffic Sample - Day 24 Sunday




Typical Traffic Sample - Day 25 Monday
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2/PS FRT W
PS FRT E
PS ATO W
PS FRT W
PS GRN W
Centralia
E Sw Blakeslee Jct
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
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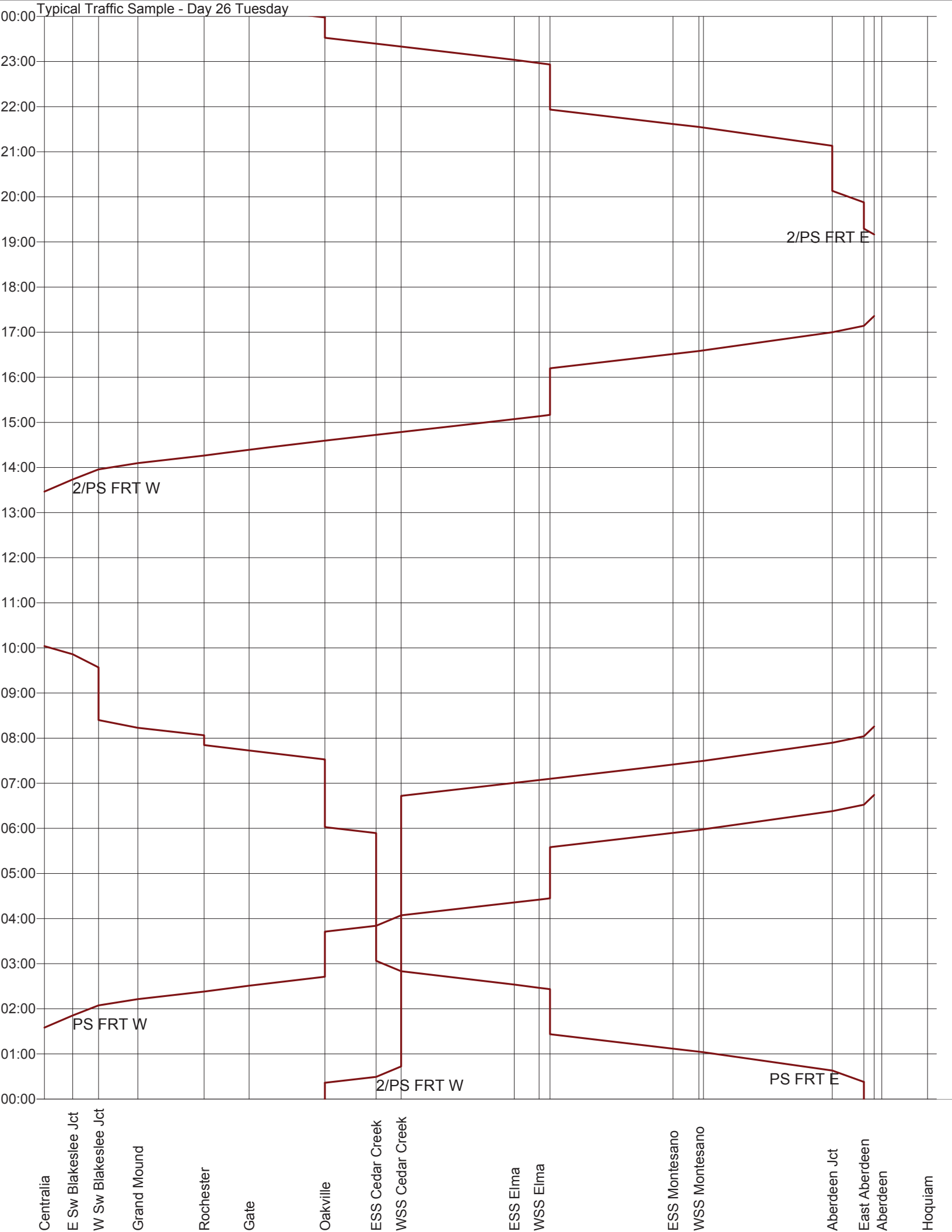
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 26 Tuesday
00:00
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2/PS FRT E
2/PS FRT W
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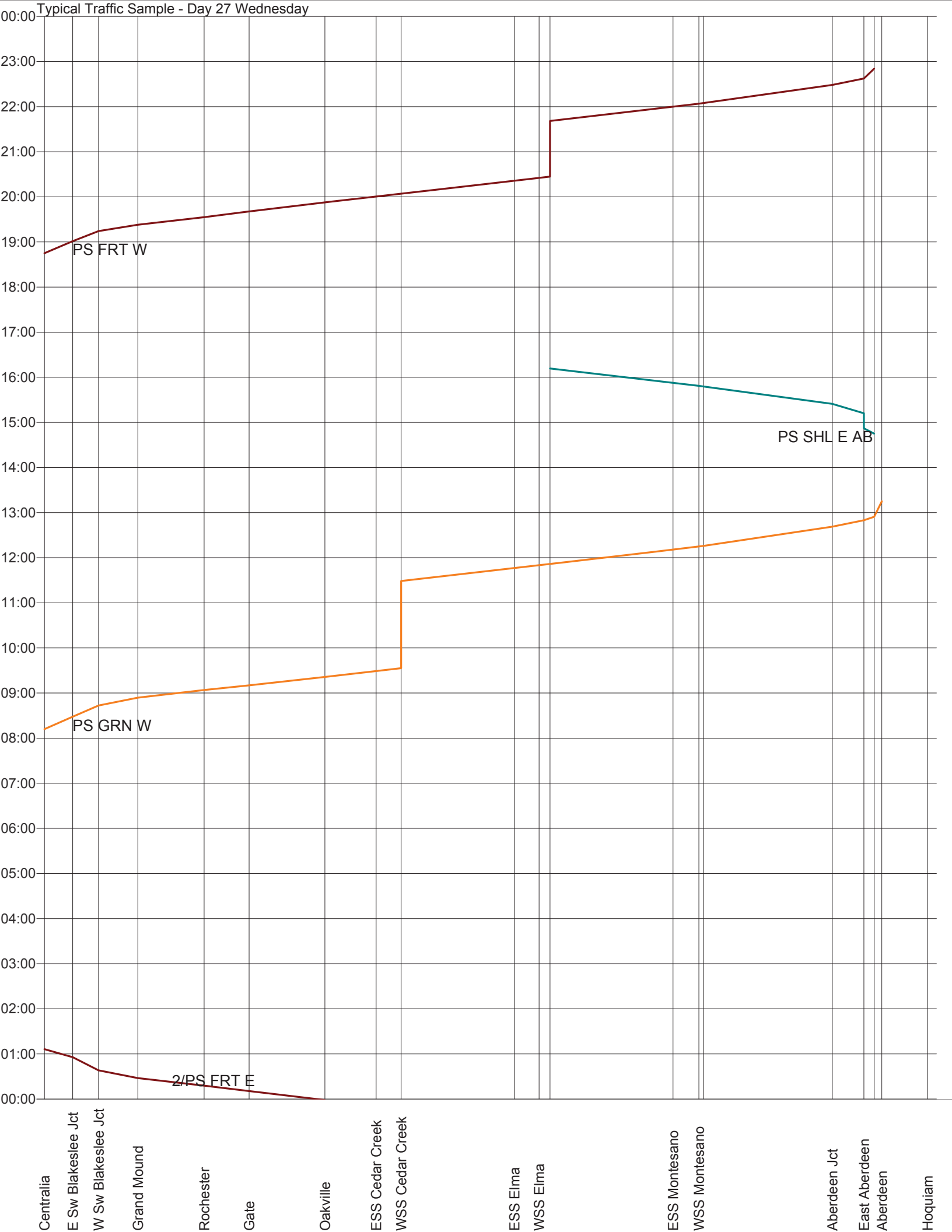
2/PS FRT W
PS FRT E
Centralia
E Sw Blakeslee Jct
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 27 Wednesday
00:00
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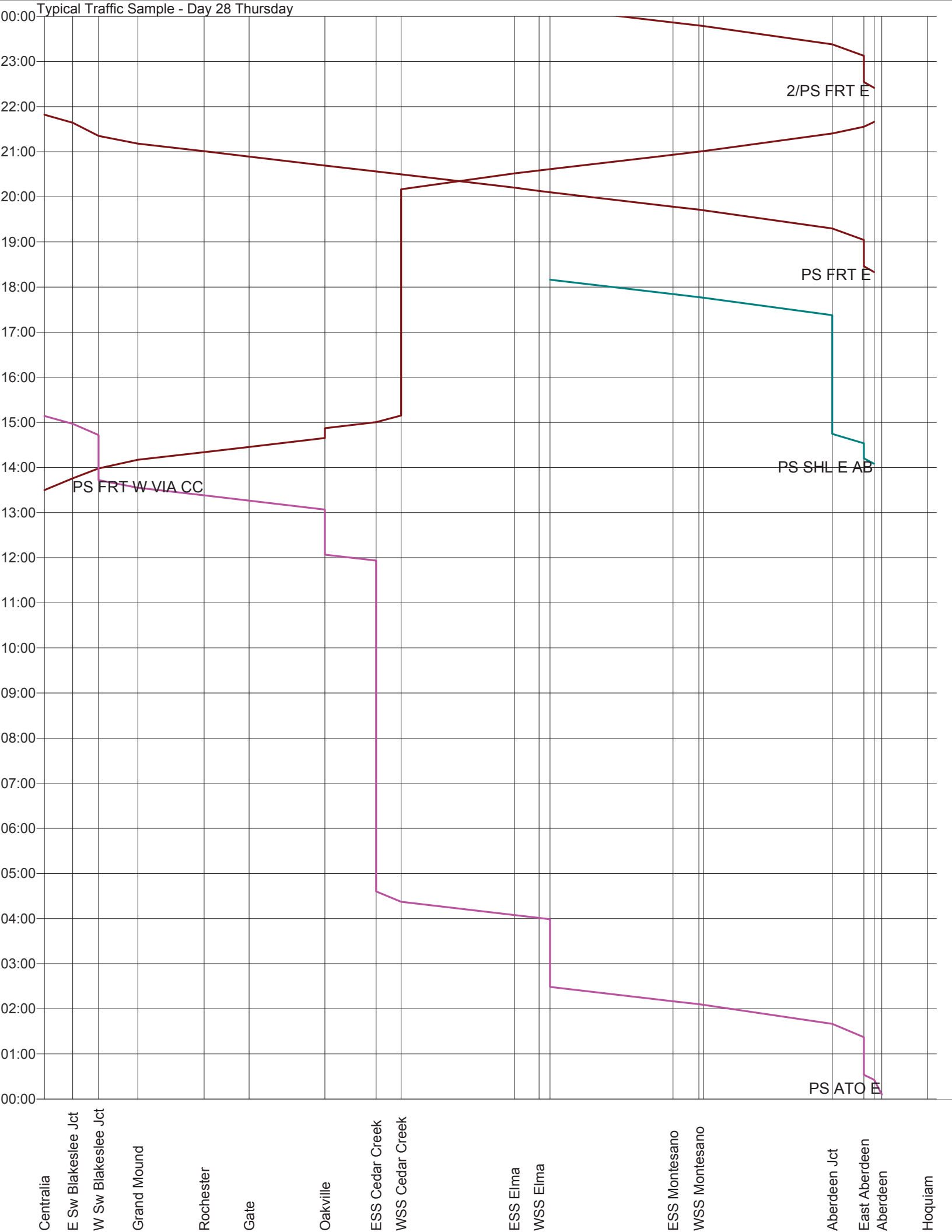
PS FRT W
PS SHL E AB
PS GRN W
2/PS FRT E
Centralia
E Sw Blakeslee Jct
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 28 Thursday
00:00
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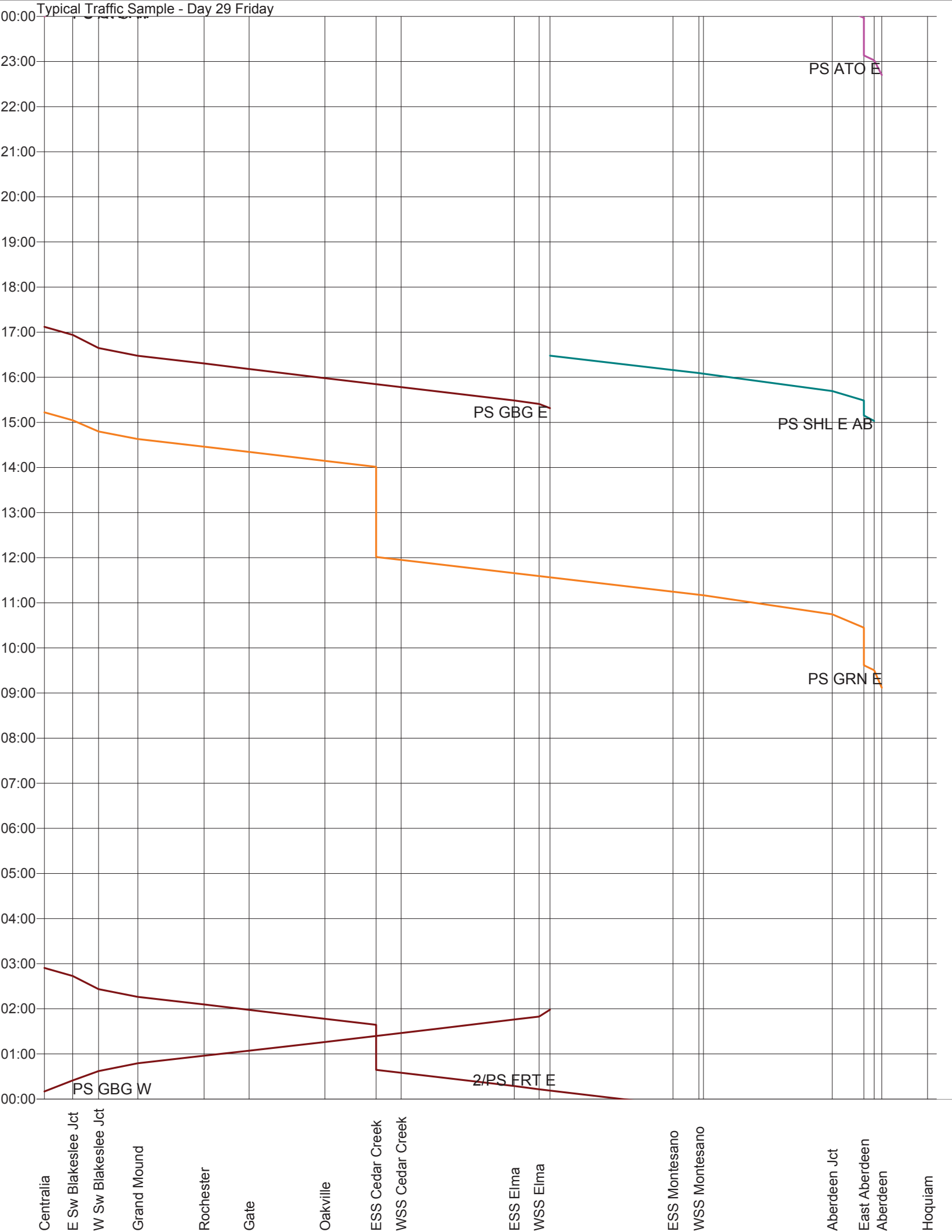
2/PS FRT E
PS FRT E
PS SHL E AB
PS FRT W VIA CC
PS ATO E
Centralia
E Sw Blakeslee Jct
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 29 Friday
00:00
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PS ATO E
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PS SHL E AB
PS GRN E
PS GBG W
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Centralia
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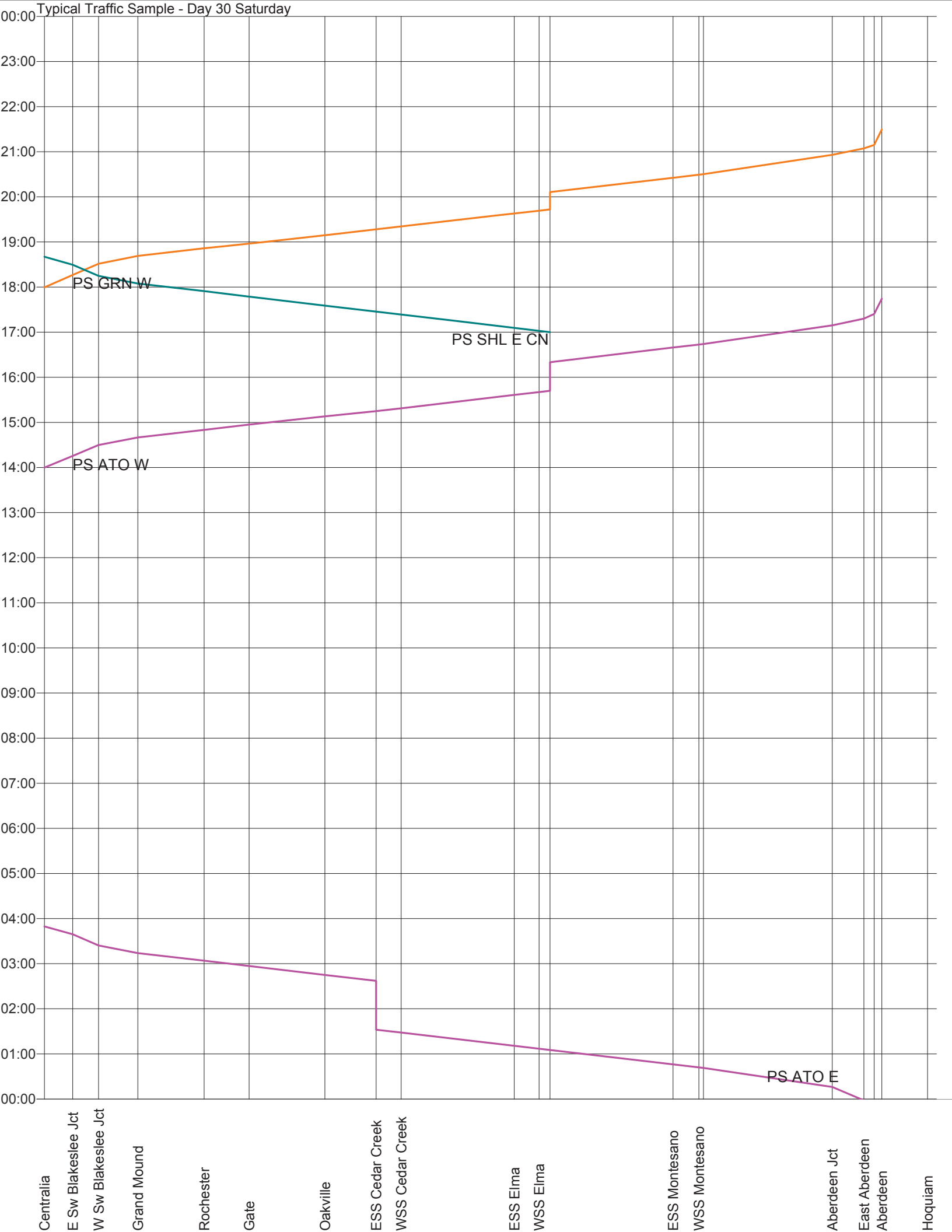
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam


Typical Traffic Sample - Day 30 Saturday
00:00
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PS GRN W
PS SHL E CN
PS ATO W
PS ATO E
Centralia
E Sw Blakeslee Jct
W Sw Blakeslee Jct
Grand Mound
Rochester
Gate
Oakville
ESS Cedar Creek
WSS Cedar Creek
ESS Elma
WSS Elma
ESS Montesano
WSS Montesano
Aberdeen Jct
East Aberdeen
Aberdeen
Hoquiam

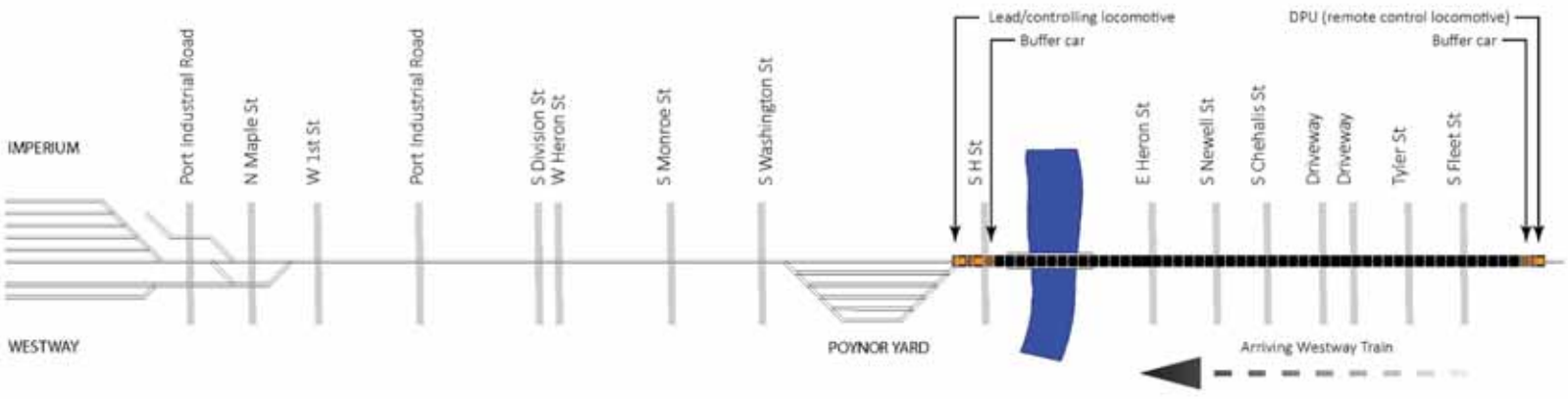
Train Name	Station Name	DEPT	Station Name	ARRV	Total Cars	Ld	Mty	Gross Weight (tons)	Total Length (feet)	HP	HP/T	Locos	Notes
CENT TURN-31	ABERDEEN	0045-1	ESSCC	224A	65	0	65	1950	3980	12000	3.1	4	TIE DOWN CEDAR CREEK
GRAIN	CENTRALIA	115A	ESSCC	419A	99	99	0	12500	6400	9000	1.5	3	TIE DOWN CEDAR CREEK
AUTO	ESSCC	422A	CENTRALIA	729A	65	0	65	1950	3980	12000	3.1	4	FROM CEDAR CREEK
CENT TURN-01	ABERDEEN	953A	ESSCC	1245	65	15	40	2865	3910	4000	1.3	2	TIE DOWN CEDAR CREEK
GRAIN	ABERDEEN	1230	CENTRALIA	2145-01	108	0	108	3215	6330	12000	3.3	3	2 CREWS
HARBOR TURN	ESSCC	1440	ABERDEEN	1630-01	99	99	0	12500	6400	9000	1.5	3	FROM CEDAR CREEK
EXTRA 02	ABERDEEN	510 A	ESSCC	0713 AM	71	0	71	2130	3500	3000	1.5	1	TIE DOWN CEDAR CREEK
SHELTON-TURN-02	ABERDEEN	1550	CENTRALIA	2310	87	64	23	8100	5450	12000	1.5	4	
EXTRA-03	ABERDEEN	751A	ELMA	1000	60	0	60	1800	3600	12000	6.2	3	
GRAIN-03	ABERDEEN	1553	CENTRALIA	1505	99	0	99	2670	6870	12000	4.2	3	
MANIFEST-03	CENTRALIA	953A	ESSCC	1215	65	50	15	5900	3950	8000	1.3	2	
CENT TURN-03	ESSCC	1646	ABERDEEN	1955	67	52	16	6323	4050	12000	1.5	4	FROM CEDAR CREEK
CENT TURN-03	ABERDEEN	2230	CENTRALIA	203-04	60	0	60	1800	3600	6000	3.1	2	
EXTRA -04	CENTRALIA	1210	ABERDEEN	1515	0	0	0	0	0	0	0	2	LITE POWER
GRAIN -04	CENTRALIA	1904	ABERDEEN	2245	100	100	0	13000	6500	12000	1	3	
CENT TURN -04	CENTRALIA	1556	ABERDEEN	2030	60	60	0	6000	3600	6000	1	2	
EXTRA -04	CENTRALIA	0101-05	ABERDEEN	0435-05	66	38	28	5100	4310	6000	1.2	2	
BANGOR TURN-05	ELMA	0920-05	CENTRALIA	1550	75	75	0	8200	4450	16000	4	4	2 CREWS
CENT TURN -05	CENTRALIA	1028	ESSCC	1218	95	95	0	12320	6654	12000	1	3	TIE DOWN CEDAR CREEK
EXTRA -05	ESSCC	2019	ABERDEEN	2247	95	95	0	12320	6654	12000	1	3	FROM CEDAR CREEK
SHELTON-TURN-05	ABERDEEN	1414	ELMA	1558	38	26	12	3200	2400	12000	4.1	4	
GRAIN -5	ABERDEEN	1734	CENTRALIA	2230	109	0	109	3310	6450	12000	4.2	4	
CENT TURN -05	CENTRALIA	1615	ABERDEEN	0120-06	72	45	27	5810	4210	8000	1.4	2	
AUTO-06	ABERDEEN	0520A	CENTRALIA	0835A	64	0	64	1930	3640	12000	6	4	
SHELTON-TURN-06	ELMA	1330	CENTRALIA	1545	94	46	48	7200	6100	12000	1.6	4	
CENT TURN -06	ABERDEEN	1815	ESSCC	2026	100	0	100	3000	6200	9000	3	3	TIE DOWN CEDAR CREEK
CENT TURN -7	CENTRALIA	2049	ABERDEEN	0614A	76	39	37	6450	4650	18000	4.1	6	
CENT TURN -7	ESSCC	0207-08	CENTRALIA	331	100	0	100	3000	6200	9000	3	3	FROM CEDAR CREEK
MANIFEST-07	ABERDEEN	900AM	CENTRALIA	1250	41	38	3	4200	2670	9000	3.3	3	
EXTRA -07	CENTRALIA	1405	ABERDEEN	1750	75	75	0	7500	5200	8000	1.1	2	
CENT TURN -08	ABERDEEN	0050A	CENTRALIA	758A	68	0	68	1940	4850	8000	4	2	
EXTRA -08	ABERDEEN	1240	CENTRALIA	1710	95	0	95	2750	6000	9000	3.3	3	
SHELTON TURN	ELMA	1415	ABERDEEN	1600	26	10	16	1450	1510	8000	3.5	4	
GARBAGE-09	CENTRALIA	1257	ESSCC	1710	48	0	48	1460	3123	9000	5.8	3	
GRAIN-09	CENTRALIA	1820	ABERDEEN	2145	102	102	0	12800	6450	12000	1	3	
GRAIN-10	CENTRALIA	100AM	ABERDEEN	1230	108	108	0	13400	6750	12000	0.9	3	2 CREWS
CENT -TURN 10	CENTRALIA	1900	ABERDEEN	2230	82	72	10	9432	6345	12000	1.3	3	
EXTRA -11	ESSCC	2230	ABERDEEN	0005-12	25	18	7	2815	1850	8000	3.3	4	FROM CEDAR CREEK
GARBAGE-11	WSSCC	0240A	ELMA	0338A	48	0	48	1510	3200	9000	6	3	
MANIFEST -11	ABERDEEN	1132	ESSCC	1410	87	41	46	6410	4810	9000	2	3	TIE DOWN CEDAR CREEK
CENT TURN-11	ESSCC	2032	CENTRALIA	2236	60	60	0	2215	3610	9000	1.2	3	FROM CEDAR CREEK
CENT TURN-12	ABERDEEN	0030A	CENTRALIA	646AM	94	0	95	2790	6400	9000	2.6	3	
AUTO-12	ABERDEEN	231A	CENTRALIA	0819AM	65	0	65	1945	3960	8000	4	2	
MANIFEST -12	ESSCC	0821A	ABERDEEN	1142	87	41	46	6450	5280	9000	1.3	3	
CENT TURN-12	CENTRALIA	1605	ABERDEEN	2000	58	58	0	5800	3670	6000	1	2	

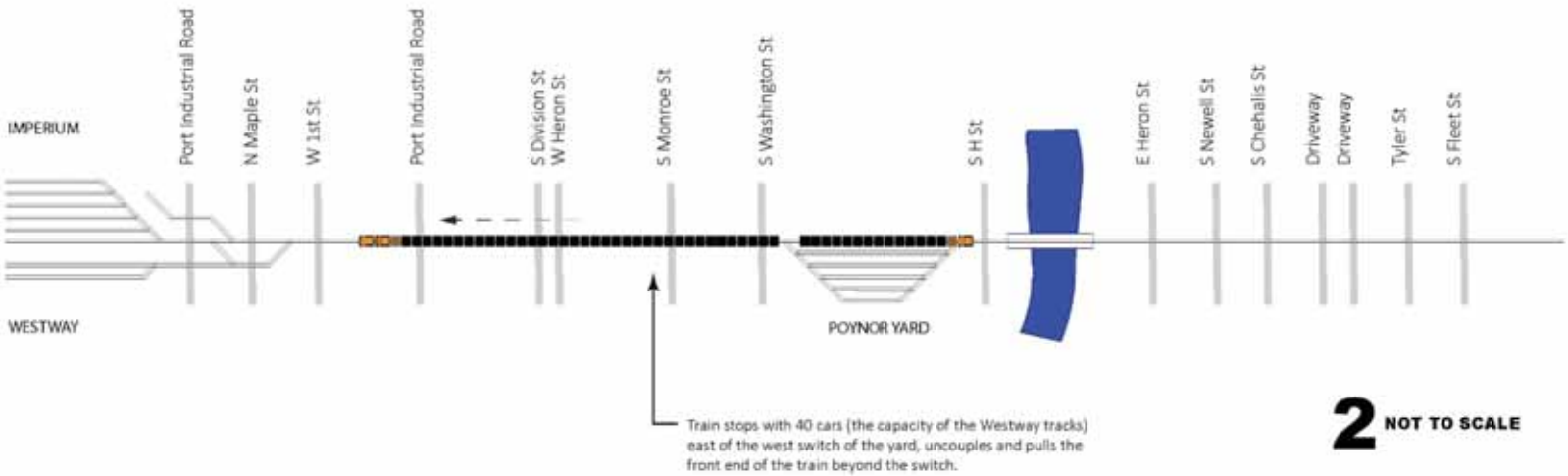
CENT TURN -13	CENTRALIA	130	ABERDEEN	615	51	23	28	3850	3210	6000	1.5	3	
SHELTON TURN -13	ABERDEEN	1230	ELMA	1450	43	9	34	1830	2810	8000	4.2	4	
GRAIN -13	ABERDEEN	1532	CENTRALIA	2030	111	0	1111	3330	6660	9000	3	3	
CENT TURN -13	CENTRALIA	1710	ABERDEEN	2130	88	56	32	7800	5400	8000	1	2	
AUTO -13	CENTRALIA	2136	ESSCC	2305	32	32	0	3600	2150	9000	2.6	3	TIE DOWN CEDAR CREEK
CENT TURN -13	ABERDEEN	2330PM	CENTRALIA	0220AM	50	20	30	3500	3240	6000	1.5	2	
SHELTON TURN -14	ELMA	750AM	ABERDEEN	900	25	21	4	2450	2610	6000	2.2	3	
SHELTON TURN -14	ABERDEEN	1425	ELMA	1551	14	4	10	1850	900	8000	4.4	4	
CENT TURN	ESSCC	1900	ABERDEEN	2051	48	35	13	4200	3100	8000	2	4	
CENT TURN -14/15	ABERDEEN	0045 -15	CENTRALIA	645	80	58	22	7400	5600	8000	1.1	3	2 CREWS
AUTO-15	ABERDEEN	200AM	CENTRALIA	0830A	80	0	80	2400	6300	9000	3.3	3	2 CREWS
GRAIN	CENTRALIA	323A	ABERDEEN	1452	101	101	0	13500	6410	12000	0.9	3	2 CREWS
EXTRA 15	CENTRALIA	1125	ESSCC	1300	60	0	60	1800	3600	9000	3.7	3	
GRAIN -16	ABERDEEN	1326	CENTRALIA	1515	108	0	107	3330	6660	9000	2.8	3	
SHELTON TURN	ESSCC	1520	CENTRALIA	1715	76	75	1	7800	4900	9000	1.2	3	FROM CEDAR CREEK
CENT TRN 17	CENTRALIA	1810	ABERDEEN	2247	90	59	31	7100	6300	8000	1	2	
CENT TRN 18	ABERDEEN	2250	ESSCC	0030AM	9	3	6	510	540	8000	16	4	TIE DOWN CEDAR CREEK
GRAIN -18	CENTRALIA	0843A	ABERDEEN	1315	97	97	0	9800	6250	12000	1.2	3	
CENT TRN 18	CENTRALIA	1551	ABERDEEN	2045	49	20	29	4100	3450	6000	1.5	2	
AUTO -18	CENTRALIA	1930	ESSCC	2321	73	73	0	7300	4900	8000	1.1	2	
CENT TRN 18/19	ABERDEEN	0015-19	CENTRALIA	956	42	36	6	4100	3450	6000	1.5	2	2 CREWS
CENT TURN 19	CENTRALIA	135 AM	ABERDEEN	533	70	0	70	2100	4600	8000	4	2	
EXTRA -19	CENTRALIA	1328	ABERDEEN	1710	86	74	12	8100	4950	8000	1	2	
CENT TURN 19	ABERDEEN	1945	CENTRALIA	0100 am	18	0	18	640	1400	6000	10	2	
GRAIN -20	CENTRALIA	812	ABERDEEN	1300	109	109	0	13000	6700	12000	0.9	3	
SHELTON TURN 20	ABERDEEN	1505	ELMA	1615	47	7	40	2100	3400	8000	4	4	
CENT TURN -20	CENTRALIA	1845	ABERDEEN	2245	105	91	14	10400	6700	12000	1.2	4	
AUTO -21	ABERDEEN	0009AM	CENTRALIA	258A	65	0	65	1940	4200	8000	4	2	
MANIFEST 21	CENTRALIA	1330	ESSCC	1500	38	13	25	2210	2400	4000	2	2	
SHELTON TURN	ABERDEEN	1425	ELMA	1810	22	19	2	2100	1240	8000	4	4	WORK
CENT TURN -21	ABERDEEN	1855	CENTRALIA	2135	96	0	96	2850	6300	9000	3.2	3	
CENT TURN -21	WSSCC	2010	ABERDEEN	2115	38	13	25	2210	2400	4000	2	2	
CENT TURN -21/22	ABERDEEN	2300-21	CENTRALIA	1358	36	33	3	3600	2150	6000	1.6	2	2 CREWS
GARBAGE -22	CENTRALIA	0010A	ESSCC	0150AM	78	78	78	8400	4800	9000	1	3	TIE DOWN CEDAR CREEK
GRAIN-22	ABERDEEN	1000	CENTRALIA	1453	96	0	96	3210	6100	9000	3	3	
GARBAGE -22 R/C	WSSCC	1430	CENTRALIA	1700	78	78	78	8400	4800	9000	1	3	FROM CEDAR CREEK
SHELTO TURN-22	ABERDEEN	1522	ELMA	1620	29	14	15	2810	2100	6000	2.2	3	
AUTO-22	ABERDEEN	2245	CENTRALIA	0232A	70	0	70	2100	4300	8000	4	2	
AUTO-23	CENTRALIA	1400	ABERDEEN	1723	42	42	0	4200	2850	8000	2	2	
SHELTO TURN-23	ELMA	1700	CENTRALIA	1820	19	7	12	1040	1450	10000	10	5	
GRAIN-23	CENTRALIA	1800	ABERDEEN	2115	109	109	0	13900	6800	12000	0.9	3	
CENT TURN-24	CENTRALIA	710AM	WSSCC	910A	49	49	0	4900	3500	8000	1.5	2	TIE DOWN CEDAR CREEK
CENT TURN-24	CENTRALIA	1815	ABERDEEN	2147	87	58	29	7456	5230	8000	1	2	
CENT TURN-24	ABERDEEN	2315	CENTRALIA	120AM	29	9	20	1540	2100	8000	4	4	
GRAIN -25	ABERDEEN	830	CENTRALIA	1230	109	0	109	3300	6543	12000	3.8	4	
CENT TURN-25	CENTRALIA	1730	ABERDEEN	2050	48	37	11	4600	2850	8000	1.6	2	
SHELTO TURN-25	CENTRALIA	1249	ELMA	1418	40	8	32	1900	2650	8000	4.2	4	
GRAIN -25	WSSCC	1500	ABERDEEN	1828	49	0	4900	4900	3500	8000	1.5	2	
GRAIN -26	CENTRALIA	2232	ABERDEEN	0341-27	97	97	0	12500	6300	12000	1	3	

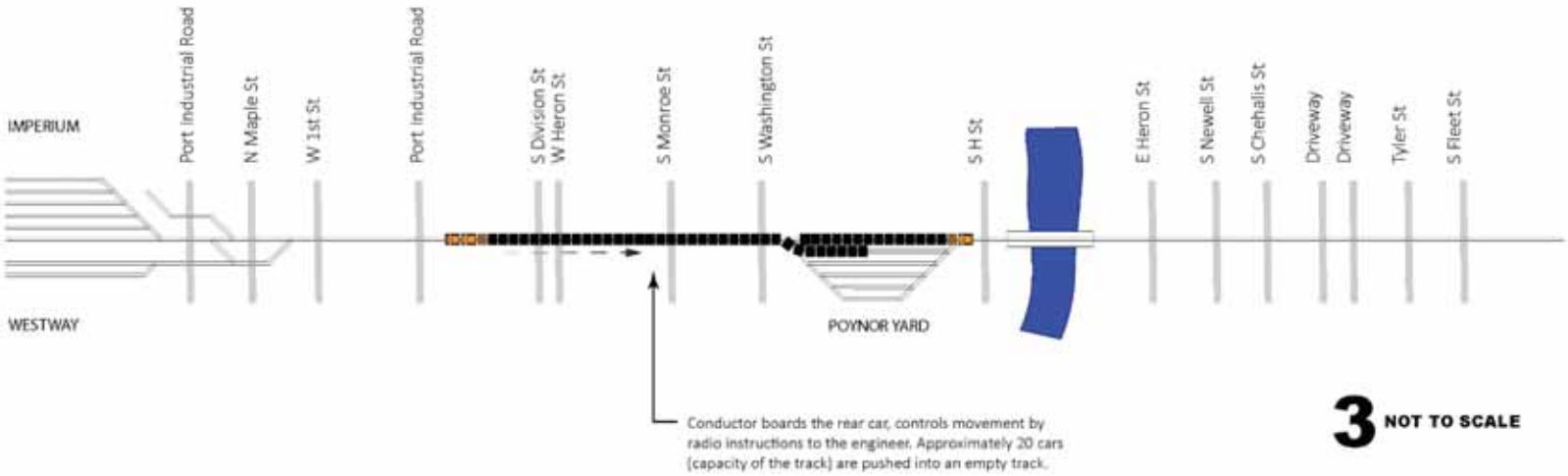
AUTO -26	ABERDEEN	2320	CENTRALIA	0205AM	70	0	70	2100	4200	8000	4	2	
SHELTON TURN 26	ELMA	1300	ABERDEEN	1415	24	18	6	2400	1800	8000	3.3	3	
GRAIN -26---2ND	CENTRALIA	1613	ABERDEEN	1945	110	110	0	14500	7200	1200	0.8	3	
CENT TURN-26	CENTRALIA	1645	ABERDEEN	2154	56	28	27	4100	3850	4000	1	2	
CENT TURN-26	ABERDEEN	2330	CENTRALIA	220	31	13	18	2100	2200	4000	2	2	
SHELTON TURN 27	ABERDEEN	1201	ELMA	1315	25	2	23	850	1510	8000	9	4	
GRAIN-27	ABERDEEN	1250	CENTRALIA	1620	97	0	97	3100	6600	12000	4	3	
AUTO -27	CENTRALIA	1300	ABERDEEN	0030AM	64	64	0	6700	4200	8000	1.3	2	2 CREWS
AUTO -27	ABERDEEN	1832	CENTRALIA	2350	68	0	68	2100	4200	12000	6	4	
AUTO -28	CENTRALIA	0636A	WSSCC	828	69	69	0	7100	4870	8000	1.1	2	TIE DOWN CEDAR CREEK
AUTO -29	ESSCC	2340PM	ABERDEEN	0100AM-30	69	69	0	7100	4870	8000	1.1	2	FROM CEDAR CREEK
GRAIN -29	CENTRALIA	2334	ABERDEEN	0215AM	100	100	0	13000	6300	16000	1.4	4	
GRAIN -29	ABERDEEN	1000	CENTRALIA	1500	107	0	107	3300	6600	12000	3.3	4	
SHELTON TURN 29	CENTRALIA	1115	ESSCC	1304	69	3	66	2600	4358	6000	2.4	3	TIE DOWN CEDAR CREEK
EXTRA 29	ABERDEEN	2100	CENTRALIA	2330	70	0	70	2100	4200	9000	4.5	3	
ELMA X 30	CENTRALIA	1836	ESSCC	2005	66	66	0	6000	4100	12000	2	4	TIE DOWN CEDAR CREEK
GRAIN -30	CENTRALIA	1947	ABERDEEN	0300 -01	106	106	0	13600	6800	12000	0.9	3	

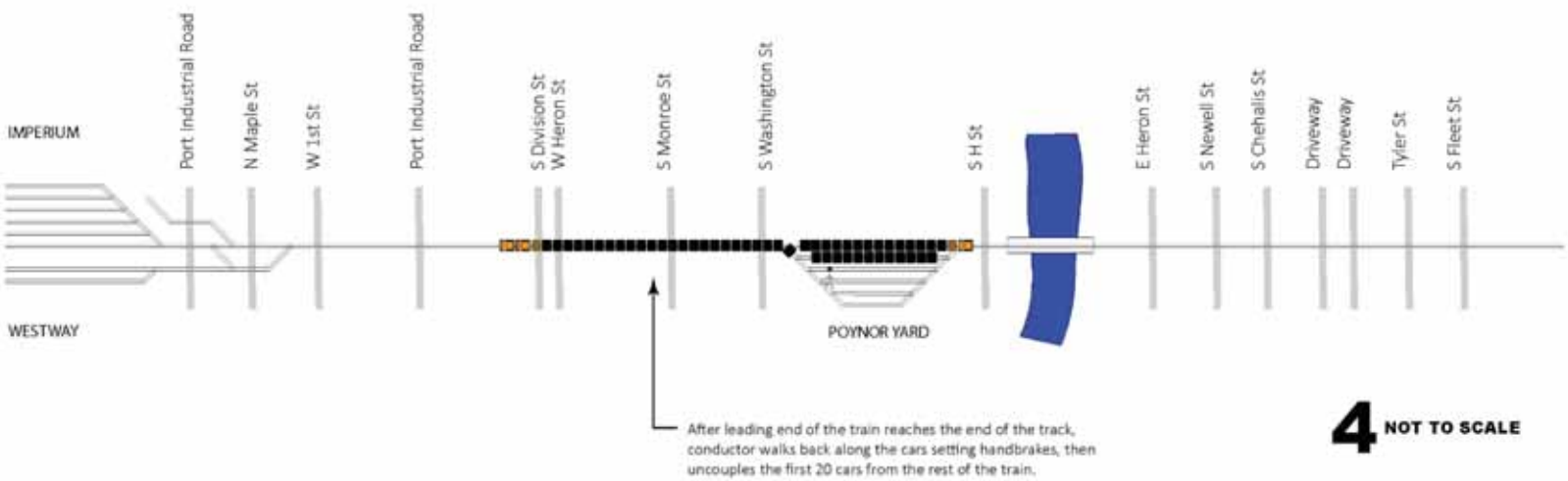
Section K.3

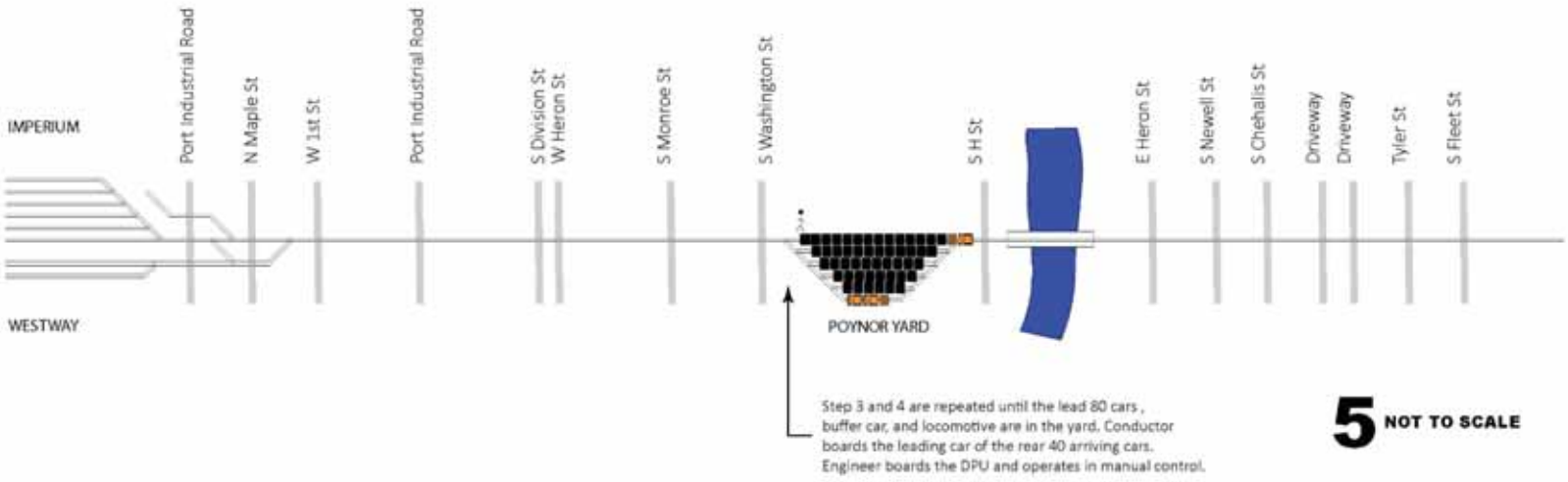
Proposed Switching Operations


Lead/controlling locomotive
Buffer car
DPU (remote control locomotive)
Buffer car
IMPERIUM
Port Industrial Road
N Maple St
W 1st St
Port Industrial Road
S Division St
W Heron St
S Monroe St
S Washington St
S H St
E Heron St
S Newell St
S Chehalis St
Driveway
Driveway
Tyler St
S Fleet St
WESTWAY
POYNOR YARD
Arriving Westway Train
1 NOT TO SCALE

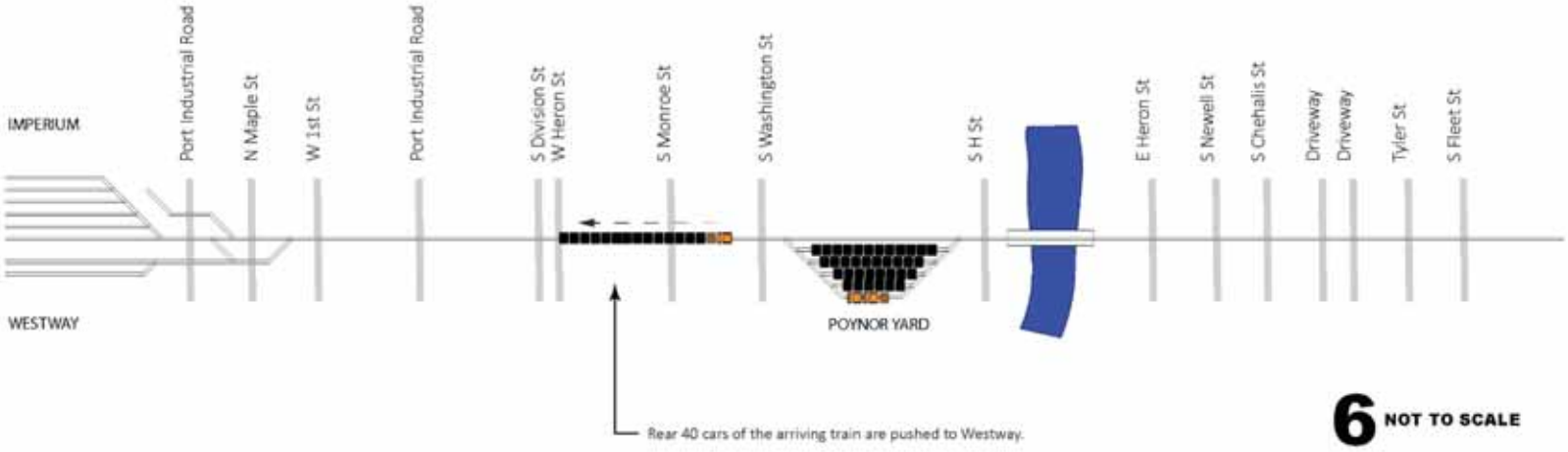

IMPERIUM
Port Industrial Road
N Maple St
W 1st St
Port Industrial Road
S Division St
W Heron St
S Monroe St
S Washington St
S H St
E Heron St
S Newell St
S Chehalis St
Driveway
Driveway
Tyler St
S Fleet St
WESTWAY
POYNOR YARD
Train stops with 40 cars (the capacity of the Westway tracks) east of the west switch of the yard, uncouples and pulls the front end of the train beyond the switch.
2 NOT TO SCALE


IMPERIUM
WESTWAY
Port Industrial Road
N Maple St
W 1st St
Port Industrial Road
S Division St
W Heron St
S Monroe St
S Washington St
S H St
E Heron St
S Newell St
S Chehalis St
Driveway
Driveway
Tyler St
S Fleet St
POYNOR YARD
Conductor boards the rear car, controls movement by radio instructions to the engineer. Approximately 20 cars (capacity of the track) are pushed into an empty track.
3 NOT TO SCALE

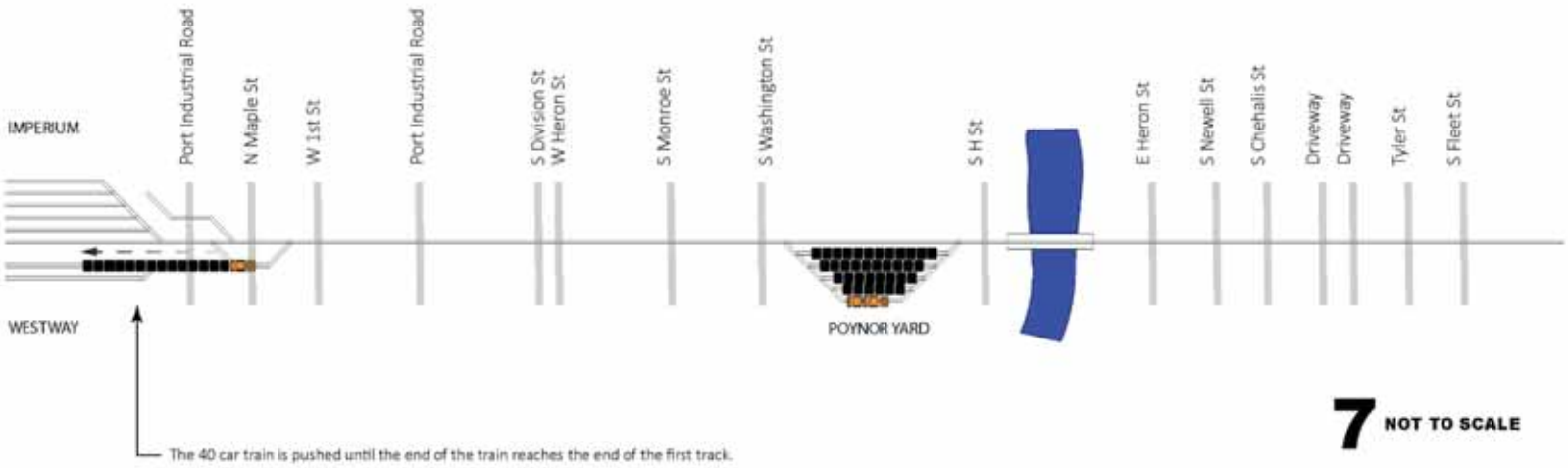

IMPERIUM
WESTWAY
Port Industrial Road
N Maple St
W 1st St
Port Industrial Road
S Division St
W Heron St
S Monroe St
S Washington St
S H St
E Heron St
S Newell St
S Chehalis St
Driveway
Driveway
Tyler St
S Fleet St
POYNOR YARD
After leading end of the train reaches the end of the track, conductor walks back along the cars setting handbrakes, then uncouples the first 20 cars from the rest of the train.
4 NOT TO SCALE



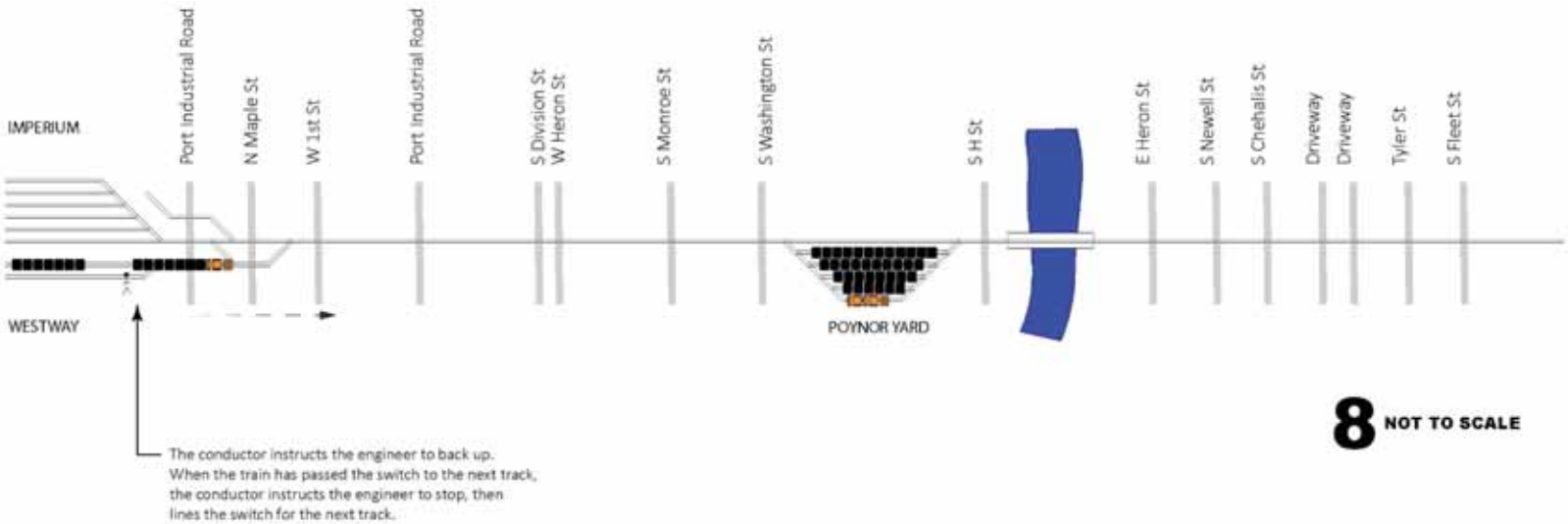
5 NOT TO SCALE



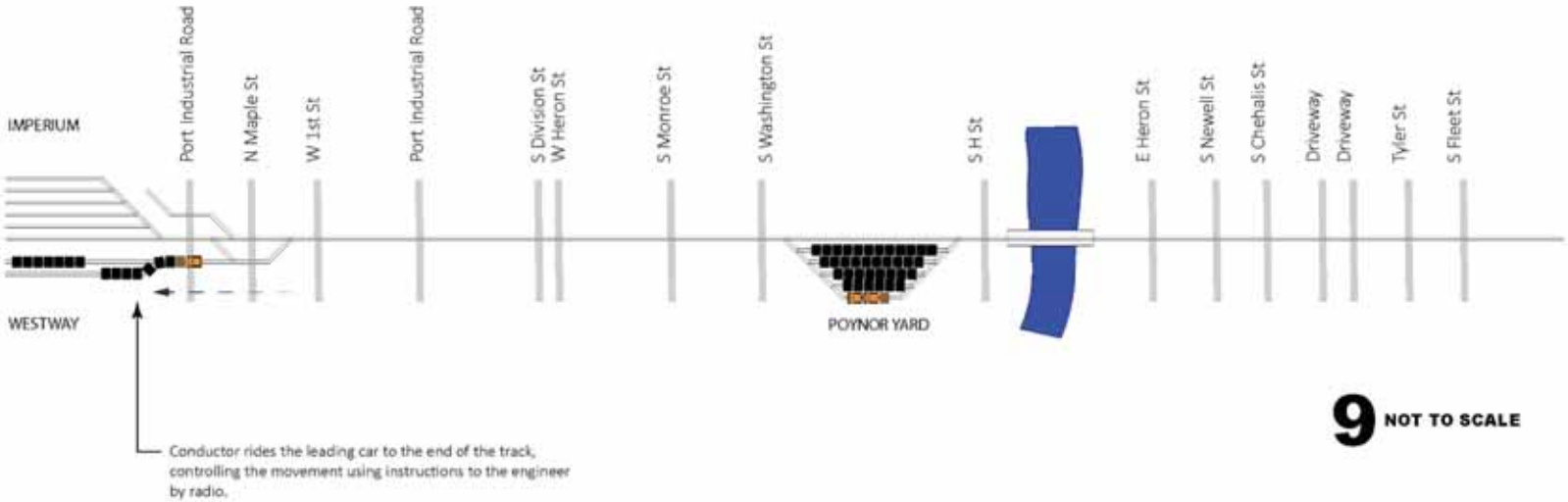
6 NOT TO SCALE



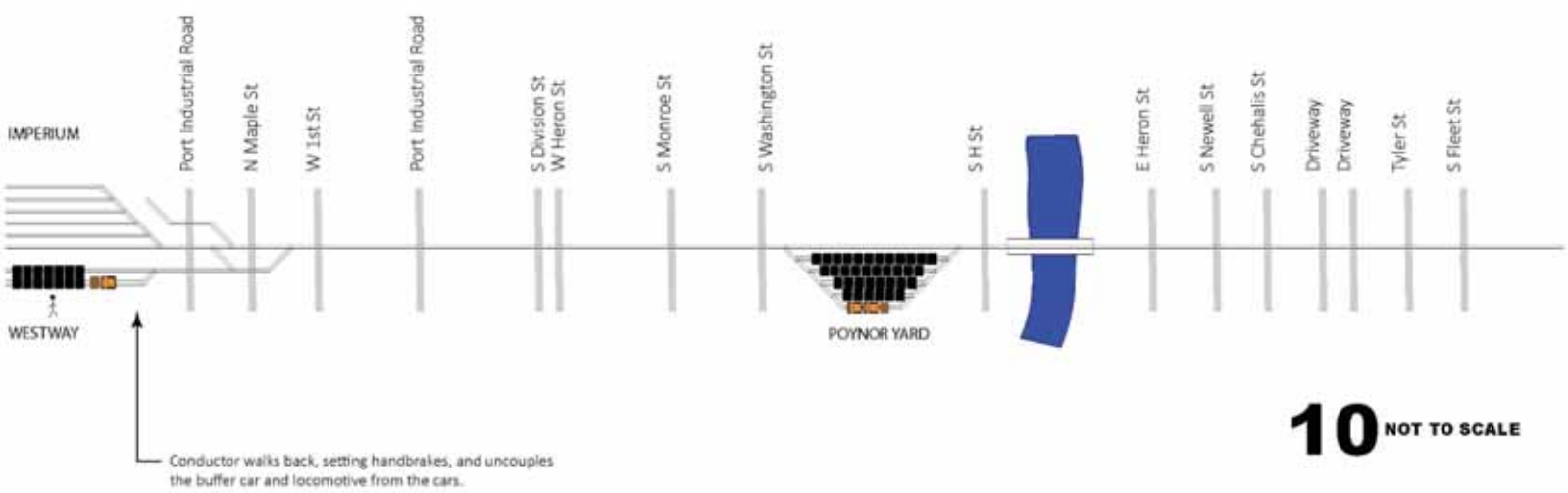
7 NOT TO SCALE



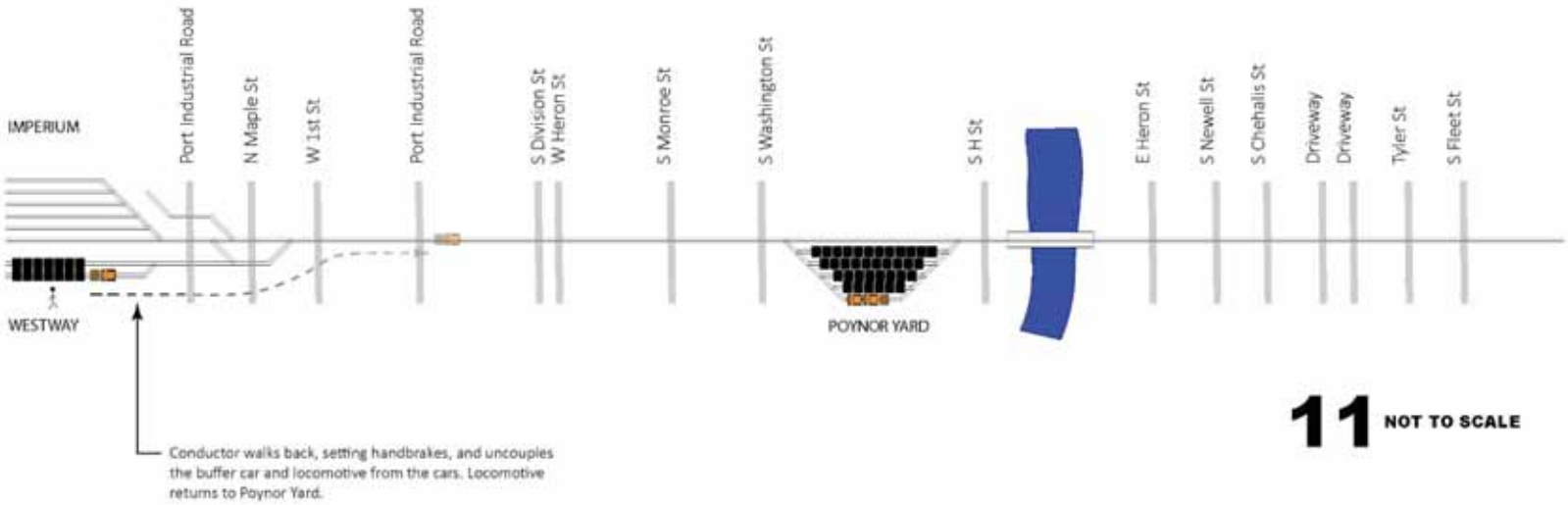
8 NOT TO SCALE



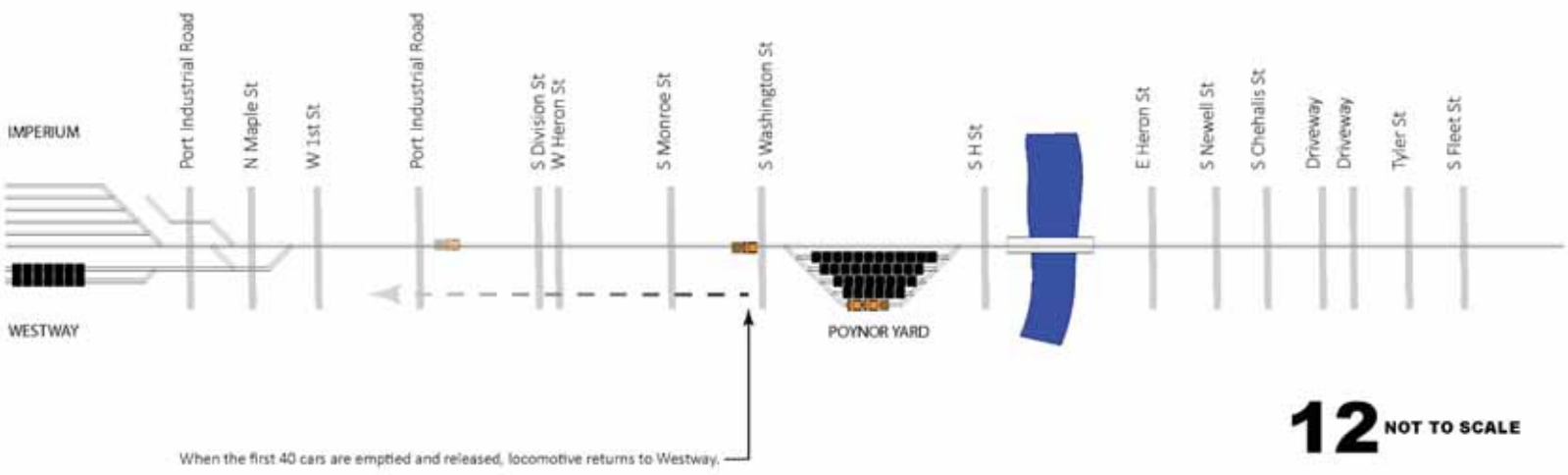
9 NOT TO SCALE



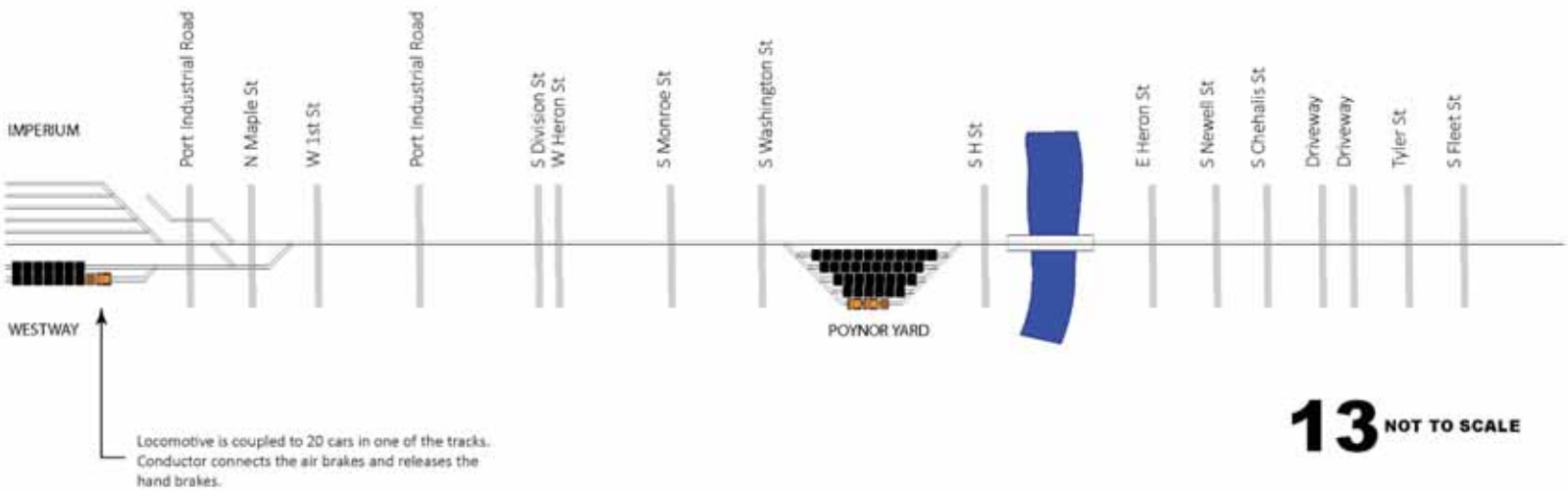
10 NOT TO SCALE



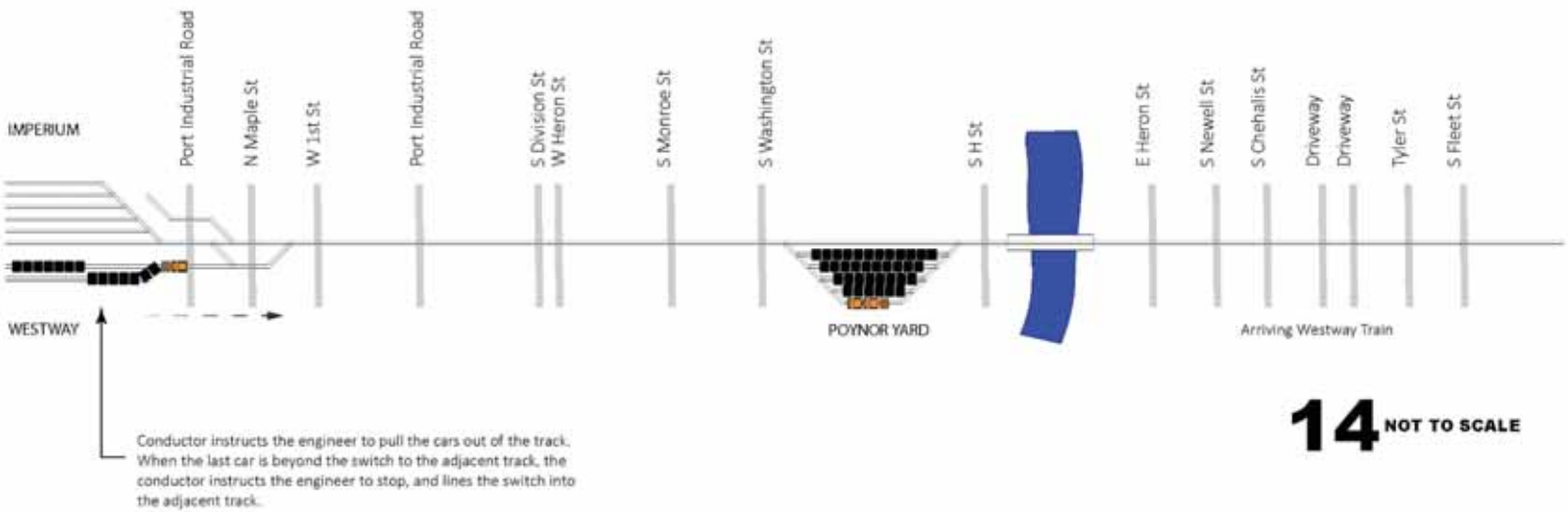
11 NOT TO SCALE



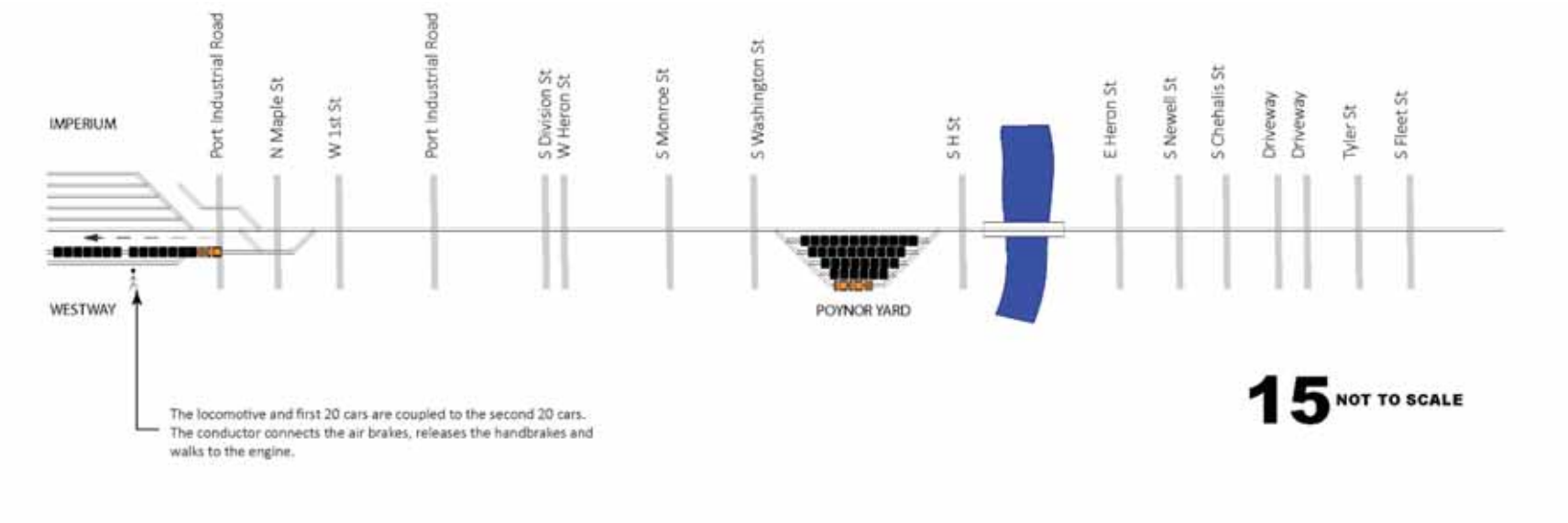
12 NOT TO SCALE

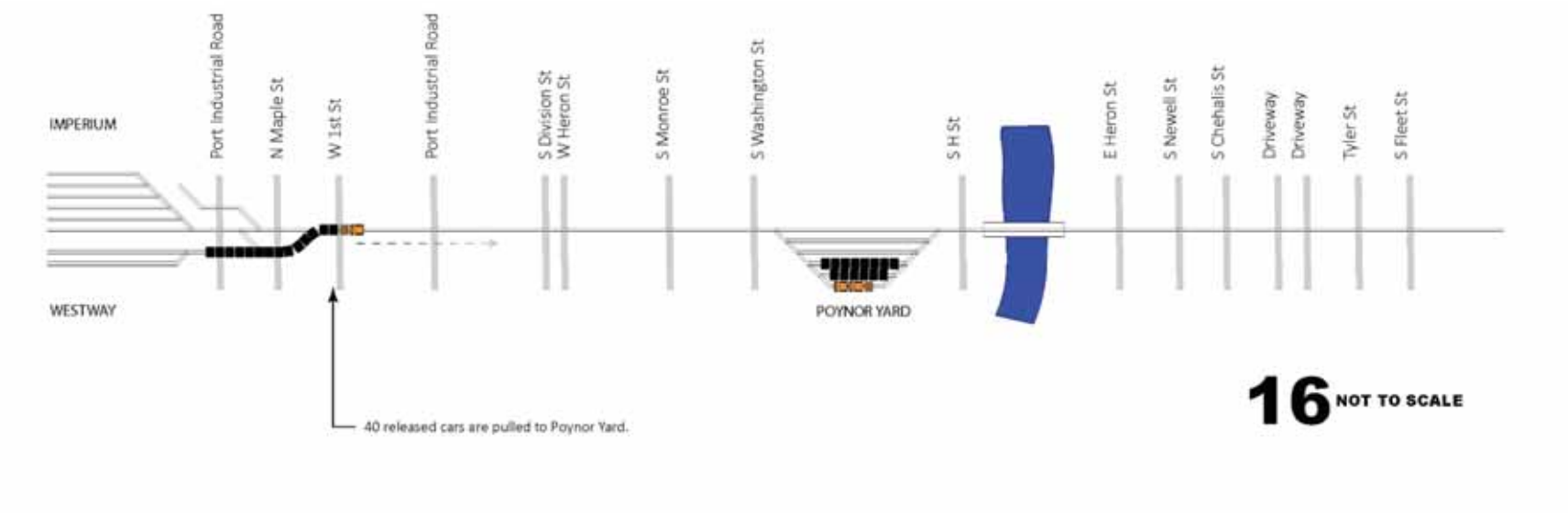


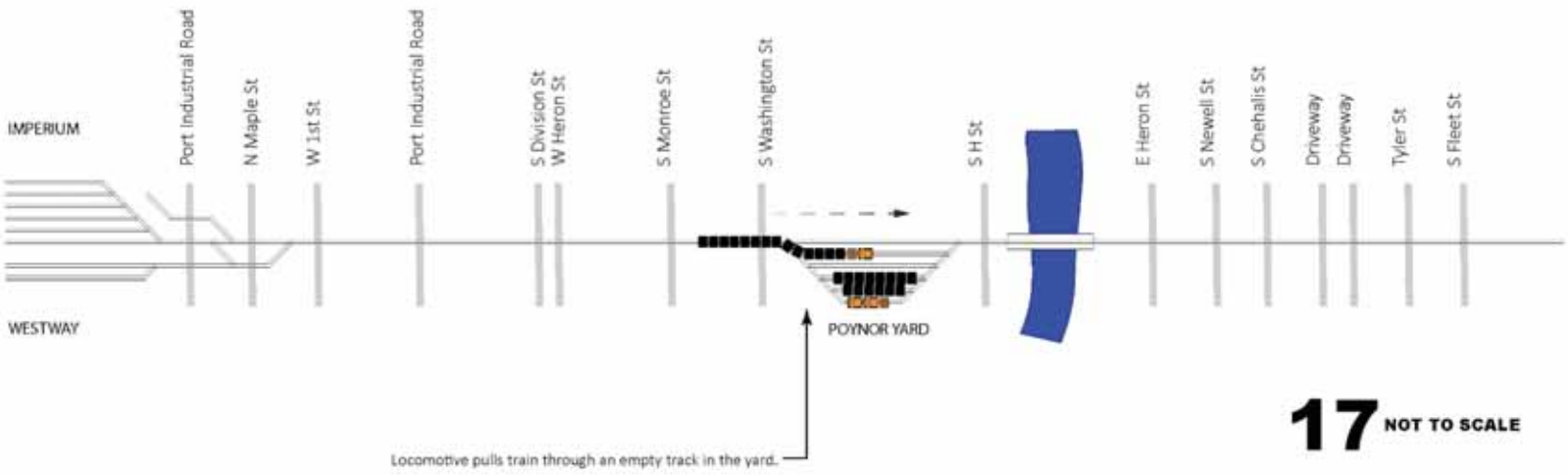
13 NOT TO SCALE



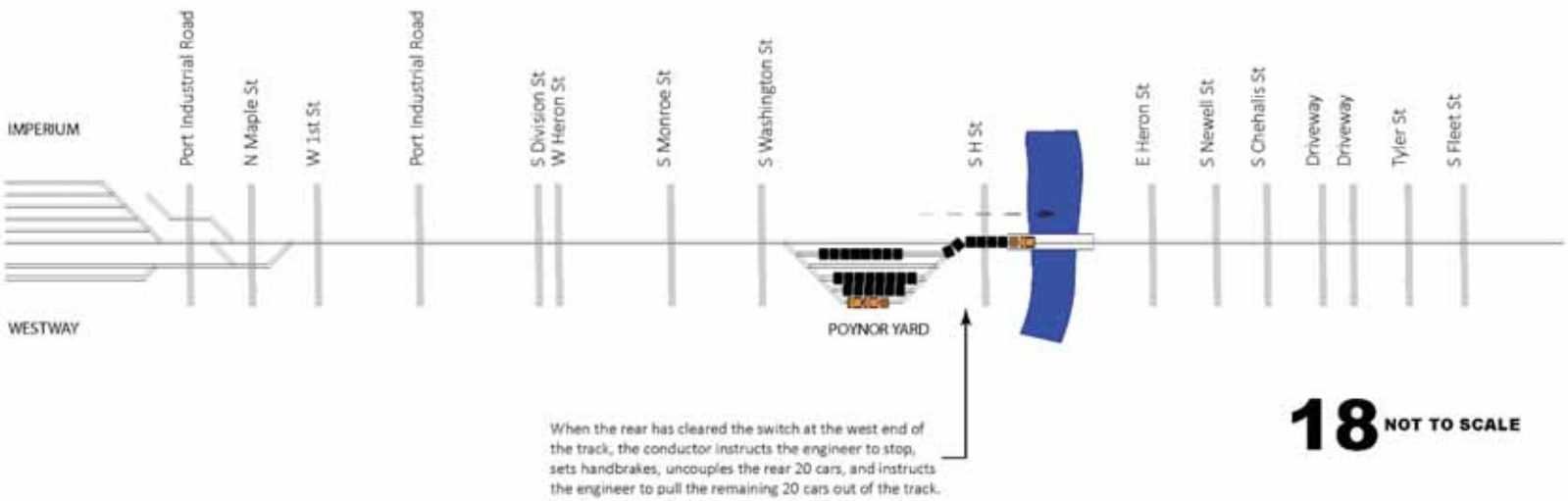
14 NOT TO SCALE


IMPERIUM
Port Industrial Road
N Maple St
W 1st St
Port Industrial Road
S Division St
W Heron St
S Monroe St
S Washington St
S H St
E Heron St
S Newell St
S Chehalis St
Driveway
Driveway
Tyler St
S Fleet St
WESTWAY
POYNOR YARD
The locomotive and first 20 cars are coupled to the second 20 cars. The conductor connects the air brakes, releases the handbrakes and walks to the engine.
15 NOT TO SCALE

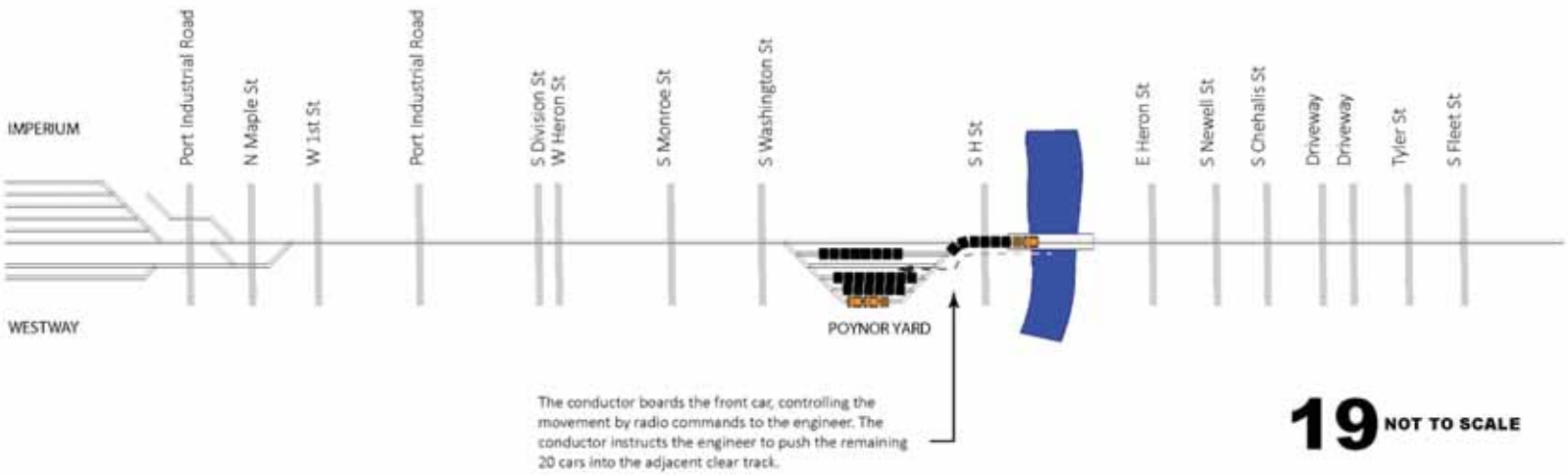

IMPERIUM
Port Industrial Road
N Maple St
W 1st St
Port Industrial Road
S Division St
W Heron St
S Monroe St
S Washington St
S H St
E Heron St
S Newell St
S Chehalis St
Driveway
Driveway
Tyler St
S Fleet St
WESTWAY
POYNOR YARD
40 released cars are pulled to Poynor Yard.
16 NOT TO SCALE

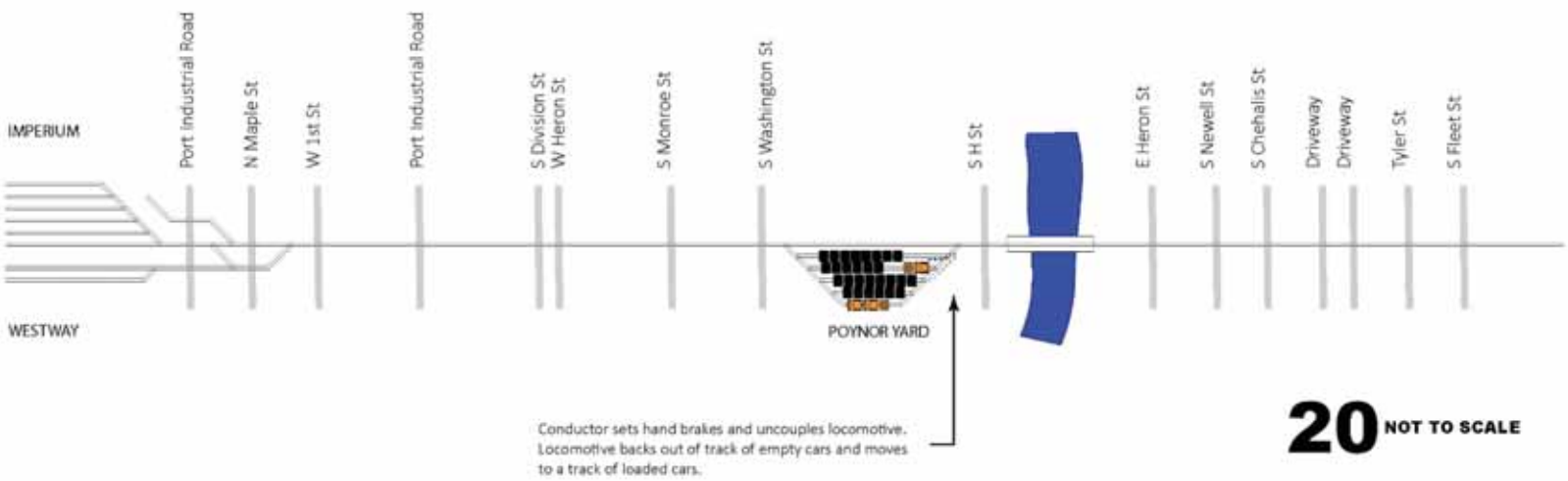


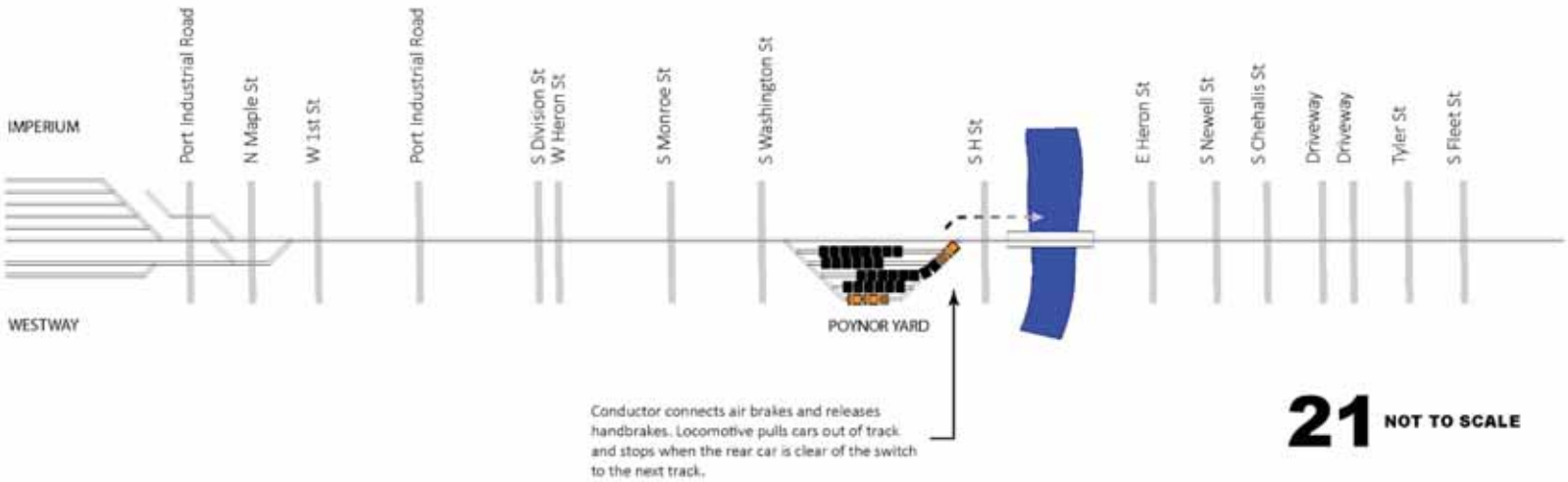
17 NOT TO SCALE



18 NOT TO SCALE


IMPERIUM
WESTWAY
Port Industrial Road
N Maple St
W 1st St
Port Industrial Road
S Division St
W Heron St
S Monroe St
S Washington St
S H St
E Heron St
S Newell St
S Chehalis St
Driveway
Driveway
Tyler St
S Fleet St
POYNOR YARD
The conductor boards the front car, controlling the movement by radio commands to the engineer. The conductor instructs the engineer to push the remaining 20 cars into the adjacent clear track.
19 NOT TO SCALE


IMPERIUM
WESTWAY
Port Industrial Road
N Maple St
W 1st St
Port Industrial Road
S Division St
W Heron St
S Monroe St
S Washington St
S H St
E Heron St
S Newell St
S Chehalis St
Driveway
Driveway
Tyler St
S Fleet St
POYNOR YARD
Conductor sets hand brakes and uncouples locomotive. Locomotive backs out of track of empty cars and moves to a track of loaded cars.
20 NOT TO SCALE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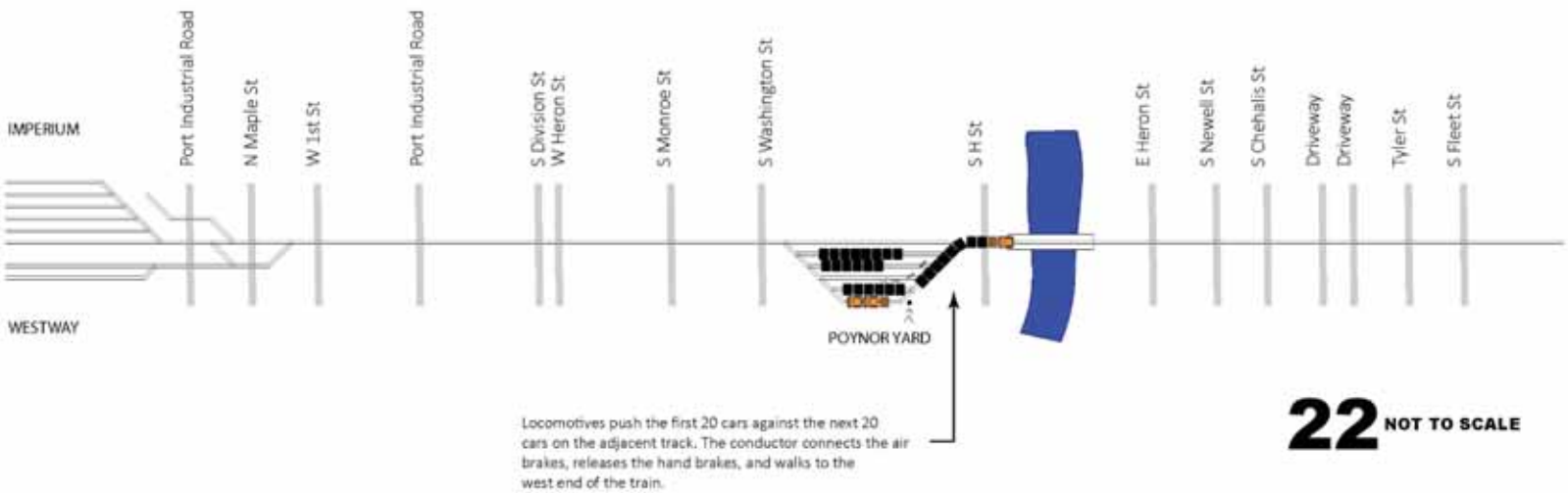
S Newell St
S Chehalis St
Driveway
Driveway
Tyler St
S Fleet St
POYNOR YARD
Conductor connects air brakes and releases handbrakes. Locomotive pulls cars out of track and stops when the rear car is clear of the switch to the next track.
21 NOT TO SCALE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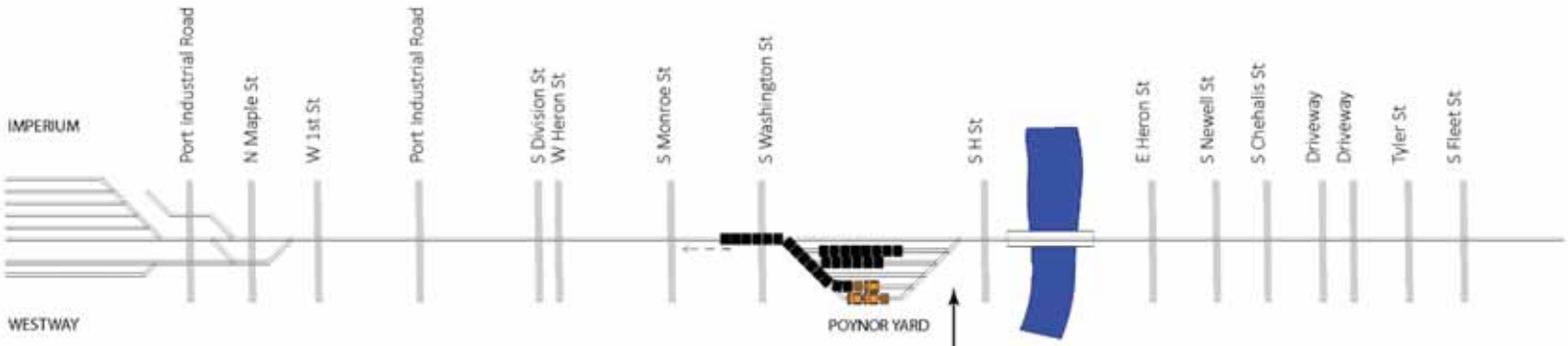
Port Industrial Road
S Division St
W Heron St
S Monroe St
S Washington St
S H St
E Heron St
S Newell St
S Chehalis St
Driveway
Driveway
Tyler St
S Fleet St
POYNOR YARD
Locomotives push the first 20 cars against the next 20 cars on the adjacent track. The conductor connects the air brakes, releases the hand brakes, and walks to the west end of the train.
22 NOT TO SCALE



40 car train is pushed to Westway. Conductor riding on the leading car controls the movement by instructing the engineer by radio.

The delivery of 40 cars is completed by repeating steps 8-11.

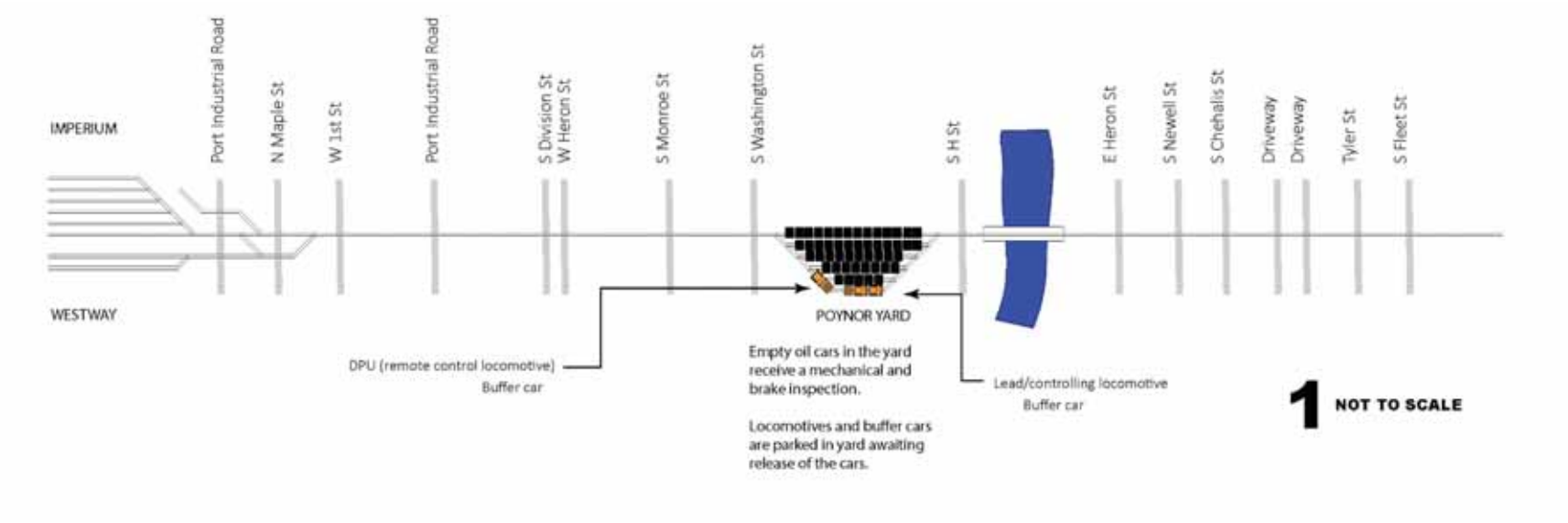
The delivery of the third group of 40 cars is completed by repeating steps 12 through 23 and 8-11.

The last empty cars are removed by repeating steps 12- 20 except the locomotive is not attached to additional cars at the end of step 20.

23 NOT TO SCALE

Section K.4

Poynor Yard Switching Operations for Rail Car Inspections


IMPERIUM
WESTWAY
Port Industrial Road
N Maple St
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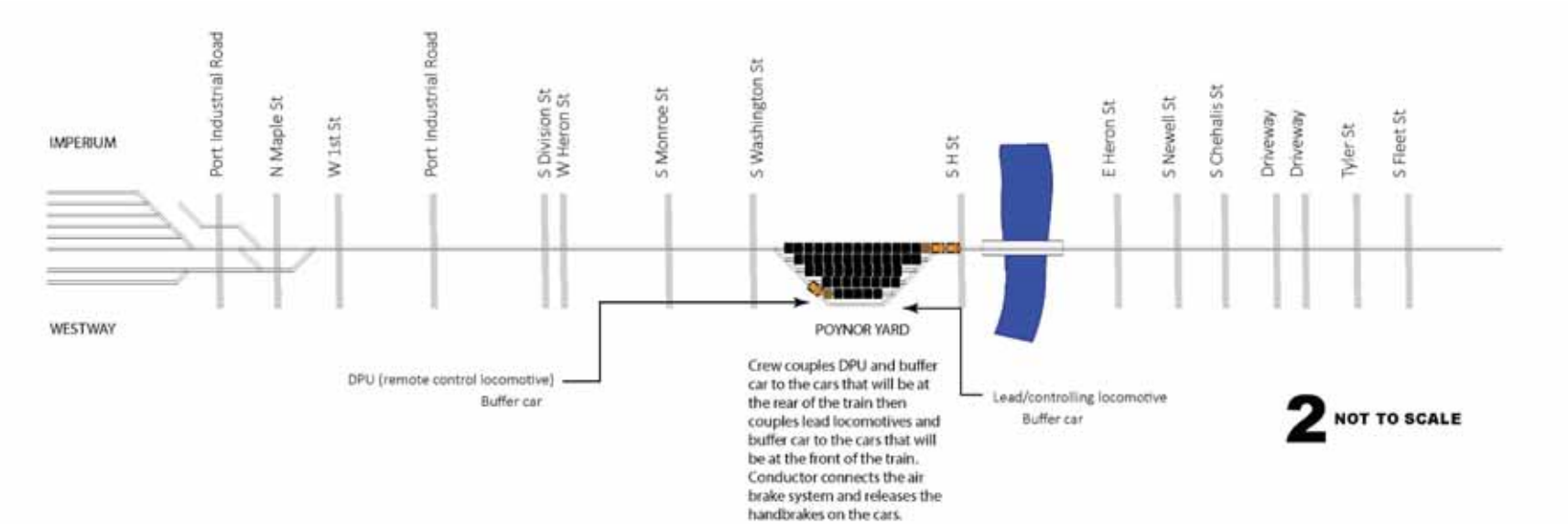
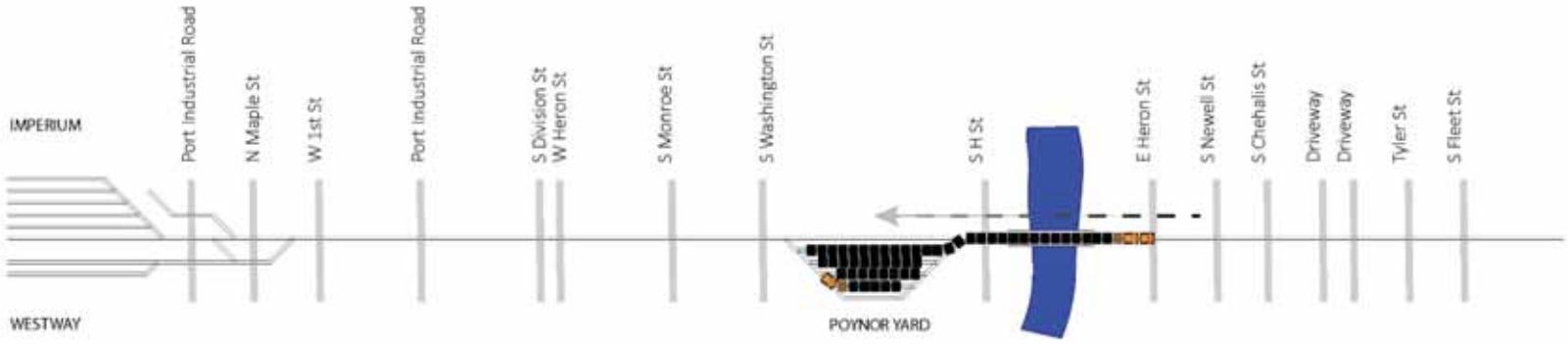
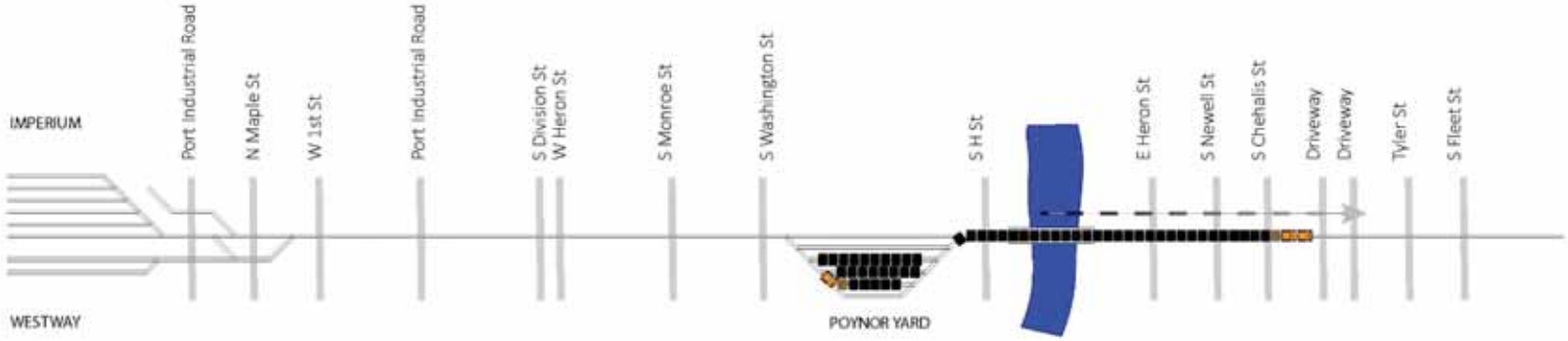
Port Industrial Road
S Division St
W Heron St
S Monroe St
S Washington St
S H St
E Heron St
S Newell St
S Chehalis St
Driveway
Driveway
Tyler St
S Fleet St
POYNOR YARD
DPU (remote control locomotive)
Buffer car
Empty oil cars in the yard receive a mechanical and brake inspection.
Locomotives and buffer cars are parked in yard awaiting release of the cars.
Lead/controlling locomotive
Buffer car
1 NOT TO SCALE


IMPERIUM
WESTWAY
Port Industrial Road
N Maple St
W 1st St
Port Industrial Road
S Division St
W Heron St
S Monroe St
S Washington St
S H St
E Heron St
S Newell St
S Chehalis St
Driveway
Driveway
Tyler St
S Fleet St
POYNOR YARD
DPU (remote control locomotive)
Buffer car
Crew couples DPU and buffer car to the cars that will be at the rear of the train then couples lead locomotives and buffer car to the cars that will be at the front of the train. Conductor connects the air brake system and releases the handbrakes on the cars.
Lead/controlling locomotive
Buffer car
2 NOT TO SCALE



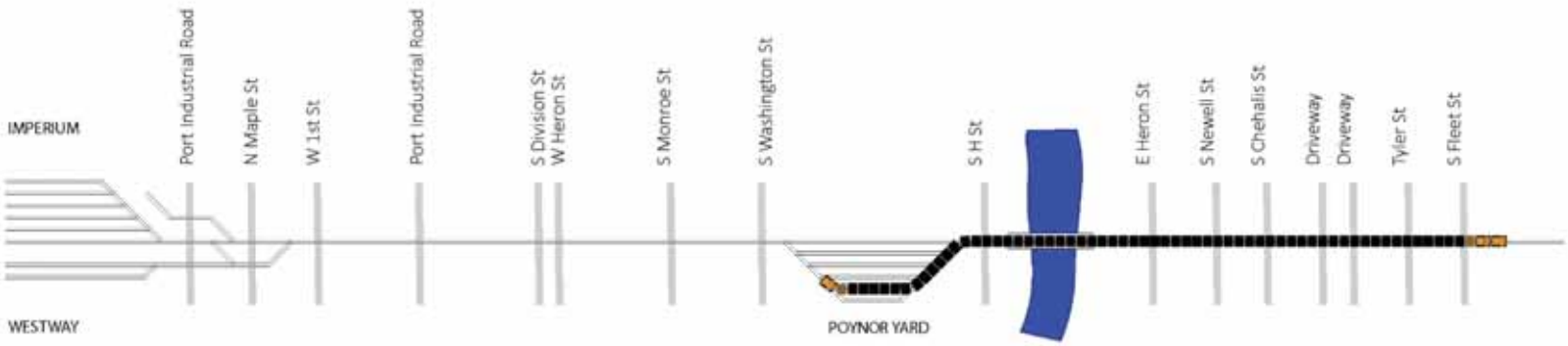
The first cut of cars are backed into the next track and coupled to the second cut of cars. The conductor connects the air brake system and releases the handbrakes.

3 NOT TO SCALE



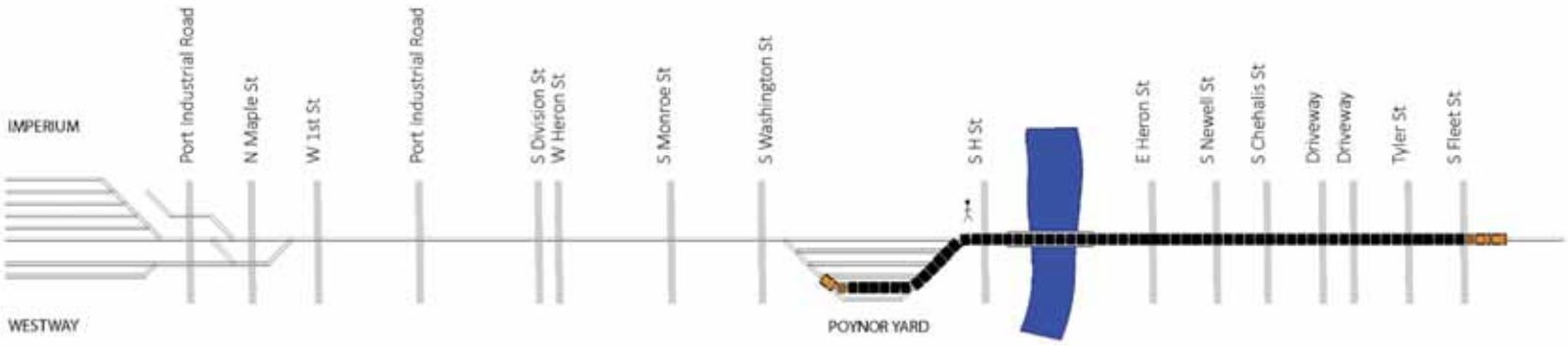
The train is pulled forward until the last car is clear of the switch to the next track.

4 NOT TO SCALE



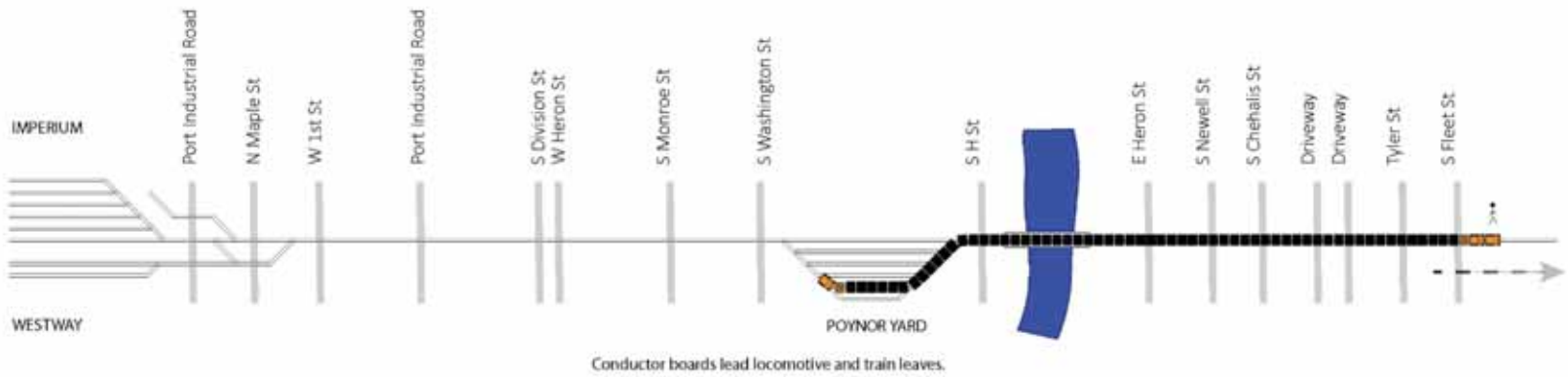
Repeat steps 3 and 4 until the entire train is coupled, the air brake system is connected, and the handbrakes are released.

5 NOT TO SCALE



When all coupling is completed and train is ready to leave, conductor walks to the lead locomotive.

6 NOT TO SCALE

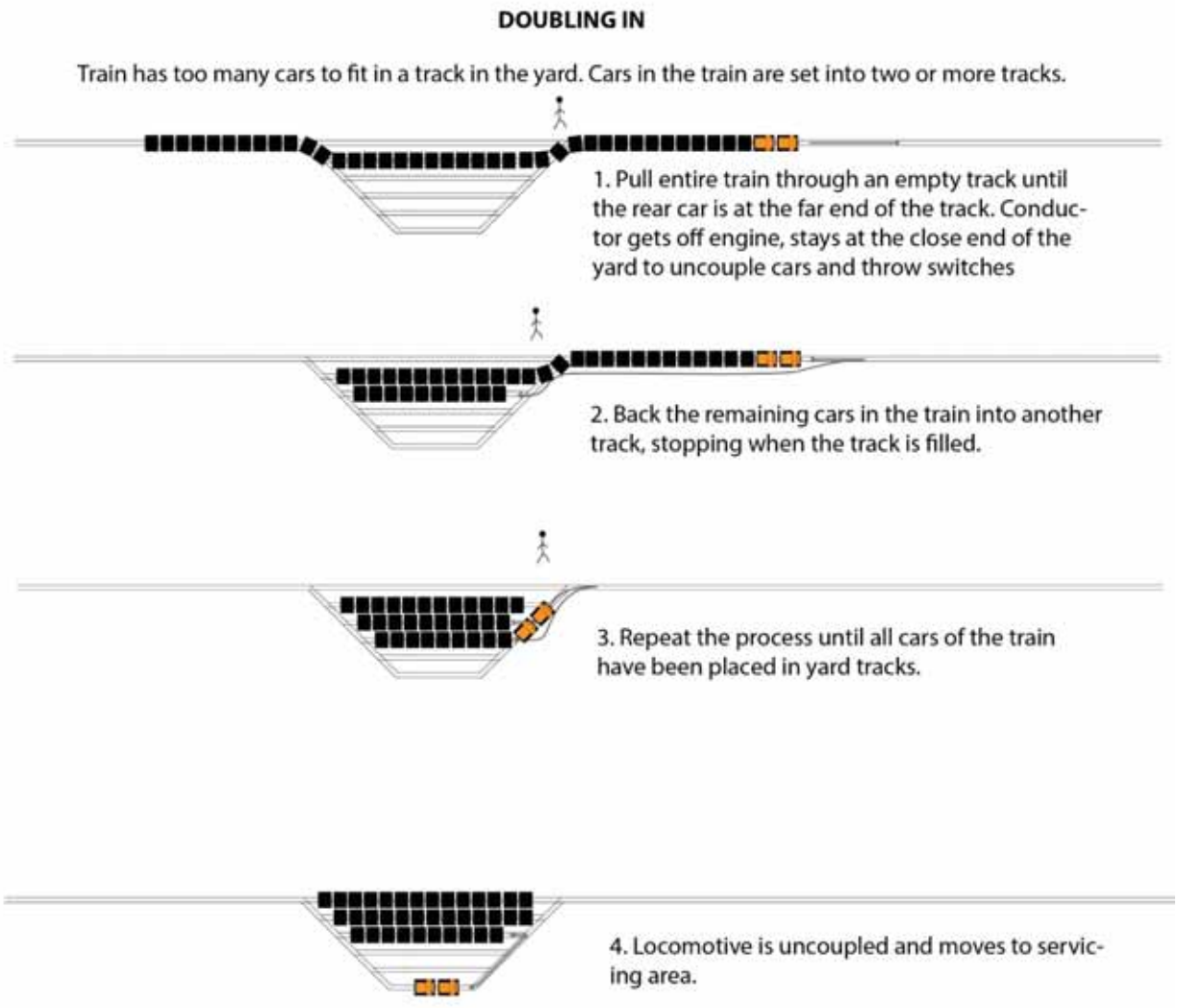


Conductor boards lead locomotive and train leaves.

7 NOT TO SCALE

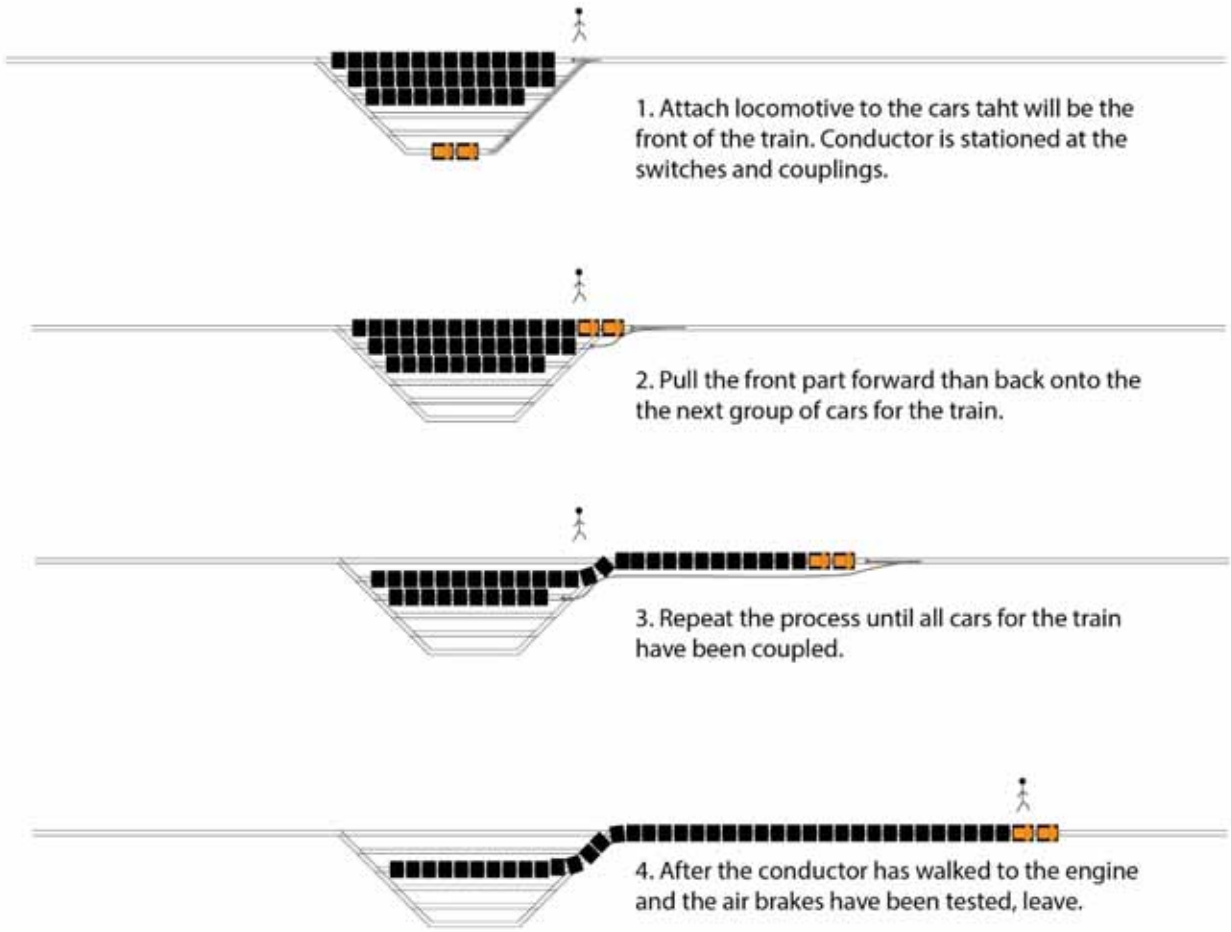
Section K.5

Doubling and Clearing


DOUBLING IN
Train has too many cars to fit in a track in the yard. Cars in the train are set into two or more tracks.
1. Pull entire train through an empty track until the rear car is at the far end of the track. Conductor gets off engine, stays at the close end of the yard to uncouple cars and throw switches
2. Back the remaining cars in the train into another track, stopping when the track is filled.
3. Repeat the process until all cars of the train have been placed in yard tracks.
4. Locomotive is uncoupled and moves to servicing area.

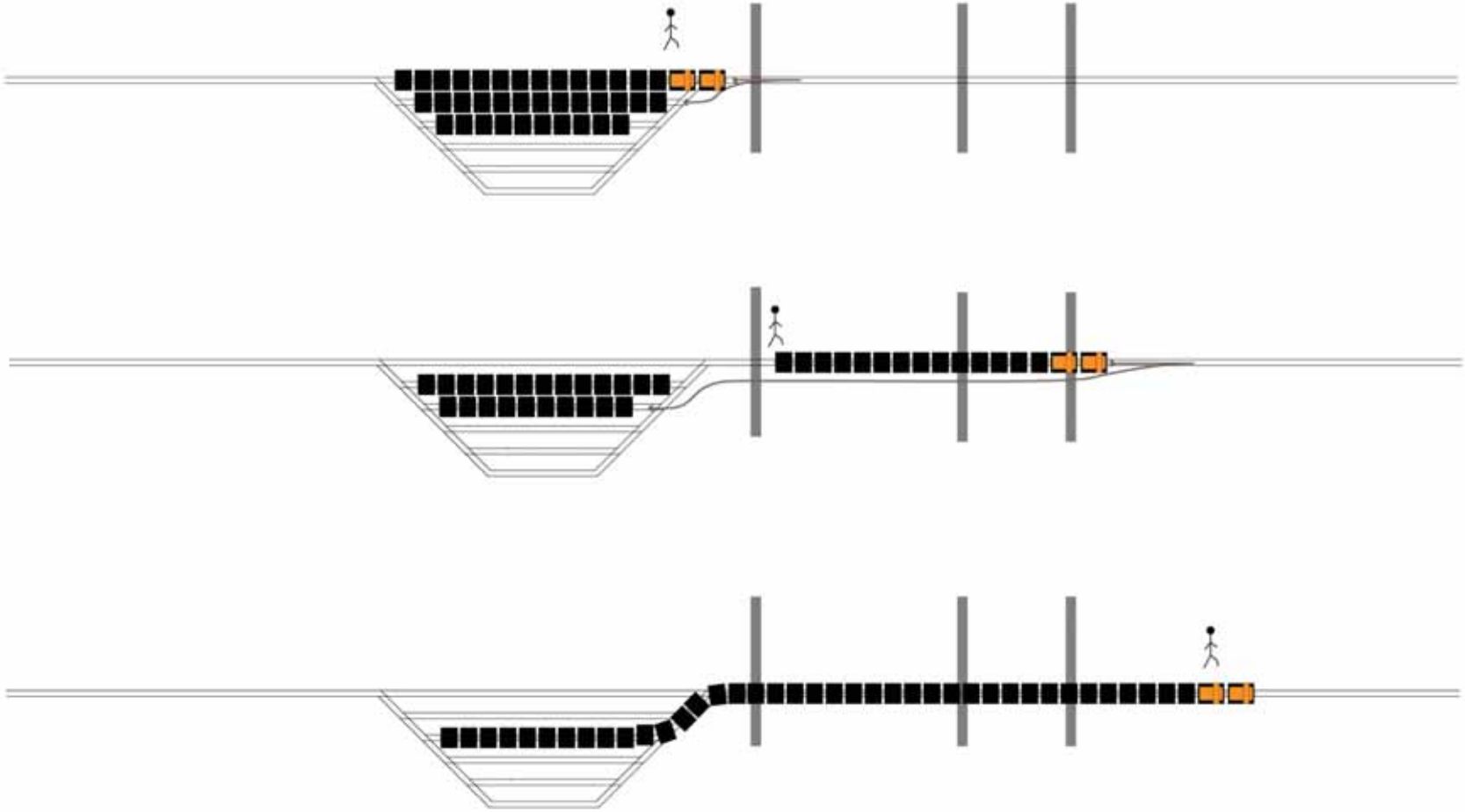
DOUBLING OUT

Train will have too many cars to fit in a track in the yard. Cars for the train are located in two or more tracks.



CLEARING A CROSSING WHILE DOUBLING IN OR OUT

While doubling in or out, a train may pull out of the yard far enough to clear a crossing near the switches. If other crossings are also blocked, the delay will increase at those crossings.



Appendix L

Vehicle Traffic Analysis

Appendix L
Vehicle Traffic Analysis

This appendix provides details of the analysis of vehicle traffic and safety in the study area that extends along the Puget Sound & Pacific Railroad (PS&P) rail line from the project site to Centralia. Specifically, this appendix describes vehicle grade-crossing delay and safety and emergency vehicle access under existing conditions, the no-action alternative, and the proposed action. The specific PS&P rail line grade crossings considered in the analysis are presented in Attachment L-1, *Vehicle Traffic Modeling.*

Attachment L-1 also describes how impacts were evaluated and the sources of information used to complete the analysis.

Existing Conditions

This section describes the roadways, intersections, and grade crossings in the study area that could be affected by construction and routine operation of the proposed action.

Existing Vehicle Traffic

The transportation system in the study area consists of a network of local roads with some collector and arterial roads. A collector road connects local roads with arterial roads. Arterial roads are high-capacity urban roads that allow vehicles to operate at higher speeds for longer distances (Federal Highway Administration 2012). Estimated vehicle traffic in and around the project site in 2012 was 5,500 vehicles per day (both directions) on Industrial Road. For roadways along the PS&P rail line, 2012 estimates range from 20 vehicles per day to 16,720 vehicles per day in both directions at grade crossings and nearby intersections.

Traffic congestion already exists in many places along area roadways and has been the subject of numerous studies over the past 20 years. For example, the *U.S. 101 Regional Circulation Project Report* (Washington State Department of Transportation 2007) examines congestion along the US Route 101 (US 101) corridor, US Route 12 (US 12), and State Route 109 (SR 109) in Aberdeen, Hoquiam, and Cosmopolis. Intersections at H Street, Heron Street, and Tyler Street, among others, were found to be experiencing congestion issues and moderate levels of vehicle delay with level of service (LOS)[1] designations at or below LOS C. These intersections are predicted to drop to a LOS F by 2030 (Washington State Department of Transportation 2007).

According to the Grays Harbor Council of Governments *Metropolitan and Regional Transportation Plan* (Grays Harbor Council of Governments 2009), traffic along the US 101 corridor between Aberdeen and Hoquiam is becoming more congested due to growth at the Port of Grays Harbor and overall population growth. Some existing traffic congestion issues are further exacerbated by current rail operations and the manual operations at the Wishkah River Bridge, such as at E Heron

[1] Level of service (LOS) refers to the movement of traffic in a particular intersection, with LOS A representing free-flowing traffic, LOS C representing increased congestion, and LOS F representing heavy traffic congestion.

Street. A TIGER Grant[2] proposal was submitted for funding to install a new electronic locking system for the bridge to alleviate some of this congestion (Port of Grays Harbor 2011). A planning study by the Grays Harbor Council of Governments is underway for the East Aberdeen Mobility Project to identify ways to relieve congestion and improve safety along US 12 and potential improvements to access into the Olympic Gateway Plaza (Grays Harbor Council of Governments pers. comm.).

Traffic congestion issues also exist in Centralia along Tower and Pearl Streets at grade crossings, particularly when trains are delayed in entering the BNSF Railway Company (BNSF) main line and wait on the PS&P rail tracks, blocking the grade crossings (Stemkoski pers. comm.). There are similar issues at Reynolds Street in Centralia, but lower annual average daily traffic (AADT) (than on Tower Street and Pearl Street) results in delays that are more limited.

Fire and Emergency Services Response

Fire and emergency services in the study area are listed in Table L-1. In addition to these municipal fire departments, Grays Harbor Fire Protection Districts (FPD) 2, 6, 14, and 15 are near the project site and potentially available to provide personnel and fire apparatus in the event of a transportation-related emergency in accordance with the countywide mutual aid agreement (Grays Harbor County 2007: 4-17). Area fire departments have adopted response time objectives that recognize the American Heart Association's 6-minute window of opportunity for resuscitation and 8-minute flashover window in which an entire space is on fire (City of Centralia and Lewis County Fire Protection District 12 2007).

Table L-1. Existing Fire and Emergency Service Stations along the PS&P Rail Line

Fire/Emergency Medical Services Department	Number of Stations	Number of Calls per Year
Hoquiam City Fire Department	2	3,000
Aberdeen City Fire Department	2	4,696
Cosmopolis City Fire Department	1	Not available
Ocean Shores Fire and Rescue Department	2	2,100
City of Westport	1	300
Markham, FPD 14	1	175
FPD 10, Wishkah	3	Not available
FPD 2, Central Park, Brady Wynoochee	3	900
City of Montesano	1	1,110
FPD 5, Satsop, Porter, Elma	4	600
City of Oakville, FPD 1	1	400
FPD 1, Rochester, Grand Mound	17	31,000
Fords Prairie, FPD 12, City of Centralia (Riverside Fire Dept.)	8	4,100

Sources: Personal communications with Fire Chief Mike Mahnke, Fire District 14; Fire Chief Leonard Johnson, Fire District 2; Fire Chief Dan Prater, Fire District 5; Fire Chief of City of Ocean Shores; Fire Chief Paul Dean, City of Hoquiam; Fire Chief Hubbard, City of Aberdeen; Fire Chief Jeff Troumbley, City of Elma; Fire Chief of Fire District #1.

[2] TIGER stands for Transportation Investment Generating Economic Recovery.

The majority of the fire and rescue departments could encounter grade crossings while responding to some calls, with the exception of the City of Ocean Shores Fire Department, City of Westport Fire Department, FPD 10, City of Cosmopolis, and FPD 14, which are not located near the PS&P rail line. However, these stations could encounter delays at grade crossings if they are responding to a call due to a mutual aid agreement with a fire station located near the PS&P rail line. Several of the FPDs have multiple stations. This analysis focuses on grade crossings near the primary station or designated headquarters.

Urgent care is available at Grays Harbor Community Hospital and Providence Centralia Hospital in Centralia and several local medical clinics, including the Harbor Internal Medicine Clinic, the Family Practice Center of Grays Harbor, the Aberdeen Primary Care, Sea Mar, Black Hills Family Practice Clinic in Elma, Broadway Family Health in Montesano, the Summit Pacific Medical Center in Elma, and Mark Reed Healthcare Clinic in McCleary. Ambulance service is provided by American Medical Response, Rochester Metro, FPD 12, FPD 5, City of Hoquiam, City of Aberdeen, City of Cosmopolis, and Ocean Shores. For more information about fire, emergency response, and medical services related to the increased potential for hazardous materials releases, see Chapter 4, *Environmental Health and Safety*.

Methods

This section describes how impacts were evaluated and the sources of information used to complete the analysis. Additional details are presented in Attachment L-1, *Vehicle Traffic Modeling.*

Roadways and Intersections

Several data sources were used to characterize study area roadways and intersections.

- AADT volumes at the grade crossings identified as potential areas of concern by the Washington State Department of Transportation (WSDOT) were dated from 1986 to 2014. Volumes were factored to reflect future 2017 no-action alternative volumes for operations analysis using the following historic growth rates found in the *Annual Energy Outlook* from the U.S. Energy Information Administration (2014).
    - 1970 to 1995: 3.1% per year
    - 1996 to 2007: 2.0% per year
- After 2007, an assumed growth rate of 1.5% was used (Washington State Department of Transportation 2014a).
- AADT for the private drive crossing was approximated from field observations and the AADT from grade crossings with similar characteristics along the corridor. Adams Street AADT was developed based on volumes found in the 2007 *U.S. 101 Regional Circulation Plan* (Washington State Department of Transportation 2007).
- The 2017 traffic volumes estimated at other key study area grade crossings were compared to volumes found in the *U.S. 101 Regional Circulation Plan* and found to be higher (Washington State Department of Transportation 2007).
- Field observations of the Olympic Gateway Plaza at Chehalis Street and Tyler Street on US 12 provided estimates for midday and evening peak hours.

- Ten years of collision records (2003 to 2013) for the study area were obtained from WSDOT and the Federal Railroad Administration (FRA) (Washington State Department of Transportation 2014a; Federal Railroad Administration 2014a).

These data were used to characterize estimated future vehicle traffic along area roadways adjacent to grade crossings of the PS&P rail line. The vehicle traffic data were then used to calculate average queue length[3] to determine if there were any storage capacity constraints. Queue length was calculated based on the number of vehicles delayed due to gate down times throughout a 24-hour period and an average vehicle length of 20 feet.

Grade-Crossing Delay and Safety

Several data sources were used to characterize grade-crossing delay and safety conditions.

- WSDOT (2014a) and Washington Utilities and Transportation Commission (2014) provided available AADT information. All local government agencies along the PS&P rail line were asked to provide updated AADT data, if available. Updated traffic maps and reports were received from the City of Montesano, City of Elma, Grays Harbor Council of Governments, and City of Aberdeen (Wincewicz pers. comm.; Starks pers. comm.; Grays Harbor Council of Governments pers. comm.). The FRA highway/rail database was used as a source of AADT data as well (Federal Railroad Administration 2014a). For S. Fleet St., Tyler St., S. Chehalis, S. Newell, E Heron Street, Dairy Queen Entrance, and the McDonald's Entrance crossings, 2014 traffic count data for peak hour levels was used and extrapolated to estimate AADT (based on 10 times the peak hour).
- Forecasted future increases in vehicle traffic.
- Existing train traffic (average number of trains per day) and operating speed on the PS&P rail line (Federal Railroad Administration 2014a).
- Future train traffic as estimated by the applicant (Chapter 2, *Proposed Action and Alternatives*).
- Train characteristics, including length and speed.
- Grade crossings on the BNSF main line, Maple Street M1, E Main Street M1, and E Locust Street M1, baseline conditions were assumed to be 40 trains per day operating at 40 miles per hour (mph), on average (Federal Railroad Administration 2014a).
- Grade-separated crossings are not included for further analysis because the roadway and train traffic are separated by either a bridge or a tunnel and train traffic does not affect vehicle delay or safety. It was assumed that train speed would increase to 20 mph through the gauntlet.[4]

Delay

For each grade crossing analyzed, the average delay per vehicle in a 24-hour period is based on the estimated time each train would block the grade crossing, the average number of trains per day, and grade-crossing characteristics (e.g., AADT, number of roadway lanes). Average delays were estimated for the no-action alternative and the proposed action. The average gate-down time at a

[3] Queue length is the total average length of delayed vehicles per lane.
[4] The gauntlet is an a series of grade crossings in Aberdeen that include E Heron Street, Newell Street, S Chehalis Street, Dairy Queen Entrance, McDonald's Entrance, Tyler Street, and Fleet Street.

grade crossing and the estimated AADT values for 2017 and 2037 were used to obtain a conservative estimate of average vehicle delay per grade crossing. This value was then used to determine the anticipated LOS at each grade crossing.

LOS designations provide a qualitative measure of traffic flow. While a designation of A indicates free-flowing traffic, a designation of F indicates that traffic is constantly slowed at that location (Table L-2). According to WSDOT LOS standards for peak hours, urban highways should meet a LOS of D and for rural highways a LOS of C in Grays Harbor County and Thurston County (Washington State Department of Transportation 2009); these conditions are currently being met on all of the area roadways.

Table L-2. Level of Service Designations

Level of Service	Average Delay for All Vehicles (seconds/vehicle)
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

Source: Transportation Research Board 2010

Peak Hour Delay and LOS Sensitivity Analyses

To supplement the analysis of estimated vehicle delay on a daily basis, delay at each grade crossing was analyzed in two sensitivity analyses for 2017 and 2037: peak hour vehicle traffic and increases in rail traffic compared to impacts on WSDOT LOS standards. For the peak hour analysis, it was assumed that an oil train would pass over the grade crossings during the evening peak hour, and vehicle traffic during the evening peak hour would be 11.5% of average daily traffic, based on available WSDOT traffic count data, except that location-specific peak hour traffic count data were used where available. The LOS sensitivity analysis examined the incremental train traffic growth above the baseline traffic at grade crossings that would cause the LOS to decline below level D or cause average queue lengths to exceed the available vehicle storage capacity.

Safety

Safety at each grade crossing was analyzed by estimating future accident frequency and the corresponding predicted interval between accidents with and without the addition of project-related rail traffic. The FRA GradeDec.Net Model was used to analyze public highway-rail grade crossings (Federal Railroad Administration 2014b) and the general accident prediction formula was used to analyze private highway-rail grade crossings. The GradeDec.Net model accounts for accident history and frequency of trains at existing grade crossings, volume of vehicle traffic, existing safety devices at the grade crossings, and other factors to determine the potential impacts of an increase in rail traffic. The model also considers the existing rail traffic volumes and the additional proposed rail traffic determined by detailed train modeling. Estimates of AADT for vehicles at each grade crossing were calculated for 2012, 2017, and 2037 based on data obtained from local agencies, WSDOT, and FRA. The general accident prediction formula used was based on FRA's *Rail-Highway Crossing Resource Allocation Procedure User's Guide* taking into account the grade crossings protection, train

speed, number of trains per day, road surface, and number of roadway lanes (Federal Railroad Administration 1987).

Impacts of the No-Action Alternative

Under the no-action alternative, the applicant would continue to operate its existing facility as described in Chapter 2, Section 2.1.2.2, *Existing Operations*. Existing rail operations that serve the project site and the immediately surrounding industrial area currently contribute to existing vehicle delays at both grade crossings and area roadways intersections. Traffic under the no-action alternative would continue to experience vehicle delays and grade-crossing safety concerns that are expected to slightly increase over the analysis period (2017 to 2037), primarily as the result of predicted growth in the region (i.e., increases in vehicle traffic).

Under the no-action alternative, AADT is estimated to increase annually at an average rate of 1.5% (U.S. Energy Information Administration 2014). On Industrial Road near the project site, AADT would range from an estimated 5,803 vehicles per day in 2017 to 7,456 vehicles per day (both directions) in 2037.

Grade-Crossing Delay

Motorists, including emergency vehicle operators, would continue to experience delays in the study area as the result of train movements under the no-action alternative. It is estimated that the average delay would range from less than 1 to 42 seconds per vehicle in 2017 and from less than 1 to 29 seconds per vehicle in 2037 for grade crossings along the PS&P rail line. The LOS designation for most grade crossings would range from LOS A to LOS D in 2017 and LOS A to LOS C in 2037 (Attachment L-1, *Vehicle Traffic Modeling*). Table L-3 presents estimated no-action conditions in 2017 and 2037 for a subset of grade crossings, including those that are currently at or have the greatest potential to fall below WSDOT standards. The complete results of the vehicle analysis are presented in Attachment L-1.

Table L-3. No-Action Alternative: LOS Designations for Key Grade Crossings in the Study Area

FRA Crossing ID	Street Name	City	2017 AADT	2037 AADT	Road Type	2017 LOS[a]	2037 LOS[b]
922990N	Industrial Rd	Aberdeen	5,795	7,494	Urban Minor Arterial	B	B
092551K	H Street[c]	Aberdeen	879	1,136	Urban Local	C	C
096695D	E Heron St	Aberdeen	3,452	4,464	Urban Local	D	C
096693P	Newell St	Aberdeen	649	839	Urban Local	C	B
096691B	S Chehalis St	Aberdeen	4,906	6,344	Urban Local	C	B
096689A	Dairy Queen Entrance	Aberdeen	157	216	Urban Local	B	A
096690U	McDonald's Entrance	Aberdeen	1,067	1,380	Urban Local	B	A
096029N	Tyler St	Aberdeen	4,048	5,235	Urban Local	B	A
096688T	Fleet St	Aberdeen	1,611	2,083	Urban Local	B	A

[a] WSDOT LOS Standards for peak-hours, urban highways should meet a LOS of D and for rural highways a LOS of C in Grays Harbor County and Thurston County (Washington State Department of Transportation 2009).

[b] Crossings 096691B, 096689A, 096690U, 096029N, and 096688T improve in 2037 due to assumed higher train speeds. These improvements allow for these grade crossings to meet or exceed the WSDOT urban highway LOS standard.

[c] Existing traffic volume for H Street is from 1986 and extrapolated to the analysis year of 2017 or 2037. Because existing land uses near the H Street grade crossing are currently vacant, actual average daily traffic at this grade crossing would be substantially lower than shown in this table. For this reason, H Street is not included in the potential vehicle delay impacts in Section 3.16, *Vehicle Traffic and Safety*.

LOS = level of service; WSDOT = Washington State Department of Transportation; FRA = Federal Railroad Administration; AADT = annual average daily traffic

In general, modeling showed that average delay (as measured by seconds of delay per vehicle) in a 24-hour period would decrease at grade crossings near Olympic Gateway Plaza over the 20-year analysis period because of infrastructure improvements. For some of the grade crossings, LOS would improve, as infrastructure improvements would allow an increase in train speed over the Wishkah River bridge so that trains would move through grade crossings faster, thereby reducing the average vehicle delay. As discussed in Section 3.15, *Rail Traffic*, additional projects under consideration could contribute to some improvements in vehicle delay. However, these projects were not included in the rail or vehicle modeling for the reasons described in Section 3.15, *Rail Traffic*. Additionally, future roadway improvements could further improve congestion and improve LOS. For example, as mentioned previously, possible options to alleviate congestion along US 12 in Aberdeen related to the East Aberdeen Mobility Project have not yet been determined and were not considered in transportation modeling.

Even if vehicle delay could be reduced by infrastructure improvements, delays in future years under the no-action alternative could still increase compared with existing conditions. Emergency vehicles could experience grade-crossing delays that affect response time. Under the no-action alternative, the chance of any vehicle (including an emergency response vehicle) experiencing some delay from a train occupying a grade crossing would range from 0.11 to 4.95% in 2017 and from 0.22 to 4.57% in 2037 along the PS&P rail line. The potential for delay further depends on where the call is located in relation to the PS&P rail line and the dispatch station, and the availability of alternate routes if a train occupies a grade crossing at the time of the call. Under the no-action alternative, emergency responders would experience additional delay, beyond existing conditions, due to PS&P rail line

operations, at some locations such as at the Olympic Gateway Plaza entrance grade crossings in Aberdeen.

During peak traffic hours (typically from 4:00 pm to 5:00 pm), roadways experience higher volumes of vehicles due to commuting schedules. A sensitivity analysis was conducted to evaluate the potential vehicle delay in the event that one grain train (approximately 6,279 feet in length) operating over public, grade crossings during peak hour traffic for the no-action alternative.[5] Baseline vehicle delay is predicted to range from 12 to 919 seconds per vehicle in 2017 and 20 to 4,500 seconds per vehicle in 2037 in Aberdeen. The higher delay estimates occur at grade crossings affected by switching and train building activities near Poynor Yard. Estimated baseline vehicle delay ranged from 5 to 6 seconds per vehicle in Elma and Montesano; 25 to 319 seconds per vehicle in Centralia; and 4 to 23 seconds per vehicle in Satsop, Malone, Porter, Oakville, and Rochester in 2017; and from 5 to 7 seconds per vehicle in Elma and Montesano; 25 to 116 seconds per vehicle in Centralia; and 4 to 50 seconds per vehicle in Satsop, Malone, Porter, Oakville, and Rochester in 2037.

Vehicle Delay at Adjacent Intersections

Increased vehicle delay from trains blocking grade crossings can have secondary impacts on nearby intersections. As vehicles begin to queue while waiting for the grade crossing to open, increased roadway congestion can affect adjacent intersections and cause additional congestion at those intersections.

Under the no-action alternative, AADT at arterial roads is predicted to range from 5,795 vehicles per day to 17,845 vehicles per day (both directions) in 2017 and from 4,788 vehicles per day to 23,076 vehicles per day (both directions) in 2037, depending on the specific intersection in question. AADT at collector roads is predicted to range from 293 vehicles per day to 13,755 vehicles per day (both directions) in 2017 and from 379 vehicles per day to 17,788 vehicles per day (both directions) in 2037. AADT at local roads is predicted to range from 21 vehicles per day to 6,391 vehicles per day (both directions) in 2017 and from 27 vehicles per day to 8,265 vehicles per day (both directions) in 2037. Attachment L-1, *Vehicle Traffic Modeling*, presents delay information for the specific intersections studied.

AADT and existing gate down time at grade crossings was used to calculate the average queuing length at grade crossings. Tables L-4 and L-5 show existing queuing lengths that exceed storage capacity under the no-action alternative for key intersections in 2017 and 2037, respectively. As mentioned previously, information for all studied intersections is presented in Attachment L-1, *Vehicle Traffic Modeling*. Intersections that are already experiencing vehicle delays and would be most affected are located in Centralia and Aberdeen; however, an increase in queuing from 2017 to 2037 is expected for many intersections in the study area under the no-action alternative due to anticipated growth in vehicle traffic. The complete results of the vehicle analysis are presented in Attachment L-1.

During an 8-hour observation on December 11, 2014, no train crossings were observed. Queue lengths were estimated by sampling the traffic entering and exiting the Olympic Gateway Plaza at Chehalis Street and Tyler Street on US 12 during midday and evening peak hours. Observed queuing

[5] One grain-train passby is used for most crossings with the exception of Industrial Road, Myrtle Street, N Maple Street, and W 1st Street, which do not have baseline grain traffic. Therefore, those crossing used an average of potential proposed action traffic for gate downtime per event.

and intersection operations corroborated the modeled 2017 no-action alternative operations in Aberdeen. The lack of pedestrian facilities and active grade-crossing gate protection in several locations appeared to pose a safety issue to vehicles turning right on red lights and pedestrians.

The queue length for most grade crossings was estimated using 2014 traffic count data with the exception of the Dairy Queen and McDonald's Entrances, which were estimated using grade crossings adjacent to the Olympic Gateway Plaza and distributed onto US 12 approaches based on evening peak hour traffic volumes from the 2007 *U.S. 101 Regional Circulation Plan* (Washington State Department of Transportation 2007). As shown, grade crossings at the Olympic Gateway Plaza in east Aberdeen and inside the plaza experience significant queuing on US 12 under existing conditions and would continue to do so under the no-action alternative.

Table L-4. 2017 No-Action Alternative Queue Estimates

Roadway Name	USDOT Crossing #	Available Storage Length (ft)				Estimated Queue Length[a] (ft)			
		WBL	EBTR	NB	SB	WBL	EBTR	NB	SB
Tower	092546N	-	-	360	-	-	-	480	-
Pearl	092547V	-	-	-	440	-	-	-	820
Fleet	096688T	350	290	80	100	160	20	180	0
Tyler	096029N	150	660	150	100	60	140	220	20
Chehalis	096691B	250	300	120	100	80	200	300	40
Newell	096693P	-	460	100	-	-	100	100	-
Heron	096695D	-	1000	-	-	-	1080	-	-
Port Industrial[b]	096711K	1200	1360	-	-	500	500	-	-

[a] Estimated Queue Length (feet) based on existing distribution of PM peak hour traffic volumes and the length of the average queue.
[b] Portland Industrial Road is an east-west street. Queuing values listed are eastbound and westbound through lengths.
WBL = westbound left; EBTR = eastbound through right; NB = northbound; SB = southbound

Table L-5. 2037 No-Action Alternative Queue Estimates

Roadway Name	USDOT Crossing #	Available Storage Length (ft)				Estimated Queue Length[a] (ft)			
		WBL	EBTR	NB	SB	WBL	EBTR	NB	SB
Tower	092546N	-	-	360	-	-	-	**620**	-
Pearl	092547V	-	-	-	440	-	-	-	**1060**
Fleet	096688T	350	290	80	100	140	20	**160**	0
Tyler	096029N	150	660	150	100	40	120	**200**	20
Chehalis	096691B	250	300	120	100	60	160	**260**	20
Newell	096693P	-	460	100	-	-	100	100	-
Heron	096695D	-	1000	-	-	-	**1,060**	-	-
Port Industrial[b]	096711K	1200	1360	-	-	660	660	-	-
Industrial Rd	922990N	510	530	-	-	**780**	**780**	-	-
W 1st St	808713U	-	-	320	240	-	-	240	240

[a] Estimated Queue Length (ft) based on existing distribution of PM peak hour traffic volumes and the length of the average queue.
[b] Portland Industrial Rd is an east-west street. Queuing values listed are eastbound and westbound through lengths.
Bold values exceed available storage.

Grade-Crossing Safety

Under the no-action alternative, the predicted frequency of a grade-crossing accident—typically a train and motor vehicle collision—would increase slightly over the 20-year analysis period because of the anticipated increase in AADT at grade crossings. The predicted interval between accidents would range from 40 to 454 years in 2017 and from 37 to 410 years in 2037 and from 18 to 742 years in 2017 and from 16 to 669 years in 2037 for all the grade crossings along the PS&P rail line. On the BNSF main line, the interval between predicted accidents for the Maple Street (092521T), E Main Street (092520L), and E Locust Street (092519S) grade crossings for the no-action alternative would range from 32 to 34 years in 2017 and from 31 to 33 years in 2037. The results of predicted accident formula and the GradeDec.Net Model for accident intervals at existing grade crossings are provided in Attachment L-1,*Vehicle Traffic Modeling*.

As with predictions for vehicle delay, accident frequencies would generally improve over the 20-year period for some grade crossings. This is due to improvements such as grade crossing protections that were assumed as part of the modeling (Table L-6). Although some grade crossing closures are likely over the 20-year analysis period, the analysis excluded any proposed closings, including the one currently proposed at Glenn Road (096657U). Additionally, as mentioned above, improvements (grade closures or separation) under the East Aberdeen Mobility project were not included in the detailed modeling, but would likely improve both delay and safety at intersections surrounding the Olympic Gateway Plaza.

Table L-6. Grade Crossing Infrastructure Projects Planned but Not Funded –No-Action Alternative (2017 and 2037)

Project Title[a]	Year	Project Lead	Location	Brief Description	Source
Tower Street Crossing	2017	WSDOT	Tower Street grade crossing with the PS&P rail line in Centralia	Add early warning system and crossing gates. Construction anticipated being complete by 2015	Stemkoski pers. comm.
Pearl Street Crossing	2017	WSDOT	Pearl Street grade crossing with the PS&P rail line in Centralia	Add early warning system and crossing gates. Construction anticipated being complete by 2015	Stemkoski pers. comm.
Devonshire Road Railroad Crossing Protection	2037	Grays Harbor County	US 12 Milepost 7.09 to 7.10	Install concrete crossing, gates, and signs (currently flashers)	Washington State Department of Transportation 2014b
Glenn Road Railroad Crossing Closure	2037	Grays Harbor County	US 12 milepost 0.0 to 0.2	Remove existing crossing and build new access road and cul-de-sac	Washington State Department of Transportation 2014b
Newman Creek Road Railroad Crossing Protection	2037	Grays Harbor County	US 12 milepost 0.21 to 0.22	Install signs and gates (currently passive)	Washington State Department of Transportation 2014b
Calder Road Railroad Crossing Protection	2037	Grays Harbor County	US 12 milepost 0.26 to 0.27	Install signs and gates (currently passive)	Washington State Department of Transportation 2014b

[a] Listed projects are currently planned projects that have not secured funding. These projects are listed under WSDOT's Six Year Transportation Improvement Plan for 2014 to 2019. These projects may or may not be funded after 2019.

WSDOT = Washington State Department of Transportation; PS&P = Puget Sound & Pacific Railroad

Impacts of the Proposed Action

This section describes the vehicle traffic and safety impacts that could occur in the study area as a result of construction and routine operation of the proposed action.

Construction

As described in Chapter 2, *Proposed Action and Alternatives*, construction of the proposed action could occur in two phases, with Phase 1 lasting 10 to 12 months and requiring approximately 86 workers and Phase 2 lasting approximately 10 months and requiring approximately 49 workers. It is assumed that for every one worker there would be one trip to and one trip from the project site, so 86 construction workers during Phase 1 would create 172 vehicle trips. Additional vehicle trips to and from the site associated with this temporary increase in construction workers and the delivery of construction equipment and materials could also increase vehicle delays at intersections

surrounding the project site. However, the potential for additional construction-related vehicle trips to affect vehicle delay times, including emergency vehicle delay times, would be minimal.

AADT on Industrial Road is estimated to be 7,495 vehicles by 2017. Construction-related vehicle traffic would result in a minimal increase to area AADT levels and would not cause a change in LOS designations for any grade crossings. Additionally, construction-related traffic would likely take varying routes to the project site and workers would have fluctuating schedules that would further spread out the potential for impacts over space and time. Increased rail traffic from delivery of construction materials could cause vehicle delays to increase. However, the anticipated delay would be typically be very similar to existing conditions because construction equipment and materials, if delivered by train, would likely occur in the form of additional cars on existing freight trains and would not increase the average number of trains per day to any appreciable extent.

Operations

Onsite

Operation of the proposed action would result in an additional 50 employee trips per day and the use of additional maintenance vehicles at maximum throughput. This would result in a minimal increase to area AADT levels and would not cause a change in LOS designations for any grade crossings. As noted in Chapter 2, *Proposed Action and Alternatives*, transport of crude oil associated with the proposed facilities would rely on rail and vessel transport. It is anticipated that tanker truck traffic would remain the same as for existing conditions and would not affect AADT on surrounding roadways. The potential grade-crossing safety and delay impacts of increased rail traffic related to the proposed action are discussed below.

Rail

Grade-Crossing Delay

As described in Chapter 2, *Proposed Action and Alternatives*, operation of the proposed action would result in increased rail traffic with increased blockages at grade crossings along the PS&P rail line (Section 3.15, *Rail Traffic*). Motorists, including emergency vehicle operators, would experience an increase in vehicle delay at grade crossings during operation of the proposed rail line. The results for all grade crossings along the PS&P rail line are presented in Attachment L-1, *Vehicle Traffic Modeling*.

The increase in the average delay compared to the no-action alternative could range from 7 to 56 additional seconds per vehicle in 2017 and 7 to 55 additional seconds per vehicle in 2037 in Aberdeen. The highest estimated delays of 56 additional seconds per vehicle would occur as a result of switching and train-building activities near Poynor Yard. The increase in the average delay compared to the no-action alternative could average 1 additional second per vehicle in Elma and Montesano; 4 additional seconds per vehicle in Centralia; 2 additional seconds per vehicle in Satsop, Malone, Porter, Oakville, and Rochester in 2017; and an average of 1 additional second per vehicle in Elma and Montesano; 6 additional seconds per vehicle in Centralia; and 2 additional seconds per vehicle in Satsop, Malone, Porter, Oakville, and Rochester in 2037.[6] Some intersections would not be

[6] Train switching movements allow for a train to be broken down into or assembled from smaller groupings of cars and for railcars to be moved between a rail yard and customer facilities.

affected by increased rail traffic related to the proposed action (0 seconds of change), but others could be substantially affected (up to 56 additional seconds of delay). As a result, the LOS designation for most grade crossings would change. Some would drop to LOS E and F, the lowest designations that indicate substantial congestion. The intersections that would be most notably affected are presented in Table L-7.

Of the 81 grade crossings modeled in the study area, nine would experience a decrease in the LOS designation due to the increased train traffic from the proposed action (see Attachment L-1for a complete list of grade crossings and additional delay metrics). These nine grade crossings would experience higher average gate down times per train due to rail switching maneuvers and activities at the Port's facilities to the west. As shown in Table L-7, the grade crossings of H Street, E Heron Street, and Newell Street in Aberdeen would not meet WSDOT operating standards if maximum throughput capacity occurs under 2017 conditions. This assumes none of the planned infrastructure improvements on the PS&P rail line would have been implemented. If the proposed oil terminal facility were to operate at half capacity in 2017, H Street would be the only grade crossing that would not meet WSDOT operating standards.

As noted under the 2037 condition, with the incorporation of PS&P rail line improvements that could allow for increased speeds in East Aberdeen (up to 20 mph in some locations), the predicted declines in LOS would be less than under 2017 conditions. However, as shown in Table L-7, the LOS at H Street still would decline to a level below the WSDOT standard.

The LOS sensitivity analysis determined that, depending on the grade crossing, the incremental increase in train traffic that could be experienced before LOS would decrease below LOS D ranged from 0.4 to 5.8 trains per day in 2017 and 0.6 to 5.3 trains per day in 2037.

Table L-7. Proposed Action: LOS Designations At or Below WSDOT Standards[a]

FRA Crossing ID	Street Name	City	AADT 2017	AADT 2037	Road Type	No Action 2017 LOS	2017 LOS	2017 LOS 50%	No Action 2037 LOS	2037 LOS
922990N	Industrial Rd	Aberdeen	5,795	7,494	Urban Minor Arterial	B	D	C	B	D
092551K	H Street[b]	Aberdeen	879	1,136	Urban Local	C	F	E	C	F
096695D	E Heron St	Aberdeen	3,452	4,464	Urban Local	D	E	D	B	D
096693P	Newell St	Aberdeen	649	839	Urban Local	C	E	D	B	D
096691B	S Chehalis St	Aberdeen	4,906	6,344	Urban Local	C	D	C	B	C
096689A	Dairy Queen Entrance	Aberdeen	157	216	Urban Local	B	D	C	A	C
096690U	McDonald's Entrance	Aberdeen	1,067	1,380	Urban Local	B	D	C	A	C
096029N	Tyler St	Aberdeen	4,048	5,235	Urban Local	B	D	C	A	C
096688T	Fleet St	Aberdeen	1,611	2,083	Urban Local	B	D	C	A	C

[a] WSDOT LOS Standards for peak-hours, urban highways should meet a LOS of D and for rural highways a LOS of C in Grays Harbor County and Thurston County (Washington State Department of Transportation 2009).

[b] Existing traffic volume for H Street is from 1986 and extrapolated to the analysis year of 2017 or 2037. Because existing land uses near the H Street grade crossing are currently vacant, actual average daily traffic at this grade crossing would be substantially lower than shown in this table. For this reason, H Street is not included in the potential vehicle delay impacts in Section 3.16, *Vehicle Traffic and Safety*.

LOS = level of service; WSDOT = Washington State Department of Transportation; FRA = Federal Railroad Administration; AADT = annual average daily traffic

As discussed in Section 3.15, *Rail Traffic*, additional improvements to the PS&P rail line infrastructure have limited potential to alter rail traffic patterns such that blocked grade crossing time could be substantially reduced. The primary mechanisms by which vehicle delay could be minimized are altering how the PS&P rail line operates within the existing infrastructure (e.g., switching movements at night) and constructing grade-separated intersections. These measures would require the participation of a broad group of stakeholders in coordination with the ongoing regional transportation planning efforts that are focused on addressing existing traffic concerns. As noted in *No-Action Alternative*, many of these areas show traffic delays under existing conditions and would continue to do so regardless of the proposed action.

In addition to impacts along the PS&P rail line, grade crossings in Centralia on the BNSF main line near the intersection with PS&P rail line could be affected as trains move from the main line onto the PS&P rail line. These intersections include Maple Street M1, E Main Street M1, and E Locust Street M1, but they were not subject to detailed modeling due to the higher volume of existing train traffic (approximately 40 trains per day) and higher average train speeds (typically about 40 mph) than currently operated on the PS&P rail line. Although these grade crossings could experience increased train traffic as a result of the proposed action, the increase would be small in comparison to the existing conditions at these grade crossings. As is the case today, for trains entering or leaving the PS&P rail line, project-related trains would take about 10 minutes to clear these grade crossings, but would contribute to minor increases in vehicle delay per day (Attachment L-1, *Vehicle Traffic Modeling*).

Grade-Crossing Delay for Peak Hour Traffic

During peak traffic hours (typically from 4:00 pm to 5:00 pm), roadways experience higher volumes of vehicles due to commuting schedules. A sensitivity analysis was conducted to evaluate the potential vehicle delay in the event that an oil train (approximately 7,419 feet in length) operated over public, grade crossings during peak hour traffic. This sensitivity analysis demonstrates that where gate downtimes would be substantial, long peak-hour vehicle queues would cause a large increase in the average delay per vehicle. Estimated increases in average vehicle delay range from 290 to 1,497 additional seconds per vehicle in 2017 and from 20 to 9,180 additional seconds per vehicle in 2037 in Aberdeen. Higher estimates of delay are due to switching activities at Poynor Yard. Estimated increases in average vehicle delay ranged from 5 to 8 additional seconds per vehicle in Elma and Montesano; 39 to 407 additional seconds per vehicle in Centralia; and 6 to 41 additional seconds per vehicle in Satsop, Malone, Porter, Oakville, and Rochester in 2017; and 5 to 8 additional seconds per vehicle in Elma and Montesano; 39 to 148 additional seconds per vehicle in Centralia; and 6 to 88 additional seconds per vehicle in Satsop, Malone, Porter, Oakville, and Rochester in 2037.

Grade-Crossing Delay for Emergency Vehicles

Emergency vehicles would experience grade-crossing delays due to increased vehicle traffic under the proposed action. For vehicles that use the grade crossings between Aberdeen and Centralia, the chance of a vehicle (including an emergency response vehicle) experiencing some delay from a train occupying a grade crossing would result in an incremental increase in possible conflicts compared to the no-action alternative. The predicted increase in potential for delay in Aberdeen would range from 0.70 to 9.4% under 2017 conditions and 0.70 to 9.2% under 2037 conditions. The highest potential delay increase of 9.4% would occur as a result of switching and train building activities near Poynor Yard. The predicted increase in potential for delay in other surrounding communities, including Elma, Montesano, Satsop, Centralia, Malone, Porter, Oakville, and Rochester, would range from 0.28 to 0.92% under 2017 and 2037 conditions. The incidence is expected to be slightly lower over the course of the 20-year analysis period due to the incorporation of infrastructure improvements.

The potential for delay of an emergency vehicle further depends on where the call is located in relation to the PS&P rail line and the dispatched station, and the availability of alternate routes if a train occupies a grade crossing at the time of the call. Emergency responders at some locations, such as the Olympic Gateway Plaza entrance grade crossings in Aberdeen, would experience additional delay beyond what is currently experienced. Refer to Chapter 4, *Environmental Health and Safety*, for a detailed discussion of increased risks and emergency response for potential hazardous materials releases.

Vehicle Delay at Adjacent Intersections

As noted previously, increased vehicle delay from trains blocking grade crossings can have secondary impacts on nearby intersections. As vehicles begin to queue while waiting for the grade crossing to open, increased roadway congestion can affect adjacent intersections and cause additional congestion at those intersections. Grade crossings along the PS&P rail line that are most likely to be affected by the proposed action are located primarily in Aberdeen.

Tables L-8 and L-9 show that the average queue length at the Port Industrial Road (096711K) grade crossing would approximately double compared to the no-action alternative (as shown in Tables L-4

and L-5) due to the lengthy project-related switching movements in 2017 and would not exceed storage capacity under 2037 conditions. With a westbound queue stretching east as far as Division Street, the Port Industrial Road crossing could begin to significantly affect local traffic flow. To mitigate vehicle delays at adjacent intersections from longer queue lengths, the storage capacity could be increased for streets experiencing impacts as a result of the proposed action.

The estimated queue length at grade crossings adjacent to the Olympic Gateway Plaza were distributed onto US 12 approaches based on evening peak hour traffic volumes listed in the 2007 *U.S. 101 Regional Circulation Plan* (Washington State Department of Transportation 2007). Tables L-8 and L-9 also show that grade crossings at the Olympic Gateway Plaza in east Aberdeen experience significant queuing on US 12 and inside the plaza itself. As shown, rail traffic associated with the proposed action, when combined with existing rail traffic, is expected to generate average queues that would exceed the available storage length Fleet Street, Tyler Street, and Chehalis Street. However, queue lengths under the proposed action compared to those anticipated under the no-action alternative (Tables L-4 and L-5) show relatively small increases (a few vehicles). In fact, queue lengths are exceeded without the proposed action

In Centralia, vehicle queues at both Tower Street and Pearl Street (also known as D Street) grade crossings would exceed the available storage under the 2017 and 2037 no-action alternative. With the addition of proposed action rail traffic, increases to average vehicle queues would be minor (a few vehicles).

Table L-8. 2017 Proposed Action Queue Estimates

Roadway Name	USDOT Crossing #	Available Storage Length (ft)				Estimated Queue Length[a] (ft)			
		WBL	EBTR	NB	SB	WBL	EBTR	NB	SB
Tower	092546N	-	-	360	-	-	-	**500**	-
Pearl	092547V	-	-	-	440	-	-	-	**860**
Fleet	096688T	350	290	80	100	200	20	**220**	0
Tyler	096029N	150	660	150	100	60	180	**280**	40
Chehalis	096691B	250	300	120	100	100	240	**360**	40
Newell	096693P	-	460	100	-	-	120	**120**	-
Heron	096695D	-	1,000	-	-	-	**1,240**	-	-
Industrial Rd	922990N	510	530	-	-	880	**880**	-	-
W 1st St	808713U	-	-	320	240	-	-	**380**	**380**

[a] Estimated Queue Length (ft) based on existing distribution of PM peak hour traffic volumes and the length of the average queue.
Bold values exceed available storage.

Table L-9. 2037 Proposed Action Queue Estimates

Roadway Name	USDOT Crossing #	Available Storage Length (ft)				Estimated Queue Length[a] (ft)			
		WBL	EBTR	NB	SB	WBL	EBTR	NB	SB
Tower	092546N	-	-	360	-	-	-	660	-
Pearl	092547V	-	-	-	440	-	-	-	1,120
Fleet	096688T	350	290	80	100	200	20	220	0
Tyler	096029N	150	660	150	100	60	180	280	40
Chehalis	096691B	250	300	120	100	100	240	360	40
Newell	096693P	-	460	100	-	-	120	120	-
Heron	096695D	-	1000	-	-	-	1,340	-	-
Port Industrial[b]	096711K	1200	1360	-	-	1300	1300	-	-
Industrial Rd	922990N	510	530	-	-	1,140	1,140	-	-
W 1st St	808713U	-	-	320	240	-	-	480	480

[a] Estimated Queue Length (ft) based on existing distribution of PM peak hour traffic volumes and the length of the average queue.
[b] Portland Industrial Rd is an east-west street. Queuing values listed are eastbound and westbound through lengths.
Bold values exceed available storage.

Many of these areas are already problems under existing conditions and would continue to be so regardless of the proposed action. A sensitivity analysis was conducted for peak hour traffic estimating vehicle queue lengths using a simulation software (Synchro) for one oil train passby during the evening peak hour traffic at the following intersections.

- Fleet Street and US 12
- Tyler Street and US 12
- Chehalis Street and US 12
- Newell Street and US 12
- Heron Street and S Harbor Street

The simulation modeling conducted analyzed four scenarios of the impacts of inbound and outbound train passbys. Scenarios were generated using the existing roadway lane configurations and traffic signal timing as well as an optimized lane configuration and signal timing to improve overall vehicle operations during/after a train pass by event. All scenarios used future 2017 intersection volumes. The scenarios are as follows.

- 2017 Existing Lanes and Timing PM Peak Hour (Inbound)
- 2017 Existing Lanes and Timing PM Peak Hour (Outbound)
- 2017 Optimized Lanes and Timing PM Peak Hour (Inbound)
- 2017 Optimized Lanes and Timing PM Peak Hour (Outbound)

The Synchro modeling results determined that the railroad crossing at Heron Street conflicts with a significant amount of Wishkah Mall traffic volume headed eastbound on US 12 and serves as the bottleneck for the entire corridor. During an outbound train event (to the project site), the PM peak hour queue spills beyond the model limits to the upstream traffic signal at F Street. During an inbound train event, the queue length at Heron Street experiences some improvement after signal timing is optimized to prioritize the eastbound flow of traffic. However, queues remain in excess of 1,000 feet.

At Chehalis Street, all available storage is filled between Harbor Street and Chehalis Street. Vehicles turning right into Wishkah Mall have few options during an outbound train event, which lasts nearly half the peak hour. The signal at Chehalis Street operates as a meter for the downstream intersections of Tyler and Fleet Street, which explains the shorter queue estimate at each of these intersections.

The optimized outbound scenario shows a longer queue estimate at Tyler and Fleet Street compared to the existing scenario because the new eastbound right turn pocket and increased cycle length at Chehalis Street allow higher volume throughput after the railroad crossing at Chehalis Street opens. This additional volume waits for the outbound train to clear the gate at Tyler Street before it can be serviced by the Tyler Street signal.

Queues in the westbound left turn pockets occur because of a single train event in the PM peak hour. At Tyler and Fleet Street during the outbound train event, the available storage length is filled and queues spill back into the westbound through movement. However, only Tyler Street experiences this problem during the shorter inbound train gate downtime. The optimized westbound left queues are longer than existing queues due to the direct conflict with the eastbound through movement. In an attempt to minimize eastbound queuing, available green time was allocated to the eastbound through movement, and resulted in longer westbound queuing.

Grade-Crossing Safety

Increased rail traffic related to the proposed action could increase the frequency of accidents along the PS&P rail line compared to the no-action alternative. The magnitude of the increase would be determined by the volume of train traffic and growth in AADT. The impacts on grade-crossing safety, specific to each grade crossing for accidents involving trains and vehicles, are summarized in Attachment L-1, *Vehicle Traffic Modeling.* Data in the attachment provide the total predicted accident rate, predicted intervals between accidents, and the decrease in years between the predicted intervals in the analysis year versus the no-action alternative for all the grade crossings along the PS&P rail line.

It is estimated that the predicted interval between accidents under the proposed action would decrease by 4.3 years to an interval of 52.9 years in 2017 and by 4 years to an interval of 43.8 years in 2037 compared to the no-action alternative. The range excludes any proposed closings of grade crossings, including the grade crossing at Glenn Road (096657U). The decrease in the predicted interval between accidents under the proposed action would range from 2.6 to 69.6 years in 2017 and from 1.7 to 62.7 years in 2037.

On the BNSF main line, the decrease in the number of years between predicted accidents for the Maple Street (092521T), E Main Street (092520L), and E Locust Street (092519S) grade crossings for the proposed action compared to the no-action alternative would be 0.3 year in 2017 and 2037.

This small decrease in the interval between the predicted accidents indicates a low level of impact from the proposed action train traffic.

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Attachment L-1
Vehicle Traffic Modeling

This attachment contains detailed analysis methods and results related to the vehicle traffic analysis, including data on roadways and intersections and grade-crossing delay and safety.

Roadways and Intersections

Traffic Volumes and Forecast Method

Available annual average daily traffic (AADT) data for the 25 study crossing intersections was dated from 1986 to 2014. Traffic volumes were increased to reflect anticipated future 2017 no-action alternative volumes using the following historic growth rates found in the *Annual Energy Outlook* from the U.S. Energy Information Administration (2013).

- 1970–1995: 3.1% per year
- 1996–2007: 2.0% per year

After 2007, an assumed growth rate of 1.5% was used, based on the U.S. Energy Information Administration report, and input from Washington State Department of Transportation (WSDOT) (Nizam pers. comm.).

Vehicle queue lengths were estimated for roadways and grade crossings near the Olympic Gateway Plaza using a simulation software (Synchro) during the PM peak hour based on one proposed action train passing by. The following intersections were modeled and analyzed within the simulation software:

- Fleet Street and US Route 12 (US 12)
- Tyler Street and US 12
- Chehalis Street and US 12
- Newell Street and US 12
- Heron Street and South Harbor Street

The model was created for four scenarios to analyze the impacts of inbound and outbound trains passing by. Scenarios were generated using the existing roadway lane configurations and traffic signal timing as well as an optimized lane configuration and signal timing to improve overall vehicle operations during/after a train pass by event. All scenarios used future 2017 intersection volumes. The optimized scenarios increased the actuated cycle length to 180 seconds, adjusted the corridor signal coordination, and added a right-turn pocket at the S Chehalis Street and US 12 intersection. The scenarios are as follows.

- 2017 Existing Lanes and Timing PM Peak Hour (Inbound)
- 2017 Existing Lanes and Timing PM Peak Hour (Outbound)
- 2017 Optimized Lanes and Timing PM Peak Hour (Inbound)

- 2017 Optimized Lanes and Timing PM Peak Hour (Outbound)

City of Aberdeen staff provided available 2014 peak hour traffic counts and WSDOT staff provided existing signal timing information for the study area corridor. Future 2017 volumes are estimated based on a 1.5% growth rate.

The model was calibrated by refining mandatory and positioning distances at all intersections to match with the available storage lengths and lane configurations. These adjustments were carried into the simulation parameters so simulated drivers would not factor the mandatory distance to increase or decrease from original input.

During simulation, the eastbound right-turn volume at Newell Street consistently generated errors. This volume was reallocated to Chehalis Street to resolve the error, but does not affect the overall result of queuing from Chehalis Street to Heron Street.

The 95th percentile vehicle queue length was determined for each movement by taking the average of five modeled simulation runs for each scenario. The 95th percentile queue is the length for a given intersection movement that has only a 5% chance of being exceeded during the peak traffic hour.

The 2017 volumes at other key study area crossings were compared to volumes found in the US Route 101 Regional Circulation Plan (Washington State Department of Transportation 2007) and found to be conservative.

Field Observations

During a field visit on December 11, 2014, existing operating conditions were observed. While no train crossing was observed during the 8-hour observations, queue lengths were estimated by sampling the traffic entering and exiting the Olympic Gateway Plaza at Chehalis Street and Tyler Street on US 12 during mid-day and PM peak hours. Observed queuing and intersection operations corroborated the modeled 2017 no-action alternative operations in Aberdeen. The lack of pedestrian facilities and active crossing gate protection in several locations appeared to pose a safety issue for right-turn-on-red vehicles and pedestrians.

Collision Analysis

Ten years of collision records (2003 to 2013) for the study area were obtained from WSDOT and the Federal Rail Administration (FRA). The data identified one collision involving a train that resulted in a possible injury at the Olympic Gateway Plaza commercial access located between Chehalis Street and Tyler Street in Aberdeen. The identified collision involved a right-turning vehicle not yielding the right-of-way to a slow-moving train. This is consistent with safety concerns identified in the field observations.

Railroad Crossing Performance Measures

Level of service (LOS) ratings and volume-to-capacity ratios are two commonly used performance measures for intersection operations.

- Delay. Delay refers to the average delay per vehicle in a 24-hour period, which is measured in seconds for a rail crossing using the average number of daily trains, average train length, train speed, and average daily traffic volumes in both directions.

- Level of service (LOS). LOS refers to a rating (A through F) based on the delay experienced by vehicles at the intersection. LOS A, B, and C indicate conditions where traffic moves without significant delays over a 24-hour period. LOS D and E are progressively worse operating conditions. LOS F represents conditions where average vehicle delay has become excessive and demand has exceeded capacity. Based on the LOS definitions in the Highway Capacity Manual (Transportation Research Board 2010) method for signalized intersections, similar delay thresholds were used to assess the average delay experienced per vehicle at each rail crossing during a 24-hour period (Table 1)

Table 1. Level of Service Designations

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

Source: Transportation Research Board 2010

- Queue: Queue refers to the total average length of delayed vehicles per lane. Calculation is based on the number of vehicles delayed due to gate down times throughout a 24-hour period and an average vehicle length of 20 feet.

Agency Operating Standards

WSDOT operating standard for all study intersections of state highways in Grays Harbor County meet its minimum acceptable LOS standard, which is LOS D for peak periods (Washington State Department of Transportation 2010). Table 2 shows the at-grade crossing and roadway characteristics.

Table 2. At-Grade Crossing and Roadway Characteristics

	Roadway			Railroad (Trains)		
Roadway Name	2017 AADT	Classification	Lanes	Protection?	No. per day	Ave. Speed (mph)
1. Tower St/SR 507	8,023	Collector	2	Overhead Lights	3.0	7
2. Pearl St/SR 507	13,755	Collector	2	Overhead Lights	3.0	7
3. Joselyn Ave	209	Local	2	Gates/Lights	3.0	25
4. Private Drive	100[a]	Local	2	None	3.0	25
5. 183rd Ave SW	785	Collector	2	Gates/Lights	3.0	25
6. Blockhouse Rd	42	Local	2	None	3.0	25
7. Murray St	178	Local	2	None	3.0	25
8. Newton St	178	Local	2	None	3.0	25
9. Shelton Rd	52	Local	2	None	3.0	25
10. Elma-Gate Rd	94	Local	2	None	3.0	25
11. Porter Creek Rd	805	Collector	2	Gates/Lights	3.0	25
12. Dunlap Rd	188	Local	2	None	3.0	25
13. Blockhouse Rd N	42	Local	2	None	3.0	25
14. Blockhouse Rd N	220	Local	2	None	3.0	25
15. Brady Loop Rd	1,046	Collector	2	Gates/Lights	3.1	25
16. Monte-Brady Rd	785	Collector	2	Gates/Lights	3.1	25
17. Main St	1,569	Collector	2	Gates/Lights	3.1	25
18. Sargent Blvd	1,250	Collector	2	Gates/Lights	3.1	12
19. Fleet St	1,611	Local	2	None	3.2	7
20. Tyler St	4,048	Local	4	Traffic Signal	3.2	7
21. Chehalis St	4,906	Local	4	Traffic Signal	3.2	6
22. Newell St	649	Local	2	Overhead Lights	3.2	6
23. Heron St	3,452	Local	2	None	3.2	5
24. Port Industrial Rd	17,845	Arterial	2	Gates/Lights	3.9	8
25. Adams St	750[a]	Local	2	None	0.2	12

[a] AADT for the Private Drive and Adams Street crossings were approximated from field observations and AADT from prior studies.

AADT = annual average daily traffic

The following Tables 3 through 8 show estimated queues and storage capacity based on AADT in 2017 and 2037 for the no-action alternative and proposed action. The average vehicle queue length is a function of the total number of roadway approach lanes, number of daily trains, and the number of vehicles delayed per day. A sensitivity analysis of peak hour traffic with one oil train pass by and 50% capacity scenarios were also conducted.

Table 3. 2017 No-Action Alternative Queue Estimates

Roadway Name	USDOT Crossing #	Available Storage Length (ft)				Estimated Queue Length[a] (ft)			
		WBL	EBTR	NB	SB	WBL	EBTR	NB	SB
1. Tower	092546N	-	-	360	-	0	0	480	0
2. Pearl	092547V	-	-	-	440	0	0	0	820
3. Joselyn Ave	092569V	220[e]	500+[e]	35[e]	500+[e]	0	0	20	0
5. 183rd Ave SW	092573K	320[e]	440[e]	230[e]		20	20	20	0
6. Blockhouse Rd	092583R	-	-	80	500+	0	0	20	20
7. Murray St	092585E	-	-	150	300	0	0	20	20
8. Newton St	092586L	-	-	220	460	0	0	20	20
9. Shelton Rd	092593W	-	-	500+[c]	60[c]	0	0	20	20
10. Elma Gate Rd W	092595K	-	-	500+	500+	0	0	20	20
11. Porter Creek Rd	092603A	220[d]	200[d]	500+[c]	290[c]	0	0	20	0
12. Dunlap Rd	096510U	-	-	500+	65	0	0	20	20
13. Blockhouse Rd W	096518Y	-	-	500+[c]	60[c]	0	0	20	20
14. Blockhouse Rd E	096515D	-	-	500+	200	0	0	20	20
15. Monte Brady Rd	096652K	-	-	500+	150	0	20	20	0
16. Monte Brady Rd	096658B	-	200	500+	-	0	0	20	20
17. Main Street	096672W	-	-	140	280	0	0	20	20
18. Junction City Rd	096687L	-	-	500+	500+	0	0	40	40
19. Fleet	096688T	350	290	80	100	160	20	180	0
20. Tyler	096029N	150	660	150	100	60	140	220	20
21. Chehalis	096691B	250	300	120	100	80	200	300	40
22. Newell	096693P	-	460	100	-	0	100	100	0
23. Heron	096695D	-	1000	-	-	0	1080	0	0
24. Port Industrial	096711K	1200	1360	-	-	500	500	0	0
25. Monroe St[f]	808707R	-	-	500+	20	0	0	20	20
26. Washington St[f]	096706N	-	-	500+	300	0	0	20	20

[a] Estimated Queue Length (feet) based on existing distribution of PM peak hour traffic volumes and the length of the average queue.
[b] Portland Industrial Road is an east-west street. Queuing values listed are eastbound and westbound through lengths.
[c] NB is actually EB and SB is actually WB
[d] WBL is actually NBL and EBTR is actually SBR
[e] NB is actually SB, EBTR is actually WBR, and WBL is actually EBL
[f] Intersections 25 and 26 were added to this project
Bold values exceed available storage.
WBL = westbound left; EBTR = eastbound through right; NB = northbound; SB = southbound

Table 4. 2037 No-Action Alternative Queue Estimates

Roadway Name	USDOT Crossing #	Available Storage Length (ft)				Estimated Queue Length[a] (ft)			
		WBL	EBTR	NB	SB	WBL	EBTR	NB	SB
1. Tower	092546N	-	-	360	-	0	0	620	0
2. Pearl	092547V	-	-	-	440	0	0	0	1060
3. Joselyn Ave	092569V	220[e]	500+[e]	35[e]	500+[e]	0	0	20	0
5. 183rd Ave SW	092573K	320[e]	440[e]	230[e]		20	20	20	0
6. Blockhouse Rd	092583R	-	-	80	500+	0	0	20	20
7. Murray St	092585E	-	-	150	300	0	0	20	20
8. Newton St	092586L	-	-	220	460	0	0	20	20
9. Shelton Rd	092593W	-	-	500+[c]	60[c]	0	0	20	20
10. Elma Gate Rd W	092595K	-	-	500+	500+	0	0	20	20
11. Porter Creek Rd	092603A	220[d]	200[d]	500+[c]	290[c]	0	0	20	0
12. Dunlap Rd	096510U	-	-	500+	65	0	0	20	20
13. Blockhouse Rd W	096518Y	-	-	500+[c]	60[c]	0	0	20	20
14. Blockhouse Rd E	096515D	-	-	500+	200	0	0	20	20
15. Monte Brady Rd	096652K	-	-	500+	150	0	20	20	0
16. Monte Brady Rd	096658B	-	200	500+	-	0	0	20	20
17. Main Street	096672W	-	-	140	280	0	0	40	40
18. Junction City Rd	096687L	-	-	500+	500+	0	0	60	60
19. Fleet	096688T	350	290	80	100	140	20	160	0
20. Tyler	096029N	150	660	150	100	40	120	200	20
21. Chehalis	096691B	250	300	120	100	60	160	260	20
22. Newell	096693P	-	460	100	-	0	100	100	0
23. Heron	096695D	-	1000	-	-	0	1060	0	0
24. Port Industrial	096711K	1200	1360	-	-	660	660	0	0
25. Monroe St[f]	808707R	-	-	500+	20	0	0	20	20
26. Washington St[f]	096706N	-	-	500+	300	0	0	20	20

[a] Estimated Queue Length (ft) based on existing distribution of PM peak hour traffic volumes and the length of the average queue.
[b] Portland Industrial Rd is an east-west street. Queuing values listed are eastbound and westbound through lengths.
[c] NB is actually EB and SB is actually WB
[d] WBL is actually NBL and EBTR is actually SBR
[e] NB is actually SB, EBTR is actually WBR, and WBL is actually EBL
[f] Intersections 25 and 26 were added to this project
Bold values exceed available storage.
WBL = westbound left; EBTR = eastbound through right; NB = northbound; SB = southbound

Table 5. 2017 Proposed Action Queue Estimates

Roadway Name	USDOT Crossing #	Available Storage Length (ft)				Estimated Queue Length[a] (ft)			
		WBL	EBTR	NB	SB	WBL	EBTR	NB	SB
1. Tower	092546N	-	-	360	-	0	0	500	0
2. Pearl	092547V	-	-	-	440	0	0	0	860
3. Joselyn Ave	092569V	220[e]	500+[e]	35[e]	500+[e]	0	0	20	0
5. 183rd Ave SW	092573K	320[e]	440[e]	230[e]		20	20	20	0
6. Blockhouse Rd	092583R	-	-	80	500+	0	0	20	20
7. Murray St	092585E	-	-	150	300	0	0	20	20
8. Newton St	092586L	-	-	220	460	0	0	20	20
9. Shelton Rd	092593W	-	-	500+[c]	60[c]	0	0	20	20
10. Elma Gate Rd W	092595K	-	-	500+	500+	0	0	20	20
11. Porter Creek Rd	092603A	220[d]	200[d]	500+[c]	290[c]	0	0	20	0
12. Dunlap Rd	096510U	-	-	500+	65	0	0	20	20
13. Blockhouse Rd W	096518Y	-	-	500+[c]	60[c]	0	0	20	20
14. Blockhouse Rd E	096515D	-	-	500+	200	0	0	20	20
15. Monte Brady Rd	096652K	-	-	500+	150	0	20	20	0
16. Monte Brady Rd	096658B	-	200	500+	-	0	0	20	20
17. Main Street	096672W	-	-	140	280	0	0	40	40
18. Junction City Rd	096687L	-	-	500+	500+	0	0	40	40
19. Fleet	096688T	350	290	80	100	200	20	220	0
20. Tyler	096029N	150	660	150	100	60	180	280	40
21. Chehalis	096691B	250	300	120	100	100	240	360	40
22. Newell	096693P	-	460	100	-	0	120	120	0
23. Heron	096695D	-	1000	-	-	0	1240	0	0
24. Port Industrial	096711K	1200	1360	-	-	1000	1000	0	0
25. Monroe St[f]	808707R	-	-	500+	20	0	0	20	20
26. Washington St[f]	096706N	-	-	500+	300	0	0	40	40

[a] Estimated Queue Length (ft) based on existing distribution of PM peak hour traffic volumes and the length of the average queue.
[b] Portland Industrial Rd is an east-west street. Queuing values listed are eastbound and westbound through lengths.
[c] NB is actually EB and SB is actually WB
[d] WBL is actually NBL and EBTR is actually SBR
[e] NB is actually SB, EBTR is actually WBR, and WBL is actually EBL
[f] Intersections 25 and 26 were added to this project
Bold values exceed available storage.
WBL = westbound left; EBTR = eastbound through right; NB = northbound; SB = southbound

Table 6. 2037 Proposed Action Queue Estimates

Roadway Name	USDOT Crossing #	Available Storage Length (ft)				Estimated Queue Length[a] (ft)			
		WBL	EBTR	NB	SB	WBL	EBTR	NB	SB
1. Tower	092546N	-	-	360	-	0	0	660	0
2. Pearl	092547V	-	-	-	440	0	0	0	1120
3. Joselyn Ave	092569V	220[e]	500+[e]	35[e]	500+[e]	0	0	20	0
5. 183rd Ave SW	092573K	320[e]	440[e]	230[e]		20	20	20	0
6. Blockhouse Rd	092583R	-	-	80	500+	0	0	20	20
7. Murray St	092585E	-	-	150	300	0	0	20	20
8. Newton St	092586L	-	-	220	460	0	0	20	20
9. Shelton Rd	092593W	-	-	500+[c]	60[c]	0	0	20	20
10. Elma Gate Rd W	092595K	-	-	500+	500+	0	0	20	20
11. Porter Creek Rd	092603A	220[d]	200[d]	500+[c]	290[c]	0	0	20	0
12. Dunlap Rd	096510U	-	-	500+	65	0	0	20	20
13. Blockhouse Rd W	096518Y	-	-	500+[c]	60[c]	0	0	20	20
14. Blockhouse Rd E	096515D	-	-	500+	200	0	0	20	20
15. Monte Brady Rd	096652K	-	-	500+	150	0	20	20	0
16. Monte Brady Rd	096658B	-	200	500+	-	0	0	20	20
17. Main Street	096672W	-	-	140	280	0	0	40	40
18. Junction City Rd	096687L	-	-	500+	500+	0	0	60	60
19. Fleet	096688T	350	290	80	100	200	20	220	0
20. Tyler	096029N	150	660	150	100	60	180	280	40
21. Chehalis	096691B	250	300	120	100	100	240	360	40
22. Newell	096693P	-	460	100	-	0	120	120	0
23. Heron	096695D	-	1000	-	-	0	1340	0	0
24. Port Industrial	096711K	1200	1360	-	-	1300	1300	0	0
25. Monroe St[f]	808707R	-	-	500+	20	0	0	20	20
26. Washington St[f]	096706N	-	-	500+	300	0	0	60	60

[a] Estimated Queue Length (ft) based on existing distribution of PM peak hour traffic volumes and the length of the average queue.
[b] Portland Industrial Rd is an east-west street. Queuing values listed are eastbound and westbound through lengths.
[c] NB is actually EB and SB is actually WB
[d] WBL is actually NBL and EBTR is actually SBR
[e] NB is actually SB, EBTR is actually WBR, and WBL is actually EBL
[f] Intersections 25 and 26 were added to this project
Bold values exceed available storage.
WBL = westbound left; EBTR = eastbound through right; NB = northbound; SB = southbound

Table 7. 2017 Proposed Action Queue Estimates During Peak Hour

Roadway Name	USDOT Crossing #	Available Storage Length (ft)				Estimated Queue Length[a] (ft)			
		WBL	EBTR	NB	SB	WBL	EBTR	NB	SB
1. Tower	092546N	-	-	360	-	0	0	1540	0
2. Pearl	092547V	-	-	-	440	0	0	0	2620
3. Joselyn Ave	092569V	220[e]	500+[e]	35[e]	500+[e]	0	0	20	0
5. 183rd Ave SW	092573K	320[e]	440[e]	230[e]		40	40	60	0
6. Blockhouse Rd	092583R	-	-	80	500+	0	0	20	20
7. Murray St	092585E	-	-	150	300	0	0	20	20
8. Newton St	092586L	-	-	220	460	0	0	20	20
9. Shelton Rd	092593W	-	-	500+[c]	60[c]	0	0	20	20
10. Elma Gate Rd W	092595K	-	-	500+	500+	0	0	20	20
11. Porter Creek Rd	092603A	220[d]	200[d]	500+[c]	290[c]	20	20	60	0
12. Dunlap Rd	096510U	-	-	500+	65	0	0	20	20
13. Blockhouse Rd W	096518Y	-	-	500+[c]	60[c]	0	0	20	20
14. Blockhouse Rd E	096515D	-	-	500+	200	0	0	20	20
15. Monte Brady Rd	096652K	-	-	500+	150	0	80	80	0
16. Monte Brady Rd	096658B	-	200	500+	-	0	0	60	60
17. Main Street	096672W	-	-	140	280	0	0	120	120
18. Junction City Rd	096687L	-	-	500+	500+	0	0	180	180
19. Fleet	096688T	350	290	80	100	620	60	700	20
20. Tyler	096029N	150	660	150	100	220	560	880	120
21. Chehalis	096691B	250	300	120	100	280	720	1100	120
22. Newell	096693P	-	460	100	-	0	320	320	0
23. Heron	096695D	-	1000	-	-	0	3460	0	0
24. Port Industrial	096711K	1200	1360	-	-	5220	5220	0	0
25. Monroe St[f]	808707R	-	-	500+	20	0	0	20	20
26. Washington St[f]	096706N	-	-	500+	300	0	0	360	360

WBL = westbound left; EBTR = eastbound through right; NB = northbound; SB = southbound

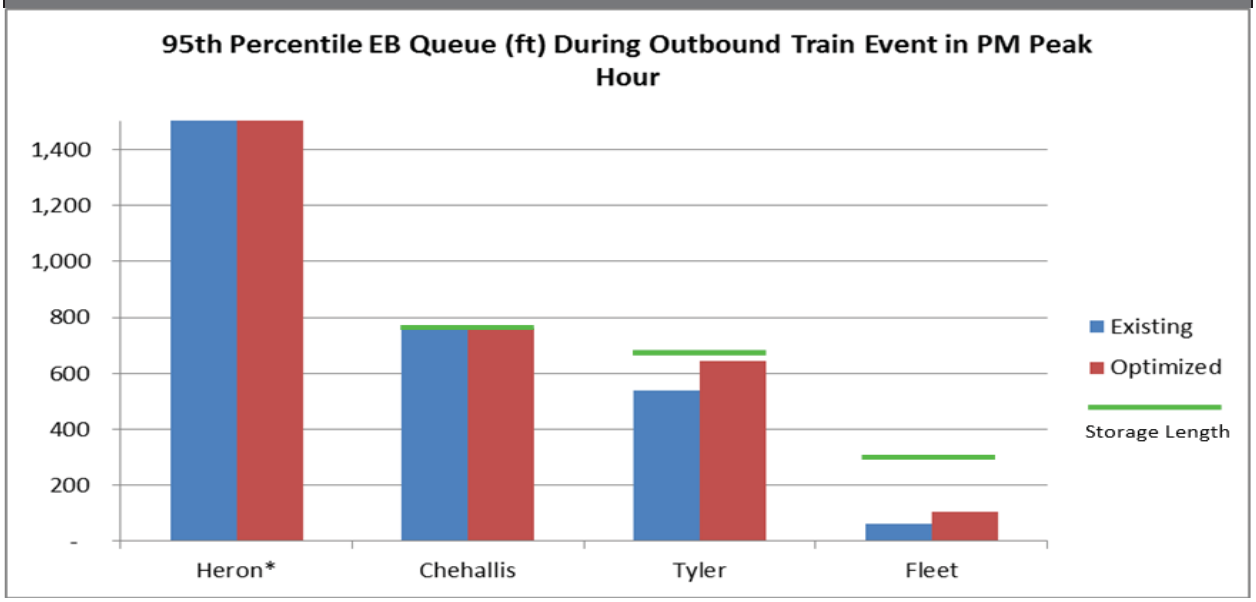
Table 8. 2037 Proposed Action Queue Estimates for During Peak Hour

Roadway Name	USDOT Crossing #	Available Storage Length (ft)				Estimated Queue Length[a] (ft)			
		WBL	EBTR	NB	SB	WBL	EBTR	NB	SB
1. Tower	092546N	-	-	360	-	0	0	1980	0
2. Pearl	092547V	-	-	-	440	0	0	0	3400
3. Joselyn Ave	092569V	220[e]	500+[e]	35[e]	500+[e]	0	0	20	0
5. 183rd Ave SW	092573K	320[e]	440[e]	230[e]		40	40	80	0
6. Blockhouse Rd	092583R	-	-	80	500+	0	0	20	20
7. Murray St	092585E	-	-	150	300	0	0	20	20
8. Newton St	092586L	-	-	220	460	0	0	20	20
9. Shelton Rd	092593W	-	-	500+[c]	60[c]	0	0	20	20
10. Elma Gate Rd W	092595K	-	-	500+	500+	0	0	20	20
11. Porter Creek Rd	092603A	220[d]	200[d]	500+[c]	290[c]	40	40	80	0
12. Dunlap Rd	096510U	-	-	500+	65	0	0	20	20
13. Blockhouse Rd W	096518Y	-	-	500+[c]	60[c]	0	0	20	20
14. Blockhouse Rd E	096515D	-	-	500+	200	0	0	20	20
15. Monte Brady Rd	096652K	-	-	500+	150	0	100	100	0
16. Monte Brady Rd	096658B	-	200	500+	-	0	0	80	80
17. Main Street	096672W	-	-	140	280	0	0	140	140
18. Junction City Rd	096687L	-	-	500+	500+	0	0	240	240
19. Fleet	096688T	350	290	80	100	800	80	900	20
20. Tyler	096029N	150	660	150	100	280	720	1140	140
21. Chehalis	096691B	250	300	120	100	360	920	1420	140
22. Newell	096693P	-	460	100	-	0	420	420	0
23. Heron	096695D	-	1000	-	-	0	4480	0	0
24. Port Industrial	096711K	1200	1360	-	-	6760	6760	0	0
25. Monroe St[f]	808707R	-	-	500+	20	0	0	20	20
26. Washington St[f]	096706N	-	-	500+	300	0	0	460	460

WBL = westbound left; EBTR = eastbound through right; NB = northbound; SB = southbound

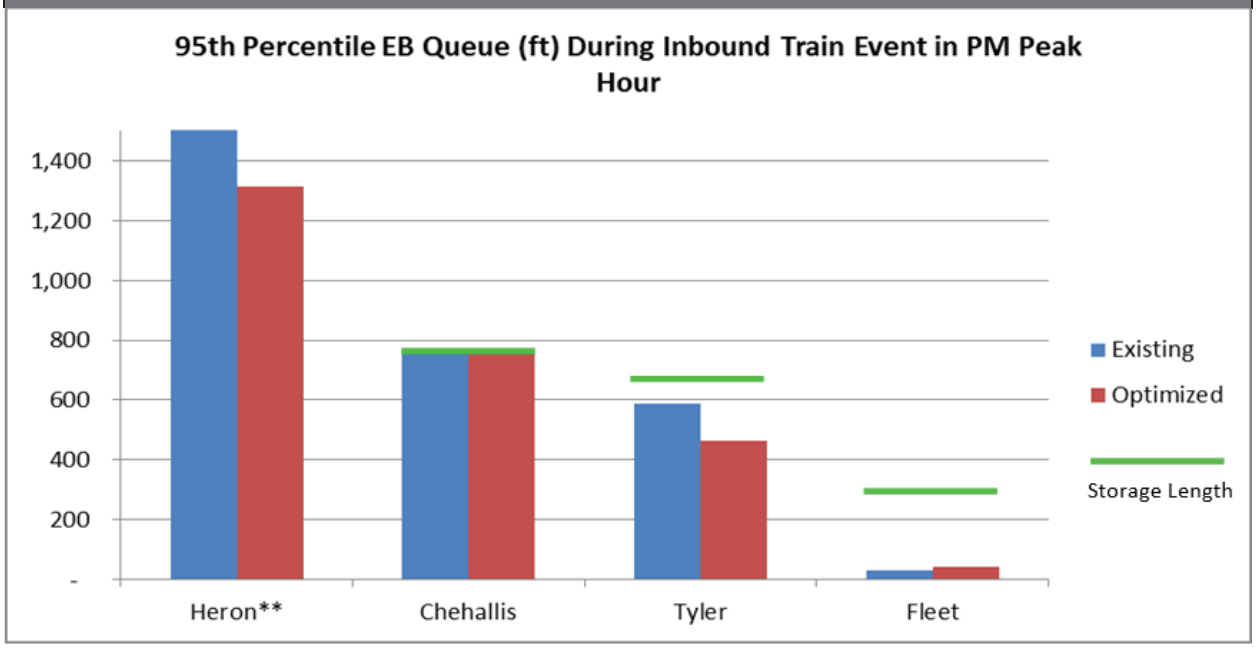
Figures 1 through 4 show the Synchro simulation results for the 95th percentile vehicle queue length was determined for each movement by taking the average of five modeled simulation runs for each scenario. The 95th percentile queue is the length for a given intersection movement that has only a 5% chance of being exceeded during the peak traffic hour. All scenarios assume one train arriving at the beginning of the PM peak hour.

Figure 1. 95th Eastbound Queue (Feet) During Outbound Train Event.



*E Heron St. 95th percentile queue exceeds available model storage.

Figure 2. 95th Eastbound Queue (Feet) During Inbound Train Event.



**E Heron St. 95th percentile queue exceeds available model storage.

Figure 3. 95th Westbound Queue (Feet) During Outbound Train Event.

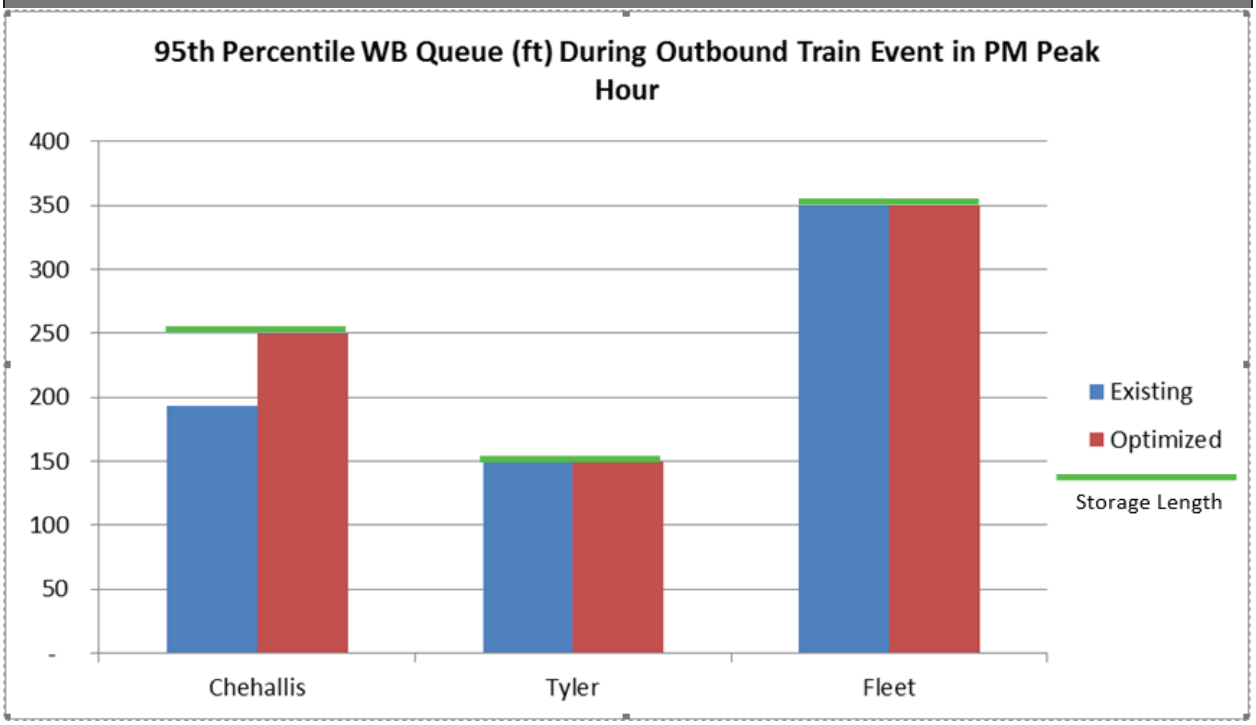
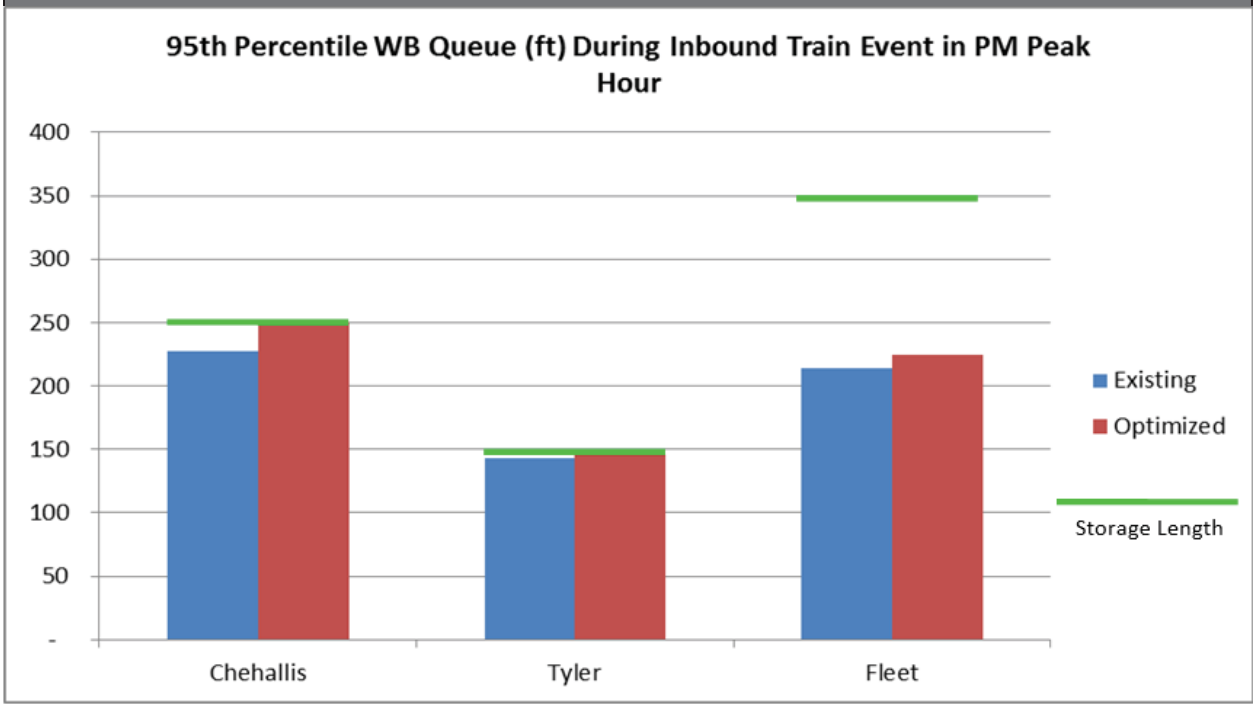


Figure 4. 95th Westbound Queue (Feet) During Inbound Train Event.



Grade-Crossing Delay

Methods

Assumptions and Data Sources for Calculations

Several data sources were used to characterize grade-crossing delay and safety conditions.

- WSDOT (2013) and Washington Utilities and Transportation Commission (2014) provided AADT. All local government agencies along the Puget Sound & Pacific Railroad (PS&P) rail line were contacted to provide up to date AADT data and updated traffic maps and reports were received from the City of Montesano, City of Elma, Grays Harbor Council of Governments, and City of Aberdeen (Wincewicz pers. comm.; Mock pers. comm.; Starks pers. comm.; Grays Harbor Council of Governments pers. comm.). The FRA highway and rail database was used to update AADT data as well (Federal Railroad Administration 2014a).
- A historic vehicle-miles traveled growth rate was applied to AADT data from 1970 to 1995 (3.1% growth rate) and from 1996 to 2011 (2% growth rate) to estimate AADT in 2012 (U.S. Energy Information Administration 2013).
- AADT values were estimated for analysis years 2018, 2023, 2030, and 2037 using the available data and an annual growth rate of 1.5% based on vehicle-miles traveled (U.S. Energy Information Administration 2014) and guidance provided by WSDOT.
- For any grade crossing for which an AADT value could not be located using state data sources or the FRA data, an average AADT value was applied based on collected AADT values for the same road type in that state.
- Existing train traffic (average number of trains per day) and operating speed on the PS&P rail line were provided (Federal Railroad Administration 2014a).
- Future train traffic (average number of trains per day) was estimated by the applicant (Chapter2, *Proposed Action and Alternatives*).
- Road and train traffic characteristics at rail and roadway crossings, including the number of tracks, number of road lanes, warning devices, daily vehicle traffic volume, road paving, road classifications, and the most recent 5 years of accident history were provided (Federal Railroad Administration 2013).
- Train models for proposed action scenarios and cumulative impact analysis included number of trains per day by commodity, train length, number of cars, number and type of locomotives, train speed, and gate-down time (Table 9). For more details on the train modeling, see Appendix K, *Rail Traffic Technical Information*. Weighted averages were used to combine train consist information for total delay and safety calculations.

Table 9. Train Consist Modeling Data

	Eastbound				Westbound			
Train Type	Trains per Year	Cars per Train	Number of Locomotives	Locomotive Type	Trains per Year	Cars per Train	Number of Locomotives	Locomotive Type
Freight	279	68	2	SD40	319	61	2	SD40
Grain	102	101	3	AC4400CW	104	98	3	AC4400CW
Auto	95	65	2	SD70	102	60	2	SD70
Aberdeen – Elma	98	37	4	GP38	26	31	4	GP38
Elma-Centralia	39	63	4	GP38	19	40	4	GP38
Garbage	26	48	3	GP38	26	48	2	GP38
Oil	230-W 365-I 774-C	122	3	AC4400CW	230-W 365-I 774-C	122	3	AC4400CW

W=Westway scenario; I=Imperium scenario; C=Cumulative Impacts Analysis

Calculations for Proposed Action and Cumulative Impacts Analysis

For each at-grade crossing analyzed, the average delay per vehicle in a 24-hour period was estimated based on the estimated time each train would block the crossing, the average number of trains per day, and grade-crossing characteristics (e.g., AADT, number of roadway lanes). The total estimated daily gate-down time at a crossing was divided by the estimated AADT values for 2017 and 2037 to obtain an estimate of average vehicle delay for each crossing. This value was then used to determine the LOS at each at-grade crossing. LOS designations provide a qualitative measure of traffic flow (Table 1). According to WSDOT, traffic for peak-hours, urban highways must meet a LOS of D and for rural highways a LOS of C in Grays Harbor County and Thurston County (Washington State Department of Transportation 2010). LOS was not evaluated for the three crossings on the BNSF Railway Company (BNSF) main line [092521T (Maple St M1), 092520L (E Main St M1), and 092519S (E Locust St M1)] due to limited data on train characteristics.

The following calculations were used to estimate traffic delay for public, at-grade crossings. The traffic delay at a crossing includes the time for the train to pass, and the time for any warning device to engage and disengage. For simplification purposes, it is assumed that both rail and road traffic would be uniform throughout the day. The first step includes the calculation of gate-down time per train event (T).

$$T = T_W + \frac{L}{V}$$

Where:

T_W = Gate warning time

L = Average train length

V = Average train speed

The gate-down time per train event calculation is only used for the manual calculations for crossings 092521T (Maple St M1), 092520L (E Main St M1), and 092519S (E Locust St M1). All remaining gate-down time came from train modeling data presented in Appendix K, *Rail Traffic Technical Information*.

The number of stopped vehicles delayed per day (NV) can be calculated as follows:

$$N_V = \frac{T}{24} * N * ADT$$

Where:

N = Number of trains per day

AADT = Average daily traffic

24 = Hours per day

The average delay per vehicle in a 24-hour period (DV) is:

$$D_V = \frac{N_V}{AADT} * \frac{T * \frac{R_D}{R_D - R_A}}{2}$$

Where:

RD = Departure rate (vehicles/lane/hour)1

RA = Arrival rate, average daily traffic converted to vehicles/lane-hour

2 = Denominator to reflect that vehicles do not experience the entire time the train is blocking the grade crossing. They are assumed to arrive on average at the midpoint of the train crossing period.

Total vehicle delay (D) is the product of average delay per vehicle (DV) and the average daily traffic (ADT).

$$D = D_V * ADT$$

The average queue length per event in a 24-hour period is:

$Q=(N_v/(R_L*N))*L_v$

RL = Number of roadway lanes in both directions

LV = Average length of a vehicle (assumed to be 20 feet)

[1] The vehicle departure rate depends on a wide range of factors such as the presence or absence of signals, number and type of lanes, lane width, grade, sight distances, type and peak of vehicle traffic, and curve radius. Data on these factors are not readily available for the grade crossings included in this analysis and, thus, calculation of crossing-specific departure rates is not feasible. Based on the Highway Capacity Manual (Transportation Research Board 2000), departure rates (in vehicles/lane-hour) are the following: highways (1,800), arterials (1,400), collectors (900), and local roads (700).

Tables 10 through 17 show the results of the grade-crossing delay analysis for the No-Action Alternative; Tables 18 through 25 show the results of the analysis for the proposed action . Tables 26 through 29 show the results of the grade-crossing delay analysis for the cumulative scenario.

No-Action Alternative

Table 10. Grade-Crossing Delay of Baseline Traffic (2017)

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
096687L	Junction City Rd	67.14	3.1	4,472	12	14.7	1,234	2	Collector	900	26	30.87	13	2	A	2	40
096682C	Central Park Dr	61.8	3.1	4,472	11	15.3	293	2	Collector	900	6	7.77	3	2	A	2	20
096680N	Aldergrove Dr	59.72	3.1	4,472	25	7.1	397	2	Local Road	700	8	2.27	2	1	A	0	20
096679U	Heikkinen Rd	59.43	3.1	4,472	25	7.1	209	1	Local Road	700	9	1.20	1	1	A	0	20
096678M	Devonshire Rd	58.91	3.1	4,472	25	7.1	1,056	2	Collector	900	22	6.10	5	1	A	0	20
096677F	County Farm Rd	58.73	3.1	4,472	25	7.1	262	2	Local Road	700	5	1.48	1	1	A	0	20
096672W	Main Street	57.72	3.1	4,472	25	7.1	1,569	2	Collector	900	33	9.20	8	1	A	0	20
400107G	Sylvia St	57.59	3.1	4,472	25	7.1	126	2	Local Road	700	3	0.71	1	1	A	0	20
096659H	Old Beacon Rd	56.02	3.1	4,472	25	7.1	94	2	Local Road	700	2	0.53	0	1	A	0	20
096658B	Monte Brady Rd	55.71	3.1	4,472	25	7.1	785	2	Collector	900	16	4.52	4	1	A	0	20
096657U	Glenn Rd	55.42	3.1	4,472	25	7.1	21	2	Local Road	700	0	0.12	0	1	A	0	20
096655F	Fairbairn Rd	54.38	3.1	4,472	25	7.1	21	2	Local Road	700	0	0.12	0	1	A	0	20
096654Y	Winkerman Rd S	54.1	3.1	4,472	25	7.1	42	2	Local Road	700	1	0.24	0	1	A	0	20
096652K	Monte Brady Rd	53.33	3.1	4,472	25	7.1	1,046	2	Collector	900	22	6.07	5	1	A	0	20
096650W	Foss Av-Monte Elma	51.98	3.1	4,472	25	7.1	4,770	2	Collector	900	99	30.34	24	1	A	0	80
096649C	Hewitt St	51.85	3.1	4,472	25	7.1	345	2	Local Road	700	7	1.98	2	1	A	0	20
096648V	Moore Rd	51.53	3.1	4,472	25	7.1	502	2	Local Road	700	10	2.88	2	1	A	0	20
096646G	Oniel Rd	51.03	3.1	4,472	25	7.1	565	2	Local Road	700	12	3.28	3	1	A	0	20
096644T	Newman Creek Rd	50.56	3.1	4,472	25	7.1	858	2	Local Road	700	18	4.98	4	1	A	0	20
096643L	Hurd Rd	50.08	3.1	4,472	25	7.1	1,370	2	Local Road	700	29	8.02	7	1	A	0	20
096642E	Calder Rd	49.36	3.1	4,472	25	7.1	596	2	Local Road	700	12	3.43	3	1	A	0	20
096641X	N 17th St	48.93	3.1	4,472	25	7.1	115	2	Local Road	700	2	0.65	1	1	A	0	20

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
096640R	N 13th St	48.7	3.1	4,472	25	7.1	649	2	Local Road	700	14	3.74	3	1	A	0	20
096639W	N 11th St	48.57	3.1	4,472	24	7.2	1,914	2	Local Road	700	40	11.74	10	1	A	0	40
096638P	N 10th St	48.51	3.1	4,472	22	8.3	272	2	Local Road	700	6	2.11	2	1	A	0	20
096636B	N 6th St	48.32	3.1	4,472	22	8.8	146	2	Local Road	700	3	1.26	1	1	A	1	20
096635U	N 5th St	48.26	3.1	4,472	22	8.8	73	2	Local Road	700	2	0.64	0	1	A	1	20
096634M	N 3rd St	48.12	3.1	4,472	21	9.9	617	2	Local Road	700	13	6.93	4	2	A	1	20
096525J	N 2d St	48.06	3.1	4,472	24	8.5	471	2	Local Road	700	10	3.83	3	1	A	0	20
096519F	Tridwell Rd	46.71	3.0	4,472	24	7.8	115	2	Local Road	700	2	0.81	1	1	A	0	20
096518Y	Blockhouse Rd W	46.33	3.0	4,568	25	7.1	220	2	Local Road	700	5	1.30	1	1	A	0	20
096515D	Blockhouse Rd E	45.26	3.0	4,568	25	7.1	42	2	Local Road	700	1	0.25	0	1	A	0	20
096510U	Dunlap Rd	44.19	3.0	4,568	25	7.1	188	2	Local Road	700	4	1.10	1	1	A	0	20
092603A	Porter Creek Rd	41.5	3.0	4,568	25	7.1	805	2	Collector	900	17	4.80	4	1	A	0	20
092595K	Elma Gare Rd W	38.46	3.0	4,568	25	7.1	94	2	Local Road	700	2	0.55	0	1	A	0	20
092593W	Shelton Rd	36.71	3.0	4,568	25	7.1	52	2	Local Road	700	1	0.31	0	1	A	0	20
92587T	Scheaffer St	33.95	3.0	4,568	25	7.1	42	2	Local Road	700	1	0.25	0	1	A	0	20
092586L	Newton St	33.65	3.0	4,568	25	7.1	178	2	Local Road	700	4	1.05	1	1	A	0	20
092585E	Murray St	33.39	3.0	4,568	25	7.1	178	2	Local Road	700	4	1.04	1	1	A	0	20
092584X	Merry Rd	33.04	3.0	4,568	25	7.1	52	2	Local Road	700	1	0.31	0	1	A	0	20
092583R	Blockhouse Rd	32.45	3.0	4,568	25	7.1	42	2	Local Road	700	1	0.24	0	1	A	0	20
092577M	Moon Rd SW	28.71	3.0	4,568	25	7.1	262	2	Local Road	700	5	1.54	1	1	A	0	20
092576F	Owings St	13.28	3.0	4,568	25	7.1	324	2	Local Road	700	7	1.90	2	1	A	0	20
092574S	Little Rock Rd	10.95	3.0	4,568	25	7.1	1,004	2	Local Road	700	21	6.05	5	1	A	0	20
092573K	183rd Ave SW	10.05	3.0	4,568	25	7.1	785	2	Collector	900	16	4.65	4	1	A	0	20
092569V	Joselyn Ave	8.45	3.0	4,568	25	7.1	209	2	Local Road	700	4	1.22	1	1	A	0	20
092567G	Tea St	7.18	3.0	4,568	25	7.1	513	2	Local Road	700	11	3.05	3	1	A	0	20
092566A	Grand Mound SW	6.84	3.0	4,568	25	7.1	345	2	Local Road	700	7	2.04	2	1	A	0	20

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
092565T	Old Hwy 99 SW	6.07	3.0	4,568	24	7.5	10,157	2	Collector	900	212	87.14	53	2	A	1	180
092563E	216th Ave SW	5.37	3.0	4,568	13	13.4	94	2	Local Road	700	2	1.96	1	2	A	1	20
092561R	222d Ave SW	4.72	3.0	4,568	10	17.2	178	2	Local Road	700	4	6.14	2	3	A	2	20
922981P	Hoss Rd	4.44	3.0	4,568	10	17.2	1,151	2	Local Road	700	24	40.95	14	3	A	2	40
922982W	Robert Thompson Rd	4.26	3.0	4,568	10	17.3	575	2	Collector	900	12	20.09	7	3	A	2	20
922980H	Kuper Rd	3.92	3.0	4,568	10	18.0	471	2	Local Road	700	10	17.89	6	3	A	2	20
092559P	Fordon Rd	3.53	3.0	4,568	10	18.0	188	2	Local Road	700	4	7.12	2	3	A	2	20
092554F	W Reynolds Ave	2.14	3.0	4,568	10	17.4	6,381	2	Arterial	1,400	133	246.20	77	3	A	2	260
092552S	J St	1.28	3.0	4,568	8	23.0	345	2	Local Road	700	7	21.38	6	4	A	4	20
092551K	H St	1.15	3.0	4,568	7	24.6	879	2	Local Road	700	18	63.18	15	4	A	4	60
092550D	G St	1.09	3.0	4,568	7	26.0	345	2	Local Road	700	7	27.26	6	4	A	5	20
092549J	F St	1.03	3.0	4,568	7	25.4	241	2	Local Road	700	5	18.09	4	4	A	5	20
092548C	E St	0.95	3.0	4,568	7	25.5	345	2	Local Road	700	7	26.20	6	4	A	5	20
092547V	D St	0.89	3.0	4,568	7	25.6	13,755	2	Collector	900	287	1527.78	244	6	A	7	820
092546N	Tower St	0.82	3.0	4,568	7	25.6	8,023	2	Collector	900	167	747.41	143	5	A	6	480
092543T	B St	54.28	3.0	4,568	7	25.1	690	2	Local Road	700	14	51.24	12	4	A	4	40

Table 11. Grade Crossing Delay of Baseline Traffic for Switching Movements (2017)

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
922990N	Industrial Rd	71.04	2.8	718	4	42.36	5,795	2	Arterial	1,400	121	1411	170	8	B	15	600
AA	Myrtle St	70.85	1.4	718	2	6.95	73	2	Arterial	1,400	2	1	0	2	A	1	20
BB	N Maple St	70.55	2.8	718	6	24.85	805	2	Local Road	700	17	63	14	5	A	5	40
808713U	W 1St St	70.41	3.1	3,409	6	18.33	4,623	2	Collector	900	96	196	59	3	A	3	200
096711K	Port Industrial Rd	70.06	3.9	1,018	8	15.99	17,845	2	Arterial	1,400	372	552	198	3	A	2	500
096710D	Division St	69.82	3.9	1,018	7	15.20	21	2	Local Road	700	0	0	0	2	A	1	20
096709J	Heron St	69.81	3.9	1,018	6	15.99	167	2	Local Road	700	3	4	2	2	A	1	20
808707R	Monroe St	69.63	4.9	4,022	6	21.81	21	2	Local Road	700	0	1	0	2	A	2	20
096706N	Washington St	69.49	4.9	4,022	5	21.96	669	2	Local Road	700	14	23	10	2	A	2	20
092551K	H Street	68.8	3.2	3,551	5	69.34	879	2	Local Road	700	18	474	42	11	C	32	140
096695D	E Heron St	68.5	3.2	3,551	5	71.22	3,452	1	Local Road	700	144	2407	171	14	D	42	1080
096693P	Newell St	68.44	3.2	3,551	6	69.55	649	2	Local Road	700	14	349	31	11	C	32	100
096691B	S Chehalis St	68.36	3.2	3,551	6	54.56	4,906	4	Local Road	700	51	1721	186	9	C	21	300
096689A	Dairy Queen Entrance	68.34	3.2	3,551	6	53.69	157	2	Local Road	700	3	50	6	8	B	19	20
096690U	McDonalds Entrance	68.31	3.2	3,551	6	53.11	1,067	2	Local Road	700	22	340	39	9	B	19	120
096029N	Tyler St	68.23	3.2	3,551	7	51.63	4,048	4	Local Road	700	42	1254	145	9	B	19	220
096688T	Fleet St	68.16	3.2	3,551	7	50.29	1,611	2	Local Road	700	34	467	56	8	B	17	180

Table 12. Grade Crossing Delay of Baseline Traffic (2037)

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
096687L	Junction City Rd	67.14	3.1	4,472	12	14.73	1,596	2	Collector	900	33	40.26	16	2	A	2	60
096682C	Central Park Dr	61.8	3.1	4,472	11	15.33	379	2	Collector	900	8	10.06	4	2	A	2	20
096680N	Aldergrove Dr	59.72	3.1	4,472	25	7.10	514	2	Local Road	700	11	2.95	3	1	A	0	20
096679U	Heikkinen Rd	59.43	3.1	4,472	25	7.11	271	1	Local Road	700	11	1.56	1	1	A	0	20
096678M	Devonshire Rd	58.91	3.1	4,472	25	7.09	1,366	2	Collector	900	28	7.95	7	1	A	0	20
096677F	County Farm Rd	58.73	3.1	4,472	25	7.08	338	2	Local Road	700	7	1.92	2	1	A	0	20
096672W	Main Street	57.72	3.1	4,472	25	7.10	2,029	2	Collector	900	42	12.03	10	1	A	0	40
400107G	Sylvia St	57.59	3.1	4,472	25	7.11	162	2	Local Road	700	3	0.92	1	1	A	0	20
096659H	Old Beacon Rd	56.02	3.1	4,472	25	7.11	122	2	Local Road	700	3	0.69	1	1	A	0	20
096658B	Monte Brady Rd	55.71	3.1	4,472	25	7.11	1,015	2	Collector	900	21	5.88	5	1	A	0	20
096657U	Glenn Rd	55.42	3.1	4,472	25	7.11	27	2	Local Road	700	1	0.15	0	1	A	0	20
096655F	Fairbairn Rd	54.38	3.1	4,472	25	7.11	27	2	Local Road	700	1	0.15	0	1	A	0	20
096654Y	Winkerman Rd S	54.1	3.1	4,472	25	7.09	54	2	Local Road	700	1	0.31	0	1	A	0	20
096652K	Monte Brady Rd	53.33	3.1	4,472	25	7.11	1,353	2	Collector	900	28	7.90	7	1	A	0	20
096650W	Foss Av-Monte Elma	51.98	3.1	4,472	25	7.11	6,168	2	Collector	900	129	40.72	30	1	A	0	100
096649C	Hewitt St	51.85	3.1	4,472	25	7.11	446	2	Local Road	700	9	2.56	2	1	A	0	20
096648V	Moore Rd	51.53	3.1	4,472	25	7.10	649	2	Local Road	700	14	3.73	3	1	A	0	20
096646G	Oniel Rd	51.03	3.1	4,472	25	7.14	730	2	Local Road	700	15	4.26	4	1	A	0	20
096644T	Newman Creek Rd	50.56	3.1	4,472	25	7.11	1,109	2	Local Road	700	23	6.49	5	1	A	0	20
096643L	Hurd Rd	50.08	3.1	4,472	25	7.08	1,772	2	Local Road	700	37	10.50	9	1	A	0	20
096642E	Calder Rd	49.36	3.1	4,472	25	7.10	771	2	Local Road	700	16	4.46	4	1	A	0	20
096641X	N 17th St	48.93	3.1	4,472	25	7.10	149	2	Local Road	700	3	0.84	1	1	A	0	20
096640R	N 13th St	48.7	3.1	4,472	25	7.11	839	2	Local Road	700	17	4.87	4	1	A	0	20
096639W	N 11th St	48.57	3.1	4,472	24	7.19	2,475	2	Local Road	700	52	15.46	12	1	A	0	40
096638P	N 10th St	48.51	3.1	4,472	22	8.29	352	2	Local Road	700	7	2.74	2	1	A	0	20

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
096636B	N 6th St	48.32	3.1	4,472	22	8.76	189	2	Local Road	700	4	1.64	1	1	A	1	20
096635U	N 5th St	48.26	3.1	4,472	22	8.83	95	2	Local Road	700	2	0.83	1	1	A	1	20
096634M	N 3rd St	48.12	3.1	4,472	21	9.92	798	2	Local Road	700	17	9.01	5	2	A	1	20
096525J	N 2d St	48.06	3.1	4,472	24	8.46	609	2	Local Road	700	13	4.97	4	1	A	0	20
096519F	Tridwell Rd	46.71	3.0	4,472	24	7.80	149	2	Local Road	700	3	1.05	1	1	A	0	20
096518Y	Blockhouse Rd W	46.33	3.0	4,568	25	7.13	284	2	Local Road	700	6	1.69	1	1	A	0	20
096515D	Blockhouse Rd E	45.26	3.0	4,568	25	7.12	54	2	Local Road	700	1	0.32	0	1	A	0	20
096510U	Dunlap Rd	44.19	3.0	4,568	25	7.09	243	2	Local Road	700	5	1.43	1	1	A	0	20
092603A	Porter Creek Rd	41.5	3.0	4,568	25	7.11	1,042	2	Collector	900	22	6.24	5	1	A	0	20
092595K	Elma Gare Rd W	38.46	3.0	4,568	25	7.10	122	2	Local Road	700	3	0.71	1	1	A	0	20
092593W	Shelton Rd	36.71	3.0	4,568	25	7.11	68	2	Local Road	700	1	0.40	0	1	A	0	20
92587T	Scheaffer St	33.95	3.0	4,568	25	7.12	54	2	Local Road	700	1	0.32	0	1	A	0	20
092586L	Newton St	33.65	3.0	4,568	25	7.11	230	2	Local Road	700	5	1.35	1	1	A	0	20
092585E	Murray St	33.39	3.0	4,568	25	7.10	230	2	Local Road	700	5	1.35	1	1	A	0	20
092584X	Merry Rd	33.04	3.0	4,568	25	7.11	68	2	Local Road	700	1	0.40	0	1	A	0	20
092583R	Blockhouse Rd	32.45	3.0	4,568	25	7.10	54	2	Local Road	700	1	0.32	0	1	A	0	20
092577M	Moon Rd SW	28.71	3.0	4,568	25	7.10	338	2	Local Road	700	7	1.99	2	1	A	0	20
092576F	Owings St	13.28	3.0	4,568	25	7.08	419	2	Local Road	700	9	2.47	2	1	A	0	20
092574S	Little Rock Rd	10.95	3.0	4,568	25	7.11	1,299	2	Local Road	700	27	7.89	6	1	A	0	20
092573K	183rd Ave SW	10.05	3.0	4,568	25	7.09	1,015	2	Collector	900	21	6.05	5	1	A	0	20
092569V	Joselyn Ave	8.45	3.0	4,568	25	7.09	271	2	Local Road	700	6	1.59	1	1	A	0	20
092567G	Tea St	7.18	3.0	4,568	25	7.12	663	2	Local Road	700	14	3.96	3	1	A	0	20
092566A	Grand Mound SW	6.84	3.0	4,568	25	7.10	446	2	Local Road	700	9	2.64	2	1	A	0	20
092565T	Old Hwy 99 SW	6.07	3.0	4,568	24	7.53	13,134	2	Collector	900	274	123.84	69	2	A	1	220
092563E	216th Ave SW	5.37	3.0	4,568	13	13.39	122	2	Local Road	700	3	2.54	1	2	A	1	20
092561R	222d Ave SW	4.72	3.0	4,568	10	17.22	230	2	Local Road	700	5	7.95	3	3	A	2	20

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
922981P	Hoss Rd	4.44	3.0	4,568	10	17.23	1,488	2	Local Road	700	31	53.51	18	3	A	2	60
922982W	Robert Thompson Rd	4.26	3.0	4,568	10	17.26	744	2	Collector	900	15	26.09	9	3	A	2	20
922980H	Kuper Rd	3.92	3.0	4,568	10	18.00	609	2	Local Road	700	13	23.24	8	3	A	2	20
092559P	Fordon Rd	3.53	3.0	4,568	10	18.03	243	2	Local Road	700	5	9.23	3	3	A	2	20
092554F	W Reynolds Ave	2.14	3.0	4,568	10	17.37	8,251	2	Arterial	1,400	172	328.49	100	3	A	2	340
092552S	J St	1.28	3.0	4,568	8	23.02	446	2	Local Road	700	9	27.74	7	4	A	4	20
092551K	H St	1.15	3.0	4,568	7	24.60	1,136	2	Local Road	700	24	82.35	19	4	A	4	60
092550D	G St	1.09	3.0	4,568	7	25.99	446	2	Local Road	700	9	35.36	8	4	A	5	20
092549J	F St	1.03	3.0	4,568	7	25.39	311	2	Local Road	700	6	23.44	5	4	A	5	20
092548C	E St	0.95	3.0	4,568	7	25.48	446	2	Local Road	700	9	33.98	8	4	A	5	20
092547V	D St	0.89	3.0	4,568	7	25.58	17,788	2	Collector	900	371	2289.22	316	7	A	8	1060
092546N	Tower St	0.82	3.0	4,568	7	25.60	10,375	2	Collector	900	216	1035.80	184	6	A	6	620
092543T	B St	54.28	3.0	4,568	7	25.06	893	2	Local Road	700	19	66.67	16	4	A	4	60

Table 13. Grade Crossing Delay of Baseline Traffic for Switching Movements (2037)

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
922990N	Industrial Rd	71.04	2.8	718	4	42.4	7,494	2	Arterial	1,400	156	1877	220	9	B	15	780
AA	Myrtle St	70.85	1.4	718	2	7.0	95	2	Arterial	1,400	2	1	0	2	A	1	20
BB	N Maple St	70.55	2.8	718	6	24.9	1,042	2	Local Road	700	22	82	18	5	A	5	60
808713U	W 1St St	70.41	3.1	3,409	6	18.3	5,979	2	Collector	900	125	263	76	3	A	3	240
096711K	Port Industrial Rd	70.06	3.9	1,018	8	16.0	23,076	2	Arterial	1,400	481	798	256	3	A	2	660
096710D	Division St	69.82	3.9	1,018	7	15.2	27	2	Local Road	700	1	1	0	2	A	1	20
096709J	Heron St	69.81	3.9	1,018	6	16.0	216	2	Local Road	700	5	5	2	2	A	1	20
808707R	Monroe St	69.63	4.9	4,022	6	21.8	27	2	Local Road	700	1	1	0	2	A	2	20
096706N	Washington St	69.49	4.9	4,022	5	22.0	866	2	Local Road	700	18	30	13	2	A	2	20
092551K	H Street	68.8	3.2	3,551	5	65.8	1,136	2	Local Road	700	24	556	52	11	C	29	160
096695D	E Heron St	68.5	3.2	3,551	5	54.5	4,464	1	Local Road	700	186	1973	169	12	C	27	1060
096693P	Newell St	68.44	3.2	3,551	6	52.3	839	2	Local Road	700	17	257	30	8	B	18	100
096691B	S Chehalis St	68.36	3.2	3,551	6	37.5	6,344	4	Local Road	700	66	1074	165	7	B	10	260
096689A	Dairy Queen Entrance	68.34	3.2	3,551	6	36.6	216	2	Local Road	700	5	32	5	6	A	9	20
096690U	McDonalds Entrance	68.31	3.2	3,551	6	35.9	1,380	2	Local Road	700	29	203	34	6	A	9	100
096029N	Tyler St	68.23	3.2	3,551	7	35.0	5,235	4	Local Road	700	55	758	127	6	A	9	200
096688T	Fleet St	68.16	3.2	3,551	7	34.2	2,083	2	Local Road	700	43	284	50	6	A	8	160

Table 14. Grade Crossing Delay of Baseline Traffic for Peak Hour (2017)

Crossing ID	Street	Milepost	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time (min)	Traffic in both directions	Number of lanes in both directions	Urban or Rural	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	vehicles delayed per day	During Gate Down Time	Level of service	per vehicle in a 24-hour period	Length per lane in Each
096687L	Junction City Rd	67.14	1.0	6,279	12	6.6	142	2	Urban Collector	Collector	900	71	56	16	4	C	23.5	160
096682C	Central Park Dr	61.8	1.0	6,279	11	6.6	34	2	Rural Major Collector	Collector	900	17	13	4	3	C	22.4	40
096680N	Aldergrove Dr	59.72	1.0	6,279	25	3.2	46	2	Rural Local	Local Road	700	23	4	2	2	A	5.2	20
096679U	Heikkinen Rd	59.43	1.0	6,279	25	3.2	24	1	Rural Local	Local Road	700	24	2	1	2	A	5.2	20
096678M	Devonshire Rd	58.91	1.0	6,279	25	3.2	121	2	Rural Minor Collector	Collector	900	61	11	6	2	A	5.4	60
096677F	County Farm Rd	58.73	1.0	6,279	25	3.2	30	2	Rural Local	Local Road	700	15	3	2	2	A	5.1	20
096672W	Main Street	57.72	1.0	6,279	25	3.2	180	2	Rural Major Collector	Collector	900	90	17	10	2	A	5.6	100
400107G	Sylvia St	57.59	1.0	6,279	25	3.2	14	2	Urban Local	Local Road	700	7	1	1	2	A	5.1	20
096659H	Old Beacon Rd	56.02	1.0	6,279	25	3.1	11	2	Rural Local	Local Road	700	5	1	1	2	A	5.0	20
096658B	Monte Brady Rd	55.71	1.0	6,279	25	3.2	90	2	Rural Minor Collector	Collector	900	45	8	5	2	A	5.3	40
096657U	Glenn Rd	55.42	1.0	6,279	25	3.2	2	2	Rural Local	Local Road	700	1	0	0	2	A	5.0	20
096655F	Fairbairn Rd	54.38	1.0	6,279	25	3.2	2	2	Rural Local	Local Road	700	1	0	0	2	A	5.1	20
096654Y	Winkerman Rd S	54.1	1.0	6,279	25	3.2	5	2	Rural Local	Local Road	700	2	0	0	2	A	5.1	20
096652K	Monte Brady Rd	53.33	1.0	6,279	25	3.2	120	2	Rural Major Collector	Collector	900	60	11	6	2	A	5.4	60
096650W	Foss Av-Monte Elma	51.98	1.0	6,279	25	3.2	548	2	Rural Major Collector	Collector	900	274	67	29	2	A	7.3	300
096649C	Hewitt St	51.85	1.0	6,279	25	3.2	40	2	Rural Local	Local Road	700	20	3	2	2	A	5.2	20
096648V	Moore Rd	51.53	1.0	6,279	25	3.2	58	2	Rural Local	Local Road	700	29	5	3	2	A	5.2	40
096646G	Oniel Rd	51.03	1.0	6,279	25	3.2	65	2	Rural Local	Local Road	700	32	6	3	2	A	5.3	40
096644T	Newman Creek Rd	50.56	1.0	6,279	25	3.2	99	2	Rural Local	Local Road	700	49	9	5	2	A	5.4	60
096643L	Hurd Rd	50.08	1.0	6,279	25	3.2	157	2	Rural Local	Local Road	700	79	15	8	2	A	5.7	80
096642E	Calder Rd	49.36	1.0	6,279	25	3.2	69	2	Rural Local	Local Road	700	34	6	4	2	A	5.3	40
096641X	N 17th St	48.93	1.0	6,279	25	3.2	13	2	Rural Local	Local Road	700	7	1	1	2	A	5.3	20
096640R	N 13th St	48.7	1.0	6,279	25	3.3	75	2	Rural Local	Local Road	700	37	7	4	2	A	5.6	40
096639W	N 11th St	48.57	1.0	6,279	24	3.2	220	2	Rural Local	Local Road	700	110	23	12	2	A	6.2	120
096638P	N 10th St	48.51	1.0	6,279	23	3.3	31	2	Rural Local	Local Road	700	16	3	2	2	A	5.4	20
096636B	N 6th St	48.32	1.0	6,279	23	3.3	17	2	Rural Local	Local Road	700	8	2	1	2	A	5.4	20
096635U	N 5th St	48.26	1.0	6,279	23	3.2	8	2	Rural Local	Local Road	700	4	1	0	2	A	5.3	20
096634M	N 3rd St	48.12	1.0	6,279	23	3.2	71	2	Rural Local	Local Road	700	35	6	4	2	A	5.5	40

Crossing ID	Street	Milepost	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time (min)	Traffic in both directions	Number of lanes in both directions	Urban or Rural	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	vehicles delayed per day	During Gate Down Time	Level of service	per vehicle in a 24-hour period	Length per lane in Each
096525J	N 2d St	48.06	1.0	6,279	24	3.2	54	2	Rural Local	Local Road	700	27	5	3	2	A	5.3	20
096519F	Tridwell Rd	46.71	1.0	6,279	25	3.2	13	2	Rural Local	Local Road	700	7	1	1	2	A	5.1	20
096518Y	Blockhouse Rd W	46.33	1.0	6,279	25	3.2	25	2	Rural Local	Local Road	700	13	2	1	2	A	5.1	20
096515D	Blockhouse Rd E	45.26	1.0	6,279	25	2.9	5	2	Rural Local	Local Road	700	2	0	0	1	A	4.3	20
096510U	Dunlap Rd	44.19	1.0	6,279	25	3.2	22	2	Rural Local	Local Road	700	11	2	1	2	A	5.1	20
092603A	Porter Creek Rd	41.5	1.0	6,279	25	3.2	93	2	Rural Minor Collector	Collector	900	46	8	5	2	A	5.3	40
092595K	Elma Gare Rd W	38.46	1.0	6,279	25	3.1	11	2	Rural Local	Local Road	700	5	1	1	2	A	4.8	20
092593W	Shelton Rd	36.71	1.0	6,279	25	3.2	6	2	Rural Local	Local Road	700	3	1	0	2	A	5.0	20
92587T	Scheaffer St	33.95	1.0	6,279	25	3.2	5	2	Rural Local	Local Road	700	2	0	0	2	A	5.0	20
092586L	Newton St	33.65	1.0	6,279	25	3.2	20	2	Rural Local	Local Road	700	10	2	1	2	A	5.1	20
092585E	Murray St	33.39	1.0	6,279	25	3.2	20	2	Rural Local	Local Road	700	10	2	1	2	A	5.1	20
092584X	Merry Rd	33.04	1.0	6,279	25	3.2	6	2	Rural Local	Local Road	700	3	1	0	2	A	5.1	20
092583R	Blockhouse Rd	32.45	1.0	6,279	25	3.2	5	2	Rural Local	Local Road	700	2	0	0	2	A	5.0	20
092577M	Moon Rd SW	28.71	1.0	6,279	25	3.2	30	2	Rural Local	Local Road	700	15	3	2	2	A	5.3	20
092576F	Owings St	13.28	1.0	6,279	25	3.2	37	2	Rural Local	Local Road	700	19	3	2	2	A	5.3	20
092574S	Little Rock Rd	10.95	1.0	6,279	25	3.4	115	2	Rural Local	Local Road	700	58	12	7	2	A	6.2	60
092573K	183rd Ave SW	10.05	1.0	6,279	25	3.2	90	2	Rural Minor Collector	Collector	900	45	8	5	2	A	5.5	40
092569V	Joselyn Ave	8.45	1.0	6,279	25	3.2	24	2	Rural Local	Local Road	700	12	2	1	2	A	5.1	20
092567G	Tea St	7.18	1.0	6,279	25	3.2	59	2	Rural Local	Local Road	700	29	5	3	2	A	5.3	40
092566A	Grand Mound SW	6.84	1.0	6,279	25	3.2	40	2	Rural Local	Local Road	700	20	3	2	2	A	5.2	20
092565T	Old Hwy 99 SW	6.07	1.0	6,279	21	4.0	1,167	2	Rural Major Collector	Collector	900	584	447	78	6	C	23.0	780
092563E	216th Ave SW	5.37	1.0	6,279	13	6.4	11	2	Rural Local	Local Road	700	5	4	1	3	C	20.7	20
092561R	222d Ave SW	4.72	1.0	6,279	10	7.5	20	2	Rural Local	Local Road	700	10	10	3	4	C	28.8	20
922981P	Hoss Rd	4.44	1.0	6,279	10	7.5	132	2	Urban Local	Local Road	700	66	69	17	4	C	31.3	160
922982W	Robert Thompson Rd	4.26	1.0	6,279	10	7.5	66	2	Rural Minor Collector	Collector	900	33	32	8	4	C	29.4	80
922980H	Kuper Rd	3.92	1.0	6,279	10	7.6	54	2	Rural Local	Local Road	700	27	27	7	4	C	29.6	60
092559P	Fordon Rd	3.53	1.0	6,279	10	7.0	22	2	Urban Local	Local Road	700	11	9	3	4	C	25.0	20
092554F	W Reynolds Ave	2.14	1.0	6,279	10	6.7	733	2	Urban Minor Arterial	Arterial	1,400	367	370	82	5	C	30.3	820
092552S	J St	1.28	1.0	6,279	8	8.8	40	2	Urban Local	Local Road	700	20	26	6	5	D	39.7	60

Crossing ID	Street	Milepost	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time (min)	Traffic in both directions	Number of lanes in both directions	Urban or Rural	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	vehicles delayed per day	During Gate Down Time	Level of service	per vehicle in a 24-hour period	Length per lane in Each
092551K	H St	1.15	1.0	6,279	7	8.8	101	2	Urban Local	Local Road	700	50	70	15	5	D	41.6	140
092550D	G St	1.09	1.0	6,279	7	9.2	40	2	Urban Local	Local Road	700	20	29	6	5	D	43.4	60
092549J	F St	1.03	1.0	6,279	7	8.8	28	2	Urban Local	Local Road	700	14	18	4	4	D	39.5	40
092548C	E St	0.95	1.0	6,279	7	8.8	40	2	Urban Local	Local Road	700	20	26	6	5	D	39.9	60
092547V	D St	0.89	1.0	6,279	7	8.8	1,580	2	Urban Collector	Collector	900	790	8406	232	36	F	319.1	2320
092546N	Tower St	0.82	1.0	6,279	7	8.8	922	2	Urban Collector	Collector	900	461	1233	136	9	F	80.2	1360
092543T	B St	54.28	1.0	6,279	7	8.9	79	2	Urban Local	Local Road	700	40	56	12	5	D	42.3	120

Table 15. Grade Crossing Delay of Baseline Traffic for Peak Hour Switching Movements (2017)[1]

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	During Gate Down Time (veh/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Length per lane in Each Direction (feet)
808714B	Port Industrial Rd (30th St)		1.0	6,279	7	4.78	734	2	Local Road	700	367	294	59	5	C	24	580
808711F	Myrtle		1.0	6,279	2	4.78	425	2	Arterial	1,400	213	96	34	3	B	13	340
808712M	Maple		1.0	6,279	7	4.78	93	2	Local Road	700	46	19	7	3	B	12	80
922990N	Industrial Rd	71.04	1.0	6,279	4	29.18	666	2	Arterial	1,400	333	6,196	324	19	F	558.4	3240
AA	Myrtle St	70.85	1.0	6,279	2	4.88	8	2	Arterial	1,400	4	2	1	2	B	12	20
BB	N Maple St	70.55	1.0	6,279	7	16.92	93	2	Local Road	700	46	236	26	9	F	153	260
808713U	W 1St St	70.41	1.0	6,279	6	10.58	531	2	Collector	900	266	702	94	8	E	79.3	940
096711K	Port Industrial Rd	70.06	1.0	6,279	8	8.97	2,050	2	Arterial	1,400	1,025	5,136	307	17	F	150.3	3060
096710D	Division St	69.82	1.0	6,279	7	8.97	2	2	Local Road	700	1	2	0	4	D	40.3	20
096709J	Heron St	69.81	1.0	6,279	6	8.97	19	2	Local Road	700	10	13	3	5	D	40.8	20
808707R	Monroe St	69.63	1.0	6,279	6	8.97	2	2	Local Road	700	1	2	0	4	D	40.3	20
096706N	Washington St	69.49	1.0	6,279	5	8.97	77	2	Local Road	700	38	55	11	5	D	42.6	120
092551K	H Street	68.8	1.0	6,279	5	30.01	101	2	Local Road	700	50	817	50	16	F	485.4	500
096695D	E Heron St	68.5	1.0	6,279	5	28.22	397	1	Local Road	700	397	6,071	187	33	F	918.5	3740
096693P	Newell St	68.44	1.0	6,279	6	27.72	75	2	Local Road	700	37	504	34	15	F	405.7	340
096691B	S Chehalis St	68.36	1.0	6,279	6	25.08	564	4	Local Road	700	141	3,698	236	16	F	393.6	1180
096689A	Dairy Queen Entrance	68.34	1.0	6,279	6	24.80	19	2	Local Road	700	10	100	8	13	F	311.8	80
096690U	McDonalds Entrance	68.31	1.0	6,279	6	24.61	123	2	Local Road	700	61	678	50	13	F	331.8	500
096029N	Tyler St	68.23	1.0	6,279	7	24.11	465	4	Local Road	700	116	2,702	187	14	F	348.5	940
096688T	Fleet St	68.16	1.0	6,279	7	23.66	185	2	Local Road	700	93	995	73	14	F	322.5	720

[1] Based on 1 grain train passby. Except for Industrial Rd (922990N), Myrtle St (AA), N Maple St (BB), and W 1st St (808713U) which are based on the average of proposed action train traffic.

Table 16. Grade Crossing Delay of Baseline Traffic for Peak Hour (2037)

Crossing ID	Street	Milepost	Number of Daily Trains	Train Speed (mph)	Gate Down-Time (min)	Peak Hour traffic in both directions (veh/hr)	Number of lanes in both directions	Urban or Rural	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
096687L	Junction City Rd	67.14	1.0	12	6.6	183	2	Urban Collector	Collector	900	92	73.71	20	4	C	24.1	200
096682C	Central Park Dr	61.8	1.0	11	6.6	44	2	Rural Major Collector	Collector	900	22	16.35	5	3	C	22.5	40
096680N	Aldergrove Dr	59.72	1.0	25	3.2	59	2	Rural Local	Local Road	700	30	5.16	3	2	A	5.2	40
096679U	Heikkinen Rd	59.43	1.0	25	3.2	31	1	Rural Local	Local Road	700	31	2.72	2	2	A	5.3	40
096678M	Devonshire Rd	58.91	1.0	25	3.2	157	2	Rural Minor Collector	Collector	900	78	14.40	8	2	A	5.5	80
096677F	County Farm Rd	58.73	1.0	25	3.2	39	2	Rural Local	Local Road	700	19	3.34	2	2	A	5.2	20
096672W	Main Street	57.72	1.0	25	3.2	233	2	Rural Major Collector	Collector	900	117	22.66	12	2	A	5.8	120
400107G	Sylvia St	57.59	1.0	25	3.2	19	2	Urban Local	Local Road	700	9	1.60	1	2	A	5.1	20
096659H	Old Beacon Rd	56.02	1.0	25	3.1	14	2	Rural Local	Local Road	700	7	1.16	1	2	A	5.0	20
096658B	Monte Brady Rd	55.71	1.0	25	3.2	117	2	Rural Minor Collector	Collector	900	58	10.55	6	2	A	5.4	60
096657U	Glenn Rd	55.42	1.0	25	3.2	3	2	Rural Local	Local Road	700	2	0.26	0	2	A	5.0	20
096655F	Fairbairn Rd	54.38	1.0	25	3.2	3	2	Rural Local	Local Road	700	2	0.27	0	2	A	5.1	20
096654Y	Winkerman Rd S	54.1	1.0	25	3.2	6	2	Rural Local	Local Road	700	3	0.53	0	2	A	5.2	20
096652K	Monte Brady Rd	53.33	1.0	25	3.2	155	2	Rural Major Collector	Collector	900	78	14.40	8	2	A	5.6	80
096650W	Foss Av-Monte Elma	51.98	1.0	25	3.2	709	2	Rural Major Collector	Collector	900	354	98.92	38	3	A	8.4	380
096649C	Hewitt St	51.85	1.0	25	3.2	51	2	Rural Local	Local Road	700	26	4.47	3	2	A	5.2	20
096648V	Moore Rd	51.53	1.0	25	3.2	75	2	Rural Local	Local Road	700	37	6.58	4	2	A	5.3	40
096646G	Oniel Rd	51.03	1.0	25	3.2	84	2	Rural Local	Local Road	700	42	7.48	4	2	A	5.3	40
096644T	Newman Creek Rd	50.56	1.0	25	3.2	127	2	Rural Local	Local Road	700	64	11.74	7	2	A	5.5	60
096643L	Hurd Rd	50.08	1.0	25	3.2	204	2	Rural Local	Local Road	700	102	19.95	11	2	A	5.9	100
096642E	Calder Rd	49.36	1.0	25	3.2	89	2	Rural Local	Local Road	700	44	8.00	5	2	A	5.4	40
096641X	N 17th St	48.93	1.0	25	3.2	17	2	Rural Local	Local Road	700	9	1.51	1	2	A	5.3	20
096640R	N 13th St	48.7	1.0	25	3.3	96	2	Rural Local	Local Road	700	48	9.13	5	2	A	5.7	60
096639W	N 11th St	48.57	1.0	24	3.2	284	2	Rural Local	Local Road	700	142	31.22	15	2	A	6.6	160
096638P	N 10th St	48.51	1.0	23	3.3	40	2	Rural Local	Local Road	700	20	3.67	2	2	A	5.4	20
096636B	N 6th St	48.32	1.0	23	3.3	22	2	Rural Local	Local Road	700	11	1.95	1	2	A	5.4	20

Crossing ID	Street	Milepost	Number of Daily Trains	Train Speed (mph)	Gate Down-Time (min)	Peak Hour traffic in both directions (veh/hr)	Number of lanes in both directions	Urban or Rural	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
096635U	N 5th St	48.26	1.0	23	3.2	11	2	Rural Local	Local Road	700	5	0.96	1	2	A	5.3	20
096634M	N 3rd St	48.12	1.0	23	3.2	92	2	Rural Local	Local Road	700	46	8.48	5	2	A	5.5	40
096525J	N 2d St	48.06	1.0	24	3.2	70	2	Rural Local	Local Road	700	35	6.28	4	2	A	5.4	40
096519F	Tridwell Rd	46.71	1.0	25	3.2	17	2	Rural Local	Local Road	700	9	1.44	1	2	A	5.1	20
096518Y	Blockhouse Rd W	46.33	1.0	25	3.2	33	2	Rural Local	Local Road	700	16	2.80	2	2	A	5.2	20
096515D	Blockhouse Rd E	45.26	1.0	25	2.9	6	2	Rural Local	Local Road	700	3	0.44	0	1	A	4.3	20
096510U	Dunlap Rd	44.19	1.0	25	3.2	28	2	Rural Local	Local Road	700	14	2.40	1	2	A	5.1	20
092603A	Porter Creek Rd	41.5	1.0	25	3.2	120	2	Rural Minor Collector	Collector	900	60	10.79	6	2	A	5.4	60
092595K	Elma Gare Rd W	38.46	1.0	25	3.1	14	2	Rural Local	Local Road	700	7	1.13	1	2	A	4.8	20
092593W	Shelton Rd	36.71	1.0	25	3.2	8	2	Rural Local	Local Road	700	4	0.65	0	2	A	5.0	20
92587T	Scheaffer St	33.95	1.0	25	3.2	6	2	Rural Local	Local Road	700	3	0.52	0	2	A	5.0	20
092586L	Newton St	33.65	1.0	25	3.2	26	2	Rural Local	Local Road	700	13	2.26	1	2	A	5.1	20
092585E	Murray St	33.39	1.0	25	3.2	26	2	Rural Local	Local Road	700	13	2.26	1	2	A	5.1	20
092584X	Merry Rd	33.04	1.0	25	3.2	8	2	Rural Local	Local Road	700	4	0.66	0	2	A	5.1	20
092583R	Blockhouse Rd	32.45	1.0	25	3.2	6	2	Rural Local	Local Road	700	3	0.52	0	2	A	5.0	20
092577M	Moon Rd SW	28.71	1.0	25	3.2	39	2	Rural Local	Local Road	700	19	3.48	2	2	A	5.4	20
092576F	Owings St	13.28	1.0	25	3.2	48	2	Rural Local	Local Road	700	24	4.25	3	2	A	5.3	20
092574S	Little Rock Rd	10.95	1.0	25	3.4	149	2	Rural Local	Local Road	700	75	15.96	8	2	A	6.4	80
092573K	183rd Ave SW	10.05	1.0	25	3.2	117	2	Rural Minor Collector	Collector	900	58	10.77	6	2	A	5.5	60
092569V	Joselyn Ave	8.45	1.0	25	3.2	31	2	Rural Local	Local Road	700	16	2.68	2	2	A	5.2	20
092567G	Tea St	7.18	1.0	25	3.2	76	2	Rural Local	Local Road	700	38	6.77	4	2	A	5.3	40
092566A	Grand Mound SW	6.84	1.0	25	3.2	51	2	Rural Local	Local Road	700	26	4.48	3	2	A	5.2	20
092565T	Old Hwy 99 SW	6.07	1.0	21	4.0	1,509	2	Rural Major Collector	Collector	900	755	1257.74	101	12	D	50.0	1020
092563E	216th Ave SW	5.37	1.0	13	6.4	14	2	Rural Local	Local Road	700	7	4.83	1	3	C	20.7	20
092561R	222d Ave SW	4.72	1.0	10	7.5	26	2	Rural Local	Local Road	700	13	12.72	3	4	C	28.9	40
922981P	Hoss Rd	4.44	1.0	10	7.5	171	2	Urban Local	Local Road	700	85	92.02	21	4	C	32.3	220
922982W	Robert Thompson Rd	4.26	1.0	10	7.5	85	2	Rural Minor Collector	Collector	900	43	42.40	11	4	C	29.8	100

Crossing ID	Street	Milepost	Number of Daily Trains	Train Speed (mph)	Gate Down-Time (min)	Peak Hour traffic in both directions (veh/hr)	Number of lanes in both directions	Urban or Rural	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
922980H	Kuper Rd	3.92	1.0	10	7.6	70	2	Rural Local	Local Road	700	35	34.97	9	4	C	30.0	80
092559P	Fordon Rd	3.53	1.0	10	7.0	28	2	Urban Local	Local Road	700	14	11.71	3	4	C	25.1	40
092554F	W Reynolds Ave	2.14	1.0	10	6.7	948	2	Urban Minor Arterial	Arterial	1,400	474	534.09	106	5	C	33.8	1060
092552S	J St	1.28	1.0	8	8.8	51	2	Urban Local	Local Road	700	26	34.23	8	5	D	40.0	80
092551K	H St	1.15	1.0	7	8.8	131	2	Urban Local	Local Road	700	65	92.56	19	5	D	42.5	200
092550D	G St	1.09	1.0	7	9.2	51	2	Urban Local	Local Road	700	26	37.42	8	5	D	43.8	80
092549J	F St	1.03	1.0	7	8.8	36	2	Urban Local	Local Road	700	18	23.66	5	5	D	39.7	60
092548C	E St	0.95	1.0	7	8.8	51	2	Urban Local	Local Road	700	26	34.44	8	5	D	40.3	80
092546N	Tower St	0.82	1.0	7	8.8	1,192	2	Urban Collector	Collector	900	596	2302.90	176	13	F	115.9	1760
092543T	B St	54.28	1.0	7	8.9	103	2	Urban Local	Local Road	700	51	73.61	15	5	D	43.1	160

Table 17. Grade Crossing Delay of Baseline Traffic for Peak Hour Switching Movements (2037)[1]

Crossing ID	Street	Milepost	Number of Daily Trains	Train Speed (mph)	Gate Down-Time per Day (min)	Peak hour traffic in both directions (veh/hr)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
808714B	Port Industrial Rd (30th St)		1.0	6,279	7	950	2	Local Road	700	475	563	76	7	D	35.6	760
808711F	Myrtle		1.0	6,279	7	550	2	Arterial	1,400	275	131	44	3	B	14.2	440
808712M	Maple		1.0	6,279	7	120	2	Local Road	700	60	25	10	3	B	12.5	100
922990N	Industrial Rd	71.04	1.0	6,279	5	861	2	Arterial	1,400	431	8820	419	21	F	614.6	4180
AA	Myrtle St	70.85	1.0	6,279	7	11	2	Arterial	1,400	5	2	1	-	B	11.9	20
BB	N Maple St	70.55	1.0	6,279	7	120	2	Local Road	700	60	312	34	-	F	156.5	340
808713U	W 1St St	70.41	1.0	6,279	6	687	2	Collector	900	343	1035	121	10,949	F	1220	1220
096711K	Port Industrial Rd	70.06	1.0	6,279	7	2,651	2	Arterial	1,400	1,326	33522	396	300,710	F	3960	3960
096710D	Division St	69.82	1.0	6,279	7	3	2	Local Road	700	2	2	0	19	B	20	20
096709J	Heron St	69.81	1.0	6,279	6	25	2	Local Road	700	12	17	4	152	F	40	40
808707R	Monroe St	69.63	1.0	6,279	6	3	2	Local Road	700	2	2	0	19	B	20	20
096706N	Washington St	69.49	1.0	6,279	5	99	2	Local Road	700	50	72	15	644	F	140	140
092551K	H Street	68.8	1.0	6,279	6	131	2	Local Road	700	65	1057	65	31,395	F	640	640
096695D	E Heron St	68.5	1.0	6,279	5	513	1	Local Road	700	513	11081	225	291,710	F	4500	4500
096693P	Newell St	68.44	1.0	6,279	6	96	2	Local Road	700	48	542	40	13,583	F	400	400
096691B	S Chehalis St	68.36	1.0	6,279	6	729	4	Local Road	700	182	4108	272	91,890	F	1360	1360
096689A	Dairy Queen Entrance	68.34	1.0	6,279	6	25	2	Local Road	700	12	102	9	2,236	F	100	100
096690U	McDonalds Entrance	68.31	1.0	6,279	6	159	2	Local Road	700	79	682	57	14,600	F	560	560
096029N	Tyler St	68.23	1.0	6,279	6	601	4	Local Road	700	150	2751	208	57,101	F	1040	1040
096688T	Fleet St	68.16	1.0	6,279	7	239	2	Local Road	700	120	993	81	20,176	F	820	820

[1] Based on 1 grain train passby. Except for Industrial Rd (922990N), Myrtle St (AA), N Maple St (BB), and W 1st St (808713U) which are based on the average of proposed action train traffic.

Proposed Action

Table 18. Grade Crossing Delay of Proposed Action Train Traffic with Baseline Traffic (2017)

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
096687L	Junction City Rd	67.14	4.4	5,323	12	24.8	1,234	2	Collector	900	26	62	21	3	A	3.0	40	1.5	9	0.70%	1.5
096682C	Central Park Dr	61.8	4.4	5,323	11	25.6	293	2	Collector	900	6	15	5	3	A	3.2	20	1.6	2	0.71%	1.6
096680N	Aldergrove Dr	59.72	4.4	5,323	25	12.2	397	2	Local Road	700	8	5	3	1	A	0.7	20	0.3	1	0.36%	0.4
096679U	Heikkinen Rd	59.43	4.4	5,323	25	12.2	209	1	Local Road	700	9	3	2	1	A	0.7	20	0.3	1	0.36%	0.4
096678M	Devonshire Rd	58.91	4.4	5,323	25	12.1	1,056	2	Collector	900	22	13	9	1	A	0.7	20	0.3	4	0.35%	0.4
096677F	County Farm Rd	58.73	4.4	5,323	25	12.0	262	2	Local Road	700	5	3	2	1	A	0.7	20	0.3	1	0.34%	0.4
096672W	Main Street	57.72	4.4	5,323	25	12.1	1,569	2	Collector	900	33	19	13	1	A	0.7	40	0.4	5	0.34%	0.4
400107G	Sylvia St	57.59	4.4	5,323	25	12.1	126	2	Local Road	700	3	1	1	1	A	0.7	20	0.3	0	0.34%	0.4
096659H	Old Beacon Rd	56.02	4.4	5,323	25	11.9	94	2	Local Road	700	2	1	1	1	A	0.7	20	0.3	0	0.33%	0.3
096658B	Monte Brady Rd	55.71	4.4	5,323	25	12.0	785	2	Collector	900	16	9	7	1	A	0.7	20	0.3	3	0.34%	0.4
096657U	Glenn Rd	55.42	4.4	5,323	25	11.9	21	2	Local Road	700	0	0	0	1	A	0.7	20	0.3	0	0.34%	0.3
096655F	Fairbairn Rd	54.38	4.4	5,323	25	12.0	21	2	Local Road	700	0	0	0	1	A	0.7	20	0.3	0	0.34%	0.4
096654Y	Winkerman Rd S	54.1	4.4	5,323	25	12.0	42	2	Local Road	700	1	0	0	1	A	0.7	20	0.3	0	0.34%	0.4
096652K	Monte Brady Rd	53.33	4.4	5,323	25	12.0	1,046	2	Collector	900	22	12	9	1	A	0.7	20	0.3	4	0.34%	0.4
096650W	Foss Av-Monte Elma	51.98	4.4	5,323	25	12.1	4,770	2	Collector	900	99	62	40	2	A	0.8	100	0.4	16	0.34%	0.4
096649C	Hewitt St	51.85	4.4	5,323	25	12.0	345	2	Local Road	700	7	4	3	1	A	0.7	20	0.3	1	0.34%	0.4
096648V	Moore Rd	51.53	4.4	5,323	25	12.0	502	2	Local Road	700	10	6	4	1	A	0.7	20	0.3	2	0.34%	0.4
096646G	Oniel Rd	51.03	4.4	5,323	25	11.8	565	2	Local Road	700	12	6	5	1	A	0.7	20	0.3	2	0.32%	0.3
096644T	Newman Creek Rd	50.56	4.4	5,323	25	12.0	858	2	Local Road	700	18	10	7	1	A	0.7	20	0.3	3	0.34%	0.4
096643L	Hurd Rd	50.08	4.4	5,323	25	11.1	1,370	2	Local Road	700	29	14	11	1	A	0.6	20	0.4	4	0.28%	0.3
096642E	Calder Rd	49.36	4.4	5,323	25	12.1	596	2	Local Road	700	12	7	5	1	A	0.7	20	0.3	2	0.34%	0.4

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
096641X	N 17th St	48.93	4.4	5,323	25	11.5	115	2	Local Road	700	2	1	1	1	A	0.6	20	0.3	0	0.30%	0.3
096640R	N 13th St	48.7	4.4	5,323	25	11.6	649	2	Local Road	700	14	7	5	1	A	0.7	20	0.3	2	0.31%	0.3
096639W	N 11th St	48.57	4.4	5,323	24	11.8	1,914	2	Local Road	700	40	22	16	1	A	0.7	40	0.4	6	0.32%	0.3
096638P	N 10th St	48.51	4.4	5,323	23	12.9	272	2	Local Road	700	6	4	2	1	A	0.8	20	0.5	1	0.32%	0.3
096636B	N 6th St	48.32	4.4	5,323	23	13.5	146	2	Local Road	700	3	2	1	2	A	0.9	20	0.5	0	0.33%	0.4
096635U	N 5th St	48.26	4.4	5,323	23	13.6	73	2	Local Road	700	2	1	1	2	A	0.9	20	0.5	0	0.33%	0.4
096634M	N 3rd St	48.12	4.4	5,323	23	14.9	617	2	Local Road	700	13	11	6	2	A	1.1	20	0.7	2	0.34%	0.4
096525J	N 2d St	48.06	4.4	5,323	24	13.3	471	2	Local Road	700	10	7	4	2	A	0.9	20	0.5	2	0.34%	0.4
096519F	Tridwell Rd	46.71	4.3	5,411	25	12.8	115	2	Local Road	700	2	2	1	2	A	0.8	20	0.4	0	0.35%	0.4
096518Y	Blockhouse Rd W	46.33	4.3	5,411	25	12.1	220	2	Local Road	700	5	3	2	1	A	0.7	20	0.4	1	0.34%	0.4
096515D	Blockhouse Rd E	45.26	4.3	5,411	25	12.1	42	2	Local Road	700	1	1	0	1	A	0.7	20	0.4	0	0.35%	0.4
096510U	Dunlap Rd	44.19	4.3	5,411	25	12.0	188	2	Local Road	700	4	2	2	1	A	0.7	20	0.4	1	0.34%	0.4
092603A	Porter Creek Rd	41.5	4.3	5,411	25	12.0	805	2	Collector	900	17	10	7	1	A	0.7	20	0.4	3	0.34%	0.4
092595K	Elma Gare Rd W	38.46	4.3	5,411	25	12.0	94	2	Local Road	700	2	1	1	1	A	0.7	20	0.4	0	0.34%	0.4
092593W	Shelton Rd	36.71	4.3	5,411	25	12.0	52	2	Local Road	700	1	1	0	1	A	0.7	20	0.4	0	0.34%	0.4
92587T	Scheaffer St	33.95	4.3	5,411	25	11.8	42	2	Local Road	700	1	0	0	1	A	0.7	20	0.4	0	0.33%	0.3
092586L	Newton St	33.65	4.3	5,411	25	11.9	178	2	Local Road	700	4	2	1	1	A	0.7	20	0.4	1	0.33%	0.3
092585E	Murray St	33.39	4.3	5,411	25	12.0	178	2	Local Road	700	4	2	1	1	A	0.7	20	0.4	1	0.34%	0.4
092584X	Merry Rd	33.04	4.3	5,411	25	12.0	52	2	Local Road	700	1	1	0	1	A	0.7	20	0.4	0	0.34%	0.4
092583R	Blockhouse Rd	32.45	4.3	5,411	25	12.0	42	2	Local Road	700	1	0	0	1	A	0.7	20	0.4	0	0.34%	0.4
092577M	Moon Rd SW	28.71	4.3	5,411	25	12.1	262	2	Local Road	700	5	3	2	1	A	0.7	20	0.4	1	0.35%	0.4
092576F	Owings St	13.28	4.3	5,411	25	12.0	324	2	Local Road	700	7	4	3	1	A	0.7	20	0.4	1	0.34%	0.4
092574S	Little Rock Rd	10.95	4.3	5,411	25	12.0	1,004	2	Local Road	700	21	12	8	1	A	0.7	20	0.4	3	0.34%	0.4
092573K	183rd Ave SW	10.05	4.3	5,411	25	12.0	785	2	Collector	900	16	9	7	1	A	0.7	20	0.4	3	0.34%	0.4
092569V	Joselyn Ave	8.45	4.3	5,411	25	12.0	209	2	Local Road	700	4	2	2	1	A	0.7	20	0.4	1	0.34%	0.4
092567G	Tea St	7.18	4.3	5,411	25	12.1	513	2	Local Road	700	11	6	4	1	A	0.7	20	0.4	2	0.34%	0.4

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
092566A	Grand Mound SW	6.84	4.3	5,411	25	12.1	345	2	Local Road	700	7	4	3	1	A	0.7	20	0.4	1	0.35%	0.4
092565T	Old Hwy 99 SW	6.07	4.3	5,411	21	14.5	10,157	2	Collector	900	212	229	103	2	A	1.4	240	0.5	49	0.49%	0.8
092563E	216th Ave SW	5.37	4.3	5,411	13	23.5	94	2	Local Road	700	2	4	2	3	A	2.7	20	1.2	1	0.70%	1.5
092561R	222d Ave SW	4.72	4.3	5,411	10	28.5	178	2	Local Road	700	4	12	4	3	A	4.0	20	2.1	1	0.78%	1.9
922981P	Hoss Rd	4.44	4.3	5,411	10	28.5	1,151	2	Local Road	700	24	79	23	3	A	4.1	60	2.1	9	0.79%	2.0
922982W	Robert Thompson Rd	4.26	4.3	5,411	10	28.9	575	2	Collector	900	12	40	12	3	A	4.1	20	2.1	5	0.81%	2.1
922980H	Kuper Rd	3.92	4.3	5,411	10	29.6	471	2	Local Road	700	10	34	10	4	A	4.4	20	2.3	4	0.81%	2.1
092559P	Fordon Rd	3.53	4.3	5,411	10	29.4	188	2	Local Road	700	4	13	4	3	A	4.3	20	2.3	1	0.79%	2.0
092554F	W Reynolds Ave	2.14	4.3	5,411	10	28.4	6,381	2	Arterial	1,400	133	462	126	4	A	4.3	300	2.3	49	0.76%	2.0
092552S	J St	1.28	4.3	5,411	8	36.0	345	2	Local Road	700	7	37	9	4	A	6.4	20	3.7	3	0.90%	2.7
092551K	H St	1.15	4.3	5,411	7	37.5	879	2	Local Road	700	18	104	23	5	A	7.1	60	4.3	8	0.90%	2.8
092550D	G St	1.09	4.3	5,411	7	39.2	345	2	Local Road	700	7	44	9	5	A	7.6	20	4.7	3	0.92%	2.9
092549J	F St	1.03	4.3	5,411	7	38.3	241	2	Local Road	700	5	29	6	5	A	7.2	20	4.5	2	0.90%	2.7
092548C	E St	0.95	4.3	5,411	7	38.4	345	2	Local Road	700	7	42	9	5	A	7.3	20	4.6	3	0.90%	2.7
092547V	D St	0.89	4.3	5,411	7	38.5	13,755	2	Collector	900	287	2444	368	7	B	10.7	860	6.7	124	0.90%	4.0
092546N	Tower St	0.82	4.3	5,411	7	38.6	8,023	2	Collector	900	167	1197	215	6	A	8.9	500	5.6	72	0.90%	3.4
092543T	B St	54.28	4.3	5,411	7	38.1	690	2	Local Road	700	14	84	18	5	A	7.3	40	4.5	6	0.91%	2.8

Table 19. Grade Crossing Delay of Proposed Action Train Traffic with Baseline Traffic for Switching Movements (2017)

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
808714B	Port Industrial Rd (30th St)		0.3	6,099	3.93	2.53	6,391	2	Local Road	700	133	65	11	6	A	0.6	420	0.6	0	0.00	-
808711F	Myrtle		0.3	6,099	4.93	2.53	3,703	2	Arterial	1,400	77	32	7	5	A	0.5	240	0.5	0	0.00	-
808712M	Maple		0.3	6,099	5.93	2.53	805	2	Local Road	700	17	7	1	5	A	0.5	60	0.5	0	0.00	-
922990N	Industrial Rd	71.04	4.1	1,206	3.9	89.57	5,795	2	Arterial	1,400	121	4351	360	12	D	45.1	880	14.6	190	3.28	30.4
AA	Myrtle St	70.85	1.4	718	2.2	6.95	73	2	Arterial	1,400	2	1	0	2	A	0.7	20	0.7	0	0.00	-
BB	N Maple St	70.55	4.1	1,206	5.7	56.66	805	2	Local Road	700	17	227	32	7	B	17	80	4.7	18	2.21	12.2
808713U	W 1St St	70.41	4.3	3,652	5.9	49.99	4,623	2	Collector	900	96	1036	161	6	B	13	380	2.5	102	2.20	10.9
096711K	Port Industrial Rd	70.06	5.2	2,071	7.6	42.07	17,845	2	Arterial	1,400	372	2889	521	6	A	10	1,000	1.9	323	1.81	7.9
096710D	Division St	69.82	5.2	2,071	6.9	45.38	21	2	Local Road	700	0	3	1	4	A	8	20	1.2	0	2.10	7.1
096709J	Heron St	69.81	5.2	2,071	6.5	48.44	167	2	Local Road	700	3	27	6	5	A	10	20	1.4	4	2.25	8.1
808707R	Monroe St	69.63	6.2	3,573	6.5	62.09	21	2	Local Road	700	0	5	1	5	B	13	20	2.0	1	2.80	11.0
096706N	Washington St	69.49	6.2	3,573	5.4	64.00	669	2	Local Road	700	14	157	30	5	B	14	40	2.1	20	2.92	12.0
092551K	H Street	68.8	4.4	3,679	5.1	135.48	879	2	Local Road	700	18	1296	83	16	F	88	180	32.4	40	4.59	56.1
096695D	E Heron St	68.5	4.4	3,679	5.5	114.53	3,452	1	Local Road	700	144	4458	275	16	E	77	1,240	41.8	104	3.01	35.7
096693P	Newell St	68.44	4.4	3,679	5.7	112.24	649	2	Local Road	700	14	652	51	13	E	60	120	32.3	19	2.97	28.0
096691B	S Chehalis St	68.36	4.4	3,679	6.0	93.92	4,906	4	Local Road	700	51	3652	320	11	D	45	360	21.0	134	2.73	23.6
096689A	Dairy Queen Entrance	68.34	4.4	3,679	6.0	92.67	157	2	Local Road	700	3	106	10	10	D	40	20	19.0	4	2.71	21.5
096690U	McDonalds Entrance	68.31	4.4	3,679	6.1	91.84	1,067	2	Local Road	700	22	727	68	11	D	41	160	19.1	29	2.69	21.8
096029N	Tyler St	68.23	4.4	3,679	6.5	89.70	4,048	4	Local Road	700	42	2712	252	11	D	40	280	18.6	107	2.64	21.6
096688T	Fleet St	68.16	4.4	3,679	6.7	87.81	1,611	2	Local Road	700	34	1021	98	10	D	38	220	17.4	42	2.61	20.6

Table 20. Grade Crossing Delay of Proposed Action Train Traffic with Baseline Traffic (2037)

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
096687L	Junction City Rd	67.14	4.4	5,323	12	24.8	1,596	2	Collector	900	33	81.28	28	3	A	3.1	60	1.5	15	0.93%	1.6
096682C	Central Park Dr	61.8	4.4	5,323	11	25.6	379	2	Collector	900	8	19.96	7	3	A	3.2	20	1.6	4	0.96%	1.6
096680N	Aldergrove Dr	59.72	4.4	5,323	25	12.2	514	2	Local Road	700	11	6.21	4	1	A	0.7	20	0.3	2	0.47%	0.4
096679U	Heikkinen Rd	59.43	4.4	5,323	25	12.2	271	1	Local Road	700	11	3.27	2	1	A	0.7	20	0.3	1	0.47%	0.4
096678M	Devonshire Rd	58.91	4.4	5,323	25	12.1	1,366	2	Collector	900	28	16.47	11	1	A	0.7	20	0.3	6	0.46%	0.4
096677F	County Farm Rd	58.73	4.4	5,323	25	12.0	338	2	Local Road	700	7	3.95	3	1	A	0.7	20	0.3	2	0.46%	0.4
096672W	Main Street	57.72	4.4	5,323	25	12.1	2,029	2	Collector	900	42	24.64	17	1	A	0.7	40	0.4	9	0.46%	0.4
400107G	Sylvia St	57.59	4.4	5,323	25	12.1	162	2	Local Road	700	3	1.89	1	1	A	0.7	20	0.3	1	0.46%	0.4
096659H	Old Beacon Rd	56.02	4.4	5,323	25	11.9	122	2	Local Road	700	3	1.37	1	1	A	0.7	20	0.3	1	0.44%	0.3
096658B	Monte Brady Rd	55.71	4.4	5,323	25	12.0	1,015	2	Collector	900	21	11.97	8	1	A	0.7	20	0.3	5	0.45%	0.4
096657U	Glenn Rd	55.42	4.4	5,323	25	11.9	27	2	Local Road	700	1	0.31	0	1	A	0.7	20	0.3	0	0.45%	0.3
096655F	Fairbairn Rd	54.38	4.4	5,323	25	12.0	27	2	Local Road	700	1	0.31	0	1	A	0.7	20	0.3	0	0.45%	0.4
096654Y	Winkerman Rd S	54.1	4.4	5,323	25	12.0	54	2	Local Road	700	1	0.63	0	1	A	0.7	20	0.3	0	0.45%	0.4
096652K	Monte Brady Rd	53.33	4.4	5,323	25	12.0	1,353	2	Collector	900	28	16.09	11	1	A	0.7	20	0.3	6	0.45%	0.4
096650W	Foss Av-Monte Elma	51.98	4.4	5,323	25	12.1	6,168	2	Collector	900	129	83.36	52	2	A	0.8	120	0.4	28	0.46%	0.4
096649C	Hewitt St	51.85	4.4	5,323	25	12.0	446	2	Local Road	700	9	5.22	4	1	A	0.7	20	0.3	2	0.45%	0.4
096648V	Moore Rd	51.53	4.4	5,323	25	12.0	649	2	Local Road	700	14	7.62	5	1	A	0.7	20	0.3	3	0.45%	0.4
096646G	Oniel Rd	51.03	4.4	5,323	25	11.8	730	2	Local Road	700	15	8.22	6	1	A	0.7	20	0.3	3	0.43%	0.3
096644T	Newman Creek Rd	50.56	4.4	5,323	25	12.0	1,109	2	Local Road	700	23	13.22	9	1	A	0.7	20	0.3	5	0.45%	0.4
096643L	Hurd Rd	50.08	4.4	5,323	25	11.1	1,772	2	Local Road	700	37	18.31	14	1	A	0.6	40	0.4	7	0.39%	0.3
096642E	Calder Rd	49.36	4.4	5,323	25	12.1	771	2	Local Road	700	16	9.14	6	1	A	0.7	20	0.3	4	0.46%	0.4
096641X	N 17th St	48.93	4.4	5,323	25	11.5	149	2	Local Road	700	3	1.57	1	1	A	0.6	20	0.3	1	0.42%	0.3
096640R	N 13th St	48.7	4.4	5,323	25	11.6	839	2	Local Road	700	17	9.23	7	1	A	0.7	20	0.3	4	0.42%	0.3
096639W	N 11th St	48.57	4.4	5,323	24	11.8	2,475	2	Local Road	700	52	29.44	20	1	A	0.7	40	0.4	11	0.43%	0.3

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
096638P	N 10th St	48.51	4.4	5,323	23	12.9	352	2	Local Road	700	7	4.72	3	1	A	0.8	20	0.5	2	0.45%	0.3
096636B	N 6th St	48.32	4.4	5,323	23	13.5	189	2	Local Road	700	4	2.76	2	2	A	0.9	20	0.5	1	0.47%	0.4
096635U	N 5th St	48.26	4.4	5,323	23	13.6	95	2	Local Road	700	2	1.40	1	2	A	0.9	20	0.5	0	0.47%	0.4
096634M	N 3rd St	48.12	4.4	5,323	23	14.9	798	2	Local Road	700	17	14.39	8	2	A	1.1	20	0.7	4	0.50%	0.4
096525J	N 2d St	48.06	4.4	5,323	24	13.3	609	2	Local Road	700	13	8.79	6	2	A	0.9	20	0.5	3	0.47%	0.4
096519F	Tridwell Rd	46.71	4.3	5,411	25	12.8	149	2	Local Road	700	3	1.99	1	2	A	0.8	20	0.4	1	0.47%	0.4
096518Y	Blockhouse Rd W	46.33	4.3	5,411	25	12.1	284	2	Local Road	700	6	3.42	2	1	A	0.7	20	0.4	1	0.46%	0.4
096515D	Blockhouse Rd E	45.26	4.3	5,411	25	12.1	54	2	Local Road	700	1	0.65	0	1	A	0.7	20	0.4	0	0.46%	0.4
096510U	Dunlap Rd	44.19	4.3	5,411	25	12.0	243	2	Local Road	700	5	2.89	2	1	A	0.7	20	0.4	1	0.45%	0.4
092603A	Porter Creek Rd	41.5	4.3	5,411	25	12.0	1,042	2	Collector	900	22	12.61	9	1	A	0.7	20	0.4	5	0.45%	0.4
092595K	Elma Gare Rd W	38.46	4.3	5,411	25	12.0	122	2	Local Road	700	3	1.43	1	1	A	0.7	20	0.4	1	0.45%	0.4
092593W	Shelton Rd	36.71	4.3	5,411	25	12.0	68	2	Local Road	700	1	0.80	1	1	A	0.7	20	0.4	0	0.45%	0.4
92587T	Scheaffer St	33.95	4.3	5,411	25	11.8	54	2	Local Road	700	1	0.62	0	1	A	0.7	20	0.4	0	0.44%	0.3
092586L	Newton St	33.65	4.3	5,411	25	11.9	230	2	Local Road	700	5	2.68	2	1	A	0.7	20	0.4	1	0.45%	0.3
092585E	Murray St	33.39	4.3	5,411	25	12.0	230	2	Local Road	700	5	2.72	2	1	A	0.7	20	0.4	1	0.45%	0.4
092584X	Merry Rd	33.04	4.3	5,411	25	12.0	68	2	Local Road	700	1	0.80	1	1	A	0.7	20	0.4	0	0.45%	0.4
092583R	Blockhouse Rd	32.45	4.3	5,411	25	12.0	54	2	Local Road	700	1	0.64	0	1	A	0.7	20	0.4	0	0.45%	0.4
092577M	Moon Rd SW	28.71	4.3	5,411	25	12.1	338	2	Local Road	700	7	4.06	3	1	A	0.7	20	0.4	2	0.46%	0.4
092576F	Owings St	13.28	4.3	5,411	25	12.0	419	2	Local Road	700	9	5.01	4	1	A	0.7	20	0.4	2	0.46%	0.4
092574S	Little Rock Rd	10.95	4.3	5,411	25	12.0	1,299	2	Local Road	700	27	15.93	11	1	A	0.7	20	0.4	6	0.45%	0.4
092573K	183rd Ave SW	10.05	4.3	5,411	25	12.0	1,015	2	Collector	900	21	12.25	8	1	A	0.7	20	0.4	5	0.45%	0.4
092569V	Joselyn Ave	8.45	4.3	5,411	25	12.0	271	2	Local Road	700	6	3.21	2	1	A	0.7	20	0.4	1	0.45%	0.4
092567G	Tea St	7.18	4.3	5,411	25	12.1	663	2	Local Road	700	14	8.03	6	1	A	0.7	20	0.4	3	0.46%	0.4
092566A	Grand Mound SW	6.84	4.3	5,411	25	12.1	446	2	Local Road	700	9	5.39	4	1	A	0.7	20	0.4	2	0.46%	0.4
092565T	Old Hwy 99 SW	6.07	4.3	5,411	21	14.5	13,134	2	Collector	900	274	325.25	133	2	A	1.5	320	0.5	80	0.61%	1.0
092563E	216th Ave SW	5.37	4.3	5,411	13	23.5	122	2	Local Road	700	3	5.50	2	3	A	2.7	20	1.2	1	0.91%	1.5

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
092561R	222d Ave SW	4.72	4.3	5,411	10	28.5	230	2	Local Road	700	5	15.35	5	3	A	4.0	20	2.1	2	1.06%	1.9
922981P	Hoss Rd	4.44	4.3	5,411	10	28.5	1,488	2	Local Road	700	31	103.43	29	4	A	4.2	60	2.1	16	1.06%	2.0
922982W	Robert Thompson Rd	4.26	4.3	5,411	10	28.9	744	2	Collector	900	15	51.56	15	3	A	4.2	40	2.1	8	1.08%	2.1
922980H	Kuper Rd	3.92	4.3	5,411	10	29.6	609	2	Local Road	700	13	44.42	13	4	A	4.4	20	2.3	7	1.09%	2.1
092559P	Fordon Rd	3.53	4.3	5,411	10	29.4	243	2	Local Road	700	5	17.31	5	3	A	4.3	20	2.3	3	1.08%	2.0
092554F	W Reynolds Ave	2.14	4.3	5,411	10	28.4	8,251	2	Arterial	1,400	172	616.23	162	4	A	4.5	380	2.3	85	1.04%	2.2
092552S	J St	1.28	4.3	5,411	8	36.0	446	2	Local Road	700	9	47.71	11	4	A	6.4	20	3.7	6	1.26%	2.7
092551K	H St	1.15	4.3	5,411	7	37.5	1,136	2	Local Road	700	24	135.01	30	5	A	7.1	60	4.3	15	1.29%	2.8
092550D	G St	1.09	4.3	5,411	7	39.2	446	2	Local Road	700	9	56.74	12	5	A	7.6	20	4.7	6	1.33%	2.9
092549J	F St	1.03	4.3	5,411	7	38.3	311	2	Local Road	700	6	37.58	8	5	A	7.2	20	4.5	4	1.30%	2.7
092548C	E St	0.95	4.3	5,411	7	38.4	446	2	Local Road	700	9	54.40	12	5	A	7.3	20	4.6	6	1.30%	2.8
092547V	D St	0.89	4.3	5,411	7	38.5	17,788	2	Collector	900	371	3656.88	476	8	B	12.3	1120	6.7	232	1.30%	5.7
092546N	Tower St	0.82	4.3	5,411	7	38.6	10,375	2	Collector	900	216	1656.20	278	6	A	9.6	660	5.6	135	1.30%	4.0
092543T	B St	54.28	4.3	5,411	7	38.1	893	2	Local Road	700	19	108.57	24	5	A	7.3	60	4.5	12	1.30%	2.8

Table 21. Grade Crossing Delay of Proposed Action Train Traffic with Baseline Traffic for Switching Movements (2037)

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
808714B	Port Industrial Rd (30th St)		0.3	6,099	5	2.53	8,265	2	Local Road	700	172	93	15	6	A	0.7	560	0.7	0	0.00	-
808711F	Myrtle		0.3	6,099	2	2.53	4,788	2	Arterial	1,400	100	44	8	5	A	0.6	320	0.6	0	0.00	-
808712M	Maple		0.3	6,099	7	2.53	1,042	2	Local Road	700	22	9	2	5	A	0.5	80	0.5	0	0.00	-
922990N	Industrial Rd	71.04	4.1	1,206	4	89.57	7,494	2	Arterial	1,400	156	5787	466	12	D	46.3	1140	15.0	246	3.28	31.3
AA	Myrtle St	70.85	1.4	718	2	6.95	95	2	Arterial	1,400	2	1	0	2	A	0.7	20	0.7	0		-
BB	N Maple St	70.55	4.1	1,206	6	56.66	1,042	2	Local Road	700	22	295	41	7	B	17.0	100	4.7	23	2.21	12.3
808713U	W 1St St	70.41	4.3	3,652	6	49.99	5,979	2	Collector	900	125	1387	208	7	B	13.9	480	2.6	131	2.20	11.3
096711K	Port Industrial Rd	70.06	5.2	2,071	8	42.07	23,076	2	Arterial	1,400	481	4180	674	6	B	10.9	1300	2.1	418	1.81	8.8
096710D	Division St	69.82	5.2	2,071	7	45.38	27	2	Local Road	700	1	4	1	4	A	8.3	20	1.2	1	2.10	7.1
096709J	Heron St	69.81	5.2	2,071	6	48.44	216	2	Local Road	700	5	34	7	5	A	9.5	20	1.4	5	2.25	8.1
808707R	Monroe St	69.63	6.2	3,573	6	62.09	27	2	Local Road	700	1	6	1	5	B	13.0	20	2.0	1	2.80	11.0
096706N	Washington St	69.49	6.2	3,573	5	64.00	866	2	Local Road	700	18	204	38	5	B	14.1	60	2.1	25	2.92	12.0
092551K	H Street	68.8	4.4	3,679	5	131.92	1,136	2	Local Road	700	24	1601	104	15	F	84.5	240	29.4	52	4.59	55.2
096695D	E Heron St	68.5	4.4	3,679	5	95.25	4,464	1	Local Road	700	186	4315	295	15	E	58.0	1340	26.5	126	2.83	31.5
096693P	Newell St	68.44	4.4	3,679	6	92.55	839	2	Local Road	700	17	576	54	11	D	41.2	120	18.4	23	2.79	22.8
096691B	S Chehalis St	68.36	4.4	3,679	6	73.62	6,344	4	Local Road	700	66	2970	324	9	C	28.1	360	10.2	159	2.51	17.9
096689A	Dairy Queen Entrance	68.34	4.4	3,679	6	72.39	216	2	Local Road	700	5	89	11	8	C	24.8	20	8.8	5	2.49	15.9
096690U	McDonalds Entrance	68.31	4.4	3,679	6	71.55	1,380	2	Local Road	700	29	576	69	8	C	25.1	160	8.8	34	2.47	16.2
096029N	Tyler St	68.23	4.4	3,679	6	69.82	5,235	4	Local Road	700	55	2165	254	9	C	24.8	280	8.7	127	2.42	16.1
096688T	Fleet St	68.16	4.4	3,679	7	68.01	2,083	2	Local Road	700	43	804	98	8	C	23.1	220	8.2	49	2.35	15.0

Table 22. Grade Crossing Delay of Peak Hour Traffic for the Proposed Action Train Traffic with Baseline Traffic (2017)

Crossing ID	Street	Milepost	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time (min)	Peak Hour Traffic in both directions (veh/hour)	Number of lanes in both directions	Urban or Rural	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
096687L	Junction City Rd	67.14	1.0	7,419	12	7.8	142	2	Urban Collector	Collector	900	71	78	18	4	C	33.1	180
096682C	Central Park Dr	61.8	1.0	7,419	11	7.9	34	2	Rural Major Collector	Collector	900	17	18	4	4	C	31.8	40
096680N	Aldergrove Dr	59.72	1.0	7,419	25	3.8	46	2	Rural Local	Local Road	700	23	6	3	2	A	7.6	20
096679U	Heikkinen Rd	59.43	1.0	7,419	25	3.8	24	1	Rural Local	Local Road	700	24	3	2	2	A	7.6	40
096678M	Devonshire Rd	58.91	1.0	7,419	25	3.8	121	2	Rural Minor Collector	Collector	900	61	16	8	2	A	7.7	80
096677F	County Farm Rd	58.73	1.0	7,419	25	3.8	30	2	Rural Local	Local Road	700	15	4	2	2	A	7.2	20
096672W	Main Street	57.72	1.0	7,419	25	3.8	180	2	Rural Major Collector	Collector	900	90	24	11	2	A	7.9	120
400107G	Sylvia St	57.59	1.0	7,419	25	3.8	14	2	Urban Local	Local Road	700	7	2	1	2	A	7.1	20
096659H	Old Beacon Rd	56.02	1.0	7,419	25	3.7	11	2	Rural Local	Local Road	700	5	1	1	2	A	6.8	20
096658B	Monte Brady Rd	55.71	1.0	7,419	25	3.7	90	2	Rural Minor Collector	Collector	900	45	11	6	2	A	7.4	60
096657U	Glenn Rd	55.42	1.0	7,419	25	3.7	2	2	Rural Local	Local Road	700	1	0	0	2	A	6.9	20
096655F	Fairbairn Rd	54.38	1.0	7,419	25	3.8	2	2	Rural Local	Local Road	700	1	0	0	2	A	7.0	20
096654Y	Winkerman Rd S	54.1	1.0	7,419	25	3.8	5	2	Rural Local	Local Road	700	2	1	0	2	A	7.1	20
096652K	Monte Brady Rd	53.33	1.0	7,419	25	3.7	120	2	Rural Major Collector	Collector	900	60	15	8	2	A	7.5	80
096650W	Foss Av-Monte Elma	51.98	1.0	7,419	25	3.8	548	2	Rural Major Collector	Collector	900	274	93	34	3	B	10.2	340
096649C	Hewitt St	51.85	1.0	7,419	25	3.7	40	2	Rural Local	Local Road	700	20	5	2	2	A	7.2	20
096648V	Moore Rd	51.53	1.0	7,419	25	3.7	58	2	Rural Local	Local Road	700	29	7	4	2	A	7.3	40
096646G	Oniel Rd	51.03	1.0	7,419	25	3.4	65	2	Rural Local	Local Road	700	32	7	4	2	A	6.1	40
096644T	Newman Creek Rd	50.56	1.0	7,419	25	3.7	99	2	Rural Local	Local Road	700	49	12	6	2	A	7.5	60
096643L	Hurd Rd	50.08	1.0	7,419	25	2.9	157	2	Rural Local	Local Road	700	79	13	8	2	A	4.8	80
096642E	Calder Rd	49.36	1.0	7,419	25	3.8	69	2	Rural Local	Local Road	700	34	8	4	2	A	7.4	40
096641X	N 17th St	48.93	1.0	7,419	25	3.3	13	2	Rural Local	Local Road	700	7	1	1	2	A	5.4	20
096640R	N 13th St	48.7	1.0	7,419	25	3.3	75	2	Rural Local	Local Road	700	37	7	4	2	A	5.9	40
096639W	N 11th St	48.57	1.0	7,419	24	3.4	220	2	Rural Local	Local Road	700	110	25	12	2	A	6.8	120

Crossing ID	Street	Milepost	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time (min)	Peak Hour Traffic in both directions (veh/hour)	Number of lanes in both directions	Urban or Rural	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
096638P	N 10th St	48.51	1.0	7,419	23	3.4	31	2	Rural Local	Local Road	700	16	3	2	2	A	5.9	20
096636B	N 6th St	48.32	1.0	7,419	23	3.7	17	2	Rural Local	Local Road	700	8	2	1	2	A	6.8	20
096635U	N 5th St	48.26	1.0	7,419	23	3.7	8	2	Rural Local	Local Road	700	4	1	1	2	A	6.8	20
096634M	N 3rd St	48.12	1.0	7,419	23	3.8	71	2	Rural Local	Local Road	700	35	9	4	2	A	7.4	40
096525J	N 2d St	48.06	1.0	7,419	24	3.7	54	2	Rural Local	Local Road	700	27	7	3	2	A	7.2	40
096519F	Tridwell Rd	46.71	1.0	7,419	25	3.8	13	2	Rural Local	Local Road	700	7	2	1	2	A	7.2	20
096518Y	Blockhouse Rd W	46.33	1.0	7,419	25	3.8	25	2	Rural Local	Local Road	700	13	3	2	2	A	7.2	20
096515D	Blockhouse Rd E	45.26	1.0	7,419	25	3.8	5	2	Rural Local	Local Road	700	2	1	0	2	A	7.2	20
096510U	Dunlap Rd	44.19	1.0	7,419	25	3.8	22	2	Rural Local	Local Road	700	11	3	1	2	A	7.1	20
092603A	Porter Creek Rd	41.5	1.0	7,419	25	3.8	93	2	Rural Minor Collector	Collector	900	46	11	6	2	A	7.4	60
092595K	Elma Gare Rd W	38.46	1.0	7,419	25	3.7	11	2	Rural Local	Local Road	700	5	1	1	2	A	7.0	20
092593W	Shelton Rd	36.71	1.0	7,419	25	3.7	6	2	Rural Local	Local Road	700	3	1	0	2	A	7.0	20
92587T	Scheaffer St	33.95	1.0	7,419	25	3.7	5	2	Rural Local	Local Road	700	2	1	0	2	A	6.7	20
092586L	Newton St	33.65	1.0	7,419	25	3.7	20	2	Rural Local	Local Road	700	10	2	1	2	A	6.9	20
092585E	Murray St	33.39	1.0	7,419	25	3.7	20	2	Rural Local	Local Road	700	10	2	1	2	A	7.1	20
092584X	Merry Rd	33.04	1.0	7,419	25	3.8	6	2	Rural Local	Local Road	700	3	1	0	2	A	7.1	20
092583R	Blockhouse Rd	32.45	1.0	7,419	25	3.8	5	2	Rural Local	Local Road	700	2	1	0	2	A	7.1	20
092577M	Moon Rd SW	28.71	1.0	7,419	25	3.8	30	2	Rural Local	Local Road	700	15	4	2	2	A	7.3	20
092576F	Owings St	13.28	1.0	7,419	25	3.8	37	2	Rural Local	Local Road	700	19	5	2	2	A	7.3	20
092574S	Little Rock Rd	10.95	1.0	7,419	25	3.7	115	2	Rural Local	Local Road	700	58	15	7	2	A	7.6	80
092573K	183rd Ave SW	10.05	1.0	7,419	25	3.8	90	2	Rural Minor Collector	Collector	900	45	11	6	2	A	7.4	60
092569V	Joselyn Ave	8.45	1.0	7,419	25	3.8	24	2	Rural Local	Local Road	700	12	3	2	2	A	7.2	20
092567G	Tea St	7.18	1.0	7,419	25	3.8	59	2	Rural Local	Local Road	700	29	7	4	2	A	7.4	40
092566A	Grand Mound SW	6.84	1.0	7,419	25	3.8	40	2	Rural Local	Local Road	700	20	5	2	2	A	7.3	20
092565T	Old Hwy 99 SW	6.07	1.0	7,419	21	5.3	1,167	2	Rural Major Collector	Collector	900	584	789	104	8	D	40.5	1040

Crossing ID	Street	Milepost	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time (min)	Peak Hour Traffic in both directions (veh/hour)	Number of lanes in both directions	Urban or Rural	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
092563E	216th Ave SW	5.37	1.0	7,419	13	7.8	11	2	Rural Local	Local Road	700	5	6	1	4	C	30.7	20
092561R	222d Ave SW	4.72	1.0	7,419	10	8.8	20	2	Rural Local	Local Road	700	10	13	3	4	D	39.1	20
922981P	Hoss Rd	4.44	1.0	7,419	10	8.8	132	2	Urban Local	Local Road	700	66	94	19	5	D	42.7	200
922982W	Robert Thompson Rd	4.26	1.0	7,419	10	9.2	66	2	Rural Minor Collector	Collector	900	33	48	10	5	D	43.5	100
922980H	Kuper Rd	3.92	1.0	7,419	10	9.0	54	2	Rural Local	Local Road	700	27	38	8	5	D	41.7	80
092559P	Fordon Rd	3.53	1.0	7,419	10	8.8	22	2	Urban Local	Local Road	700	11	14	3	4	D	39.6	40
092554F	W Reynolds Ave	2.14	1.0	7,419	10	8.4	733	2	Urban Minor Arterial	Arterial	1,400	367	588	103	6	D	48.1	1040
092552S	J St	1.28	1.0	7,419	8	10.2	40	2	Urban Local	Local Road	700	20	35	7	5	D	53.2	60
092551K	H St	1.15	1.0	7,419	7	10.2	101	2	Urban Local	Local Road	700	50	94	17	5	E	55.6	180
092550D	G St	1.09	1.0	7,419	7	10.3	40	2	Urban Local	Local Road	700	20	36	7	5	D	54.6	60
092549J	F St	1.03	1.0	7,419	7	10.0	28	2	Urban Local	Local Road	700	14	23	5	5	D	50.5	40
092548C	E St	0.95	1.0	7,419	7	10.0	40	2	Urban Local	Local Road	700	20	34	7	5	D	51.0	60
092547V	D St	0.89	1.0	7,419	7	10.0	1,580	2	Urban Collector	Collector	900	790	10722	262	41	F	407.0	2620
092546N	Tower St	0.82	1.0	7,419	7	10.0	922	2	Urban Collector	Collector	900	461	1568	153	10	F	102.1	1540
092543T	B St	54.28	1.0	7,419	7	10.0	79	2	Urban Local	Local Road	700	40	70	13	5	D	53.2	140

Table 23. Grade Crossing Delay of Peak Hour Traffic for the Proposed Action Train Traffic with Baseline Traffic for Switching Movements (2017)

Crossing ID	Street	Milepost	Number of Daily Trains	Train Speed (mph)	Gate Down-Time per Day (min)	Average daily traffic in both directions (veh/day)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
808714B	Port Industrial Rd (30th St)		1.0	7,419	7	0.00	734	Local Road	700	367	0	0		A	0	0
808711F	Myrtle		1.0	7,419	2	0.00	425	Arterial	1,400	213	0	0		A	0	0
808712M	Maple		1.0	7,419	7	0.00	93	Local Road	700	46	0	0		A	0	0
922990N	Industrial Rd	71.04	1.0	7,419	4	37.62	666	Arterial	1,400	333	10,301	417	25	F	928.2	4180
AA	Myrtle St	70.85	1.0	7,419	2	0.00	8	Arterial	1,400	4	0	0		A	0	0
BB	N Maple St	70.55	1.0	7,419	7	25.35	93	Local Road	700	46	531	39	14	F	344	400
808713U	W 1St St	70.41	1.0	7,419	6	27.14	531	Collector	900	266	4,626	240	19	F	522.6	2400
096711K	Port Industrial Rd	70.06	1.0	7,419	8	20.78	2,050	Arterial	1,400	1,025	27,567	710	39	F	806.7	7100
096710D	Division St	69.82	1.0	7,419	7	24.05	2	Local Road	700	1	12	1	12	F	289.7	20
096709J	Heron St	69.81	1.0	7,419	6	25.86	19	Local Road	700	10	109	8	13	F	339.0	80
808707R	Monroe St	69.63	1.0	7,419	6	32.10	2	Local Road	700	1	21	1	16	F	516.1	20
096706N	Washington St	69.49	1.0	7,419	5	33.50	77	Local Road	700	38	761	43	18	F	593.7	420
092551K	H Street	68.8	1.0	7,419	5	52.71	101	Local Road	700	50	2,519	89	28	F	1497.0	880
096695D	E Heron St	68.5	1.0	7,419	5	34.52	397	Local Road	700	397	9,085	228	40	F	1374.4	4560
096693P	Newell St	68.44	1.0	7,419	6	34.03	75	Local Road	700	37	759	42	18	F	611.4	420
096691B	S Chehalis St	68.36	1.0	7,419	6	31.37	564	Local Road	700	141	5,786	295	20	F	615.9	1480
096689A	Dairy Queen Entrance	68.34	1.0	7,419	6	31.06	19	Local Road	700	10	157	10	16	F	489.0	100
096690U	McDonalds Entrance	68.31	1.0	7,419	6	30.86	123	Local Road	700	61	1,066	63	17	F	521.8	640
096029N	Tyler St	68.23	1.0	7,419	7	30.34	465	Local Road	700	116	4,279	235	18	F	552.0	1180
096688T	Fleet St	68.16	1.0	7,419	7	29.90	185	Local Road	700	93	1,589	92	17	F	515.1	920

Table 24. Grade Crossing Delay of Peak Hour Traffic for the Proposed Action Train Traffic with Baseline Traffic (2037)

Crossing ID	Street	Milepost	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time (min)	Peak Hour traffic in both directions (veh/hr)	Number of lanes in both directions	Urban or Rural	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
096687L	Junction City Rd	67.14	1.0	7,419	12	7.8	183	2	Urban Collector	Collector	900	92	104	24	4	C	33.9	240
096682C	Central Park Dr	61.8	1.0	7,419	11	7.9	44	2	Rural Major Collector	Collector	900	22	23	6	4	C	31.9	60
096680N	Aldergrove Dr	59.72	1.0	7,419	25	3.8	59	2	Rural Local	Local Road	700	30	8	4	2	A	7.7	40
096679U	Heikkinen Rd	59.43	1.0	7,419	25	3.8	31	1	Rural Local	Local Road	700	31	4	2	2	A	7.7	40
096678M	Devonshire Rd	58.91	1.0	7,419	25	3.8	157	2	Rural Minor Collector	Collector	900	78	21	10	2	A	7.9	100
096677F	County Farm Rd	58.73	1.0	7,419	25	3.8	39	2	Rural Local	Local Road	700	19	5	2	2	A	7.3	20
096672W	Main Street	57.72	1.0	7,419	25	3.8	233	2	Rural Major Collector	Collector	900	117	32	15	2	A	8.1	140
400107G	Sylvia St	57.59	1.0	7,419	25	3.8	19	2	Urban Local	Local Road	700	9	2	1	2	A	7.2	20
096659H	Old Beacon Rd	56.02	1.0	7,419	25	3.7	14	2	Rural Local	Local Road	700	7	2	1	2	A	6.8	20
096658B	Monte Brady Rd	55.71	1.0	7,419	25	3.7	117	2	Rural Minor Collector	Collector	900	58	15	7	2	A	7.5	80
096657U	Glenn Rd	55.42	1.0	7,419	25	3.7	3	2	Rural Local	Local Road	700	2	0	0	2	A	6.9	20
096655F	Fairbairn Rd	54.38	1.0	7,419	25	3.8	3	2	Rural Local	Local Road	700	2	0	0	2	A	7.0	20
096654Y	Winkerman Rd S	54.1	1.0	7,419	25	3.8	6	2	Rural Local	Local Road	700	3	1	0	2	A	7.1	20
096652K	Monte Brady Rd	53.33	1.0	7,419	25	3.7	155	2	Rural Major Collector	Collector	900	78	20	10	2	A	7.7	100
096650W	Foss Av-Monte Elma	51.98	1.0	7,419	25	3.8	709	2	Rural Major Collector	Collector	900	354	138	44	3	B	11.7	440
096649C	Hewitt St	51.85	1.0	7,419	25	3.7	51	2	Rural Local	Local Road	700	26	6	3	2	A	7.3	40
096648V	Moore Rd	51.53	1.0	7,419	25	3.7	75	2	Rural Local	Local Road	700	37	9	5	2	A	7.4	40
096646G	Oniel Rd	51.03	1.0	7,419	25	3.4	84	2	Rural Local	Local Road	700	42	9	5	2	A	6.1	40
096644T	Newman Creek Rd	50.56	1.0	7,419	25	3.7	127	2	Rural Local	Local Road	700	64	16	8	2	A	7.7	80
096643L	Hurd Rd	50.08	1.0	7,419	25	2.9	204	2	Rural Local	Local Road	700	102	17	10	2	A	5.0	100
096642E	Calder Rd	49.36	1.0	7,419	25	3.8	89	2	Rural Local	Local Road	700	44	11	6	2	A	7.5	60
096641X	N 17th St	48.93	1.0	7,419	25	3.3	17	2	Rural Local	Local Road	700	9	2	1	2	A	5.5	20
096640R	N 13th St	48.7	1.0	7,419	25	3.3	96	2	Rural Local	Local Road	700	48	10	5	2	A	6.0	60
096639W	N 11th St	48.57	1.0	7,419	24	3.4	284	2	Rural Local	Local Road	700	142	34	16	2	A	7.2	160
096638P	N 10th St	48.51	1.0	7,419	23	3.4	40	2	Rural Local	Local Road	700	20	4	2	2	A	6.0	20

Crossing ID	Street	Milepost	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time (min)	Peak Hour traffic in both directions (veh/hr)	Number of lanes in both directions	Urban or Rural	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
096636B	N 6th St	48.32	1.0	7,419	23	3.7	22	2	Rural Local	Local Road	700	11	2	1	2	A	6.8	20
096635U	N 5th St	48.26	1.0	7,419	23	3.7	11	2	Rural Local	Local Road	700	5	1	1	2	A	6.8	20
096634M	N 3rd St	48.12	1.0	7,419	23	3.8	92	2	Rural Local	Local Road	700	46	12	6	2	A	7.5	60
096525J	N 2d St	48.06	1.0	7,419	24	3.7	70	2	Rural Local	Local Road	700	35	9	4	2	A	7.3	40
096519F	Tridwell Rd	46.71	1.0	7,419	25	3.8	17	2	Rural Local	Local Road	700	9	2	1	2	A	7.2	20
096518Y	Blockhouse Rd W	46.33	1.0	7,419	25	3.8	33	2	Rural Local	Local Road	700	16	4	2	2	A	7.3	20
096515D	Blockhouse Rd E	45.26	1.0	7,419	25	3.8	6	2	Rural Local	Local Road	700	3	1	0	2	A	7.2	20
096510U	Dunlap Rd	44.19	1.0	7,419	25	3.8	28	2	Rural Local	Local Road	700	14	3	2	2	A	7.2	20
092603A	Porter Creek Rd	41.5	1.0	7,419	25	3.8	120	2	Rural Minor Collector	Collector	900	60	15	7	2	A	7.5	80
092595K	Elma Gare Rd W	38.46	1.0	7,419	25	3.7	14	2	Rural Local	Local Road	700	7	2	1	2	A	7.0	20
092593W	Shelton Rd	36.71	1.0	7,419	25	3.7	8	2	Rural Local	Local Road	700	4	1	0	2	A	7.1	20
92587T	Scheaffer St	33.95	1.0	7,419	25	3.7	6	2	Rural Local	Local Road	700	3	1	0	2	A	6.7	20
092586L	Newton St	33.65	1.0	7,419	25	3.7	26	2	Rural Local	Local Road	700	13	3	2	2	A	7.0	20
092585E	Murray St	33.39	1.0	7,419	25	3.7	26	2	Rural Local	Local Road	700	13	3	2	2	A	7.1	20
092584X	Merry Rd	33.04	1.0	7,419	25	3.8	8	2	Rural Local	Local Road	700	4	1	0	2	A	7.1	20
092583R	Blockhouse Rd	32.45	1.0	7,419	25	3.8	6	2	Rural Local	Local Road	700	3	1	0	2	A	7.1	20
092577M	Moon Rd SW	28.71	1.0	7,419	25	3.8	39	2	Rural Local	Local Road	700	19	5	2	2	A	7.3	20
092576F	Owings St	13.28	1.0	7,419	25	3.8	48	2	Rural Local	Local Road	700	24	6	3	2	A	7.3	40
092574S	Little Rock Rd	10.95	1.0	7,419	25	3.7	149	2	Rural Local	Local Road	700	75	20	9	2	A	7.8	100
092573K	183rd Ave SW	10.05	1.0	7,419	25	3.8	117	2	Rural Minor Collector	Collector	900	58	15	7	2	A	7.5	80
092569V	Joselyn Ave	8.45	1.0	7,419	25	3.8	31	2	Rural Local	Local Road	700	16	4	2	2	A	7.2	20
092567G	Tea St	7.18	1.0	7,419	25	3.8	76	2	Rural Local	Local Road	700	38	9	5	2	A	7.5	40
092566A	Grand Mound SW	6.84	1.0	7,419	25	3.8	51	2	Rural Local	Local Road	700	26	6	3	2	A	7.4	40
092565T	Old Hwy 99 SW	6.07	1.0	7,419	21	5.3	1,509	2	Rural Major Collector	Collector	900	755	2219	134	17	F	88.2	1340
092563E	216th Ave SW	5.37	1.0	7,419	13	7.8	14	2	Rural Local	Local Road	700	7	7	2	4	C	30.8	20
092561R	222d Ave SW	4.72	1.0	7,419	10	8.8	26	2	Rural Local	Local Road	700	13	17	4	4	D	39.3	40

Crossing ID	Street	Milepost	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time (min)	Peak Hour traffic in both directions (veh/hr)	Number of lanes in both directions	Urban or Rural	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
922981P	Hoss Rd	4.44	1.0	7,419	10	8.8	171	2	Urban Local	Local Road	700	85	125	25	5	D	44.0	260
922982W	Robert Thompson Rd	4.26	1.0	7,419	10	9.2	85	2	Rural Minor Collector	Collector	900	43	63	13	5	D	43.9	140
922980H	Kuper Rd	3.92	1.0	7,419	10	9.0	70	2	Rural Local	Local Road	700	35	49	10	5	D	42.2	100
092559P	Fordon Rd	3.53	1.0	7,419	10	8.8	28	2	Urban Local	Local Road	700	14	19	4	5	D	39.8	40
092554F	W Reynolds Ave	2.14	1.0	7,419	10	8.4	948	2	Urban Minor Arterial	Arterial	1,400	474	849	133	6	D	53.7	1340
092552S	J St	1.28	1.0	7,419	8	10.2	51	2	Urban Local	Local Road	700	26	46	9	5	D	53.7	80
092551K	H St	1.15	1.0	7,419	7	10.2	131	2	Urban Local	Local Road	700	65	124	22	6	E	56.9	220
092550D	G St	1.09	1.0	7,419	7	10.3	51	2	Urban Local	Local Road	700	26	47	9	5	E	55.1	80
092549J	F St	1.03	1.0	7,419	7	10.0	36	2	Urban Local	Local Road	700	18	30	6	5	D	50.8	60
092548C	E St	0.95	1.0	7,419	7	10.0	51	2	Urban Local	Local Road	700	26	44	9	5	D	51.5	80
092546N	Tower St	0.82	1.0	7,419	7	10.0	1,192	2	Urban Collector	Collector	900	596	2930	198	15	F	147.5	1980
092543T	B St	54.28	1.0	7,419	7	10.0	103	2	Urban Local	Local Road	700	51	93	17	5	D	54.1	180

Table 25. Grade Crossing Delay of Peak Hour Traffic for the Proposed Action Train Traffic with Baseline Traffic for Switching Movements (2037)

Crossing ID	Street	Milepost	Number of Daily Trains	Average Train Length (feet)	Train Speed (mph)	Gate Down-Time per Day (min)	Peak hour traffic in both directions (veh/hr)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)
808714B	Port Industrial Rd (30th St)		1.0	7,419	7	0.00	950	2	Local Road	700	475	0	0		A	0.0	0
808711F	Myrtle		1.0	7,419	7	0.00	550	2	Arterial	1,400	275	0	0		A	0.0	0
808712M	Maple		1.0	7,419	7	0.00	120	2	Local Road	700	60	0	0		A	0.0	0
922990N	Industrial Rd	71.04	1.0	7,419	5	37.62	861	2	Arterial	1,400	431	14662	540	27	F	1021.7	5400
AA	Myrtle St	70.85	1.0	7,419	7	0.00	11	2	Arterial	1,400	5	0	0		A	0.0	0
BB	N Maple St	70.55	1.0	7,419	7	25.35	120	2	Local Road	700	60	701	51	14	F	351.3	500
808713U	W 1St St	70.41	1.0	7,419	6	27.14	687	2	Collector	900	343	6820	311	185,108	F	3100	3100
096711K	Port Industrial Rd	70.06	1.0	7,419	7	20.78	2,651	2	Arterial	1,400	1,326	179945	918	3,739,847	F	9180	9180
096710D	Division St	69.82	1.0	7,419	7	24.05	3	2	Local Road	700	2	15	1	361	F	20	20
096709J	Heron St	69.81	1.0	7,419	6	25.86	25	2	Local Road	700	12	141	11	3,648	F	100	100
808707R	Monroe St	69.63	1.0	7,419	6	32.10	3	2	Local Road	700	2	27	2	859	F	20	20
096706N	Washington St	69.49	1.0	7,419	5	33.50	99	2	Local Road	700	50	1001	56	33,547	F	560	560
092551K	H Street	68.8	1.0	7,419	6	52.71	131	2	Local Road	700	65	3333	115	175,695	F	1140	1140
096695D	E Heron St	68.5	1.0	7,419	5	32.48	513	1	Local Road	700	513	16863	278	547,638	F	5560	5560
096693P	Newell St	68.44	1.0	7,419	6	32.05	96	2	Local Road	700	48	886	51	28,391	F	520	520
096691B	S Chehalis St	68.36	1.0	7,419	6	28.82	729	4	Local Road	700	182	6819	350	196,515	F	1760	1760
096689A	Dairy Queen Entrance	68.34	1.0	7,419	6	28.53	25	2	Local Road	700	12	172	12	4,901	F	120	120
096690U	McDonalds Entrance	68.31	1.0	7,419	6	28.38	159	2	Local Road	700	79	1200	75	34,065	F	740	740
096029N	Tyler St	68.23	1.0	7,419	6	27.78	601	4	Local Road	700	150	4925	278	136,782	F	1400	1400
096688T	Fleet St	68.16	1.0	7,419	7	26.93	239	2	Local Road	700	120	1744	107	46,962	F	1080	1080

Cumulative Impacts

Table 26. Grade Crossing Delay of Proposed Cumulative Train Traffic with Baseline Traffic (2017)

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
096687L	Junction City Rd	67.14	7.3	6,174	12	47.6	1,234	2	Collector	900	26	136	41	3	A	6.6	60	1.5	28	2.28	5.1
096682C	Central Park Dr	61.8	7.3	6,174	11	48.3	293	2	Collector	900	6	33	10	3	A	6.7	20	1.6	7	2.29	5.1
096680N	Aldergrove Dr	59.72	7.3	6,174	25	22.7	397	2	Local Road	700	8	10	6	2	A	1.5	20	0.3	4	1.08	1.1
096679U	Heikkinen Rd	59.43	7.3	6,174	25	22.7	209	1	Local Road	700	9	5	3	2	A	1.5	20	0.3	2	1.08	1.1
096678M	Devonshire Rd	58.91	7.3	6,174	25	22.4	1,056	2	Collector	900	22	26	16	2	A	1.5	20	0.3	11	1.06	1.1
096677F	County Farm Rd	58.73	7.3	6,174	25	22.2	262	2	Local Road	700	5	6	4	2	A	1.4	20	0.3	3	1.05	1.1
096672W	Main Street	57.72	7.3	6,174	25	22.2	1,569	2	Collector	900	33	38	24	2	A	1.4	40	0.4	16	1.05	1.1
400107G	Sylvia St	57.59	7.3	6,174	25	22.2	126	2	Local Road	700	3	3	2	2	A	1.4	20	0.3	1	1.05	1.1
096659H	Old Beacon Rd	56.02	7.3	6,174	25	21.6	94	2	Local Road	700	2	2	1	1	A	1.3	20	0.3	1	1.00	1.0
096658B	Monte Brady Rd	55.71	7.3	6,174	25	22.1	785	2	Collector	900	16	18	12	2	A	1.4	20	0.3	8	1.04	1.1
096657U	Glenn Rd	55.42	7.3	6,174	25	21.8	21	2	Local Road	700	0	0	0	1	A	1.3	20	0.3	0	1.02	1.0
096655F	Fairbairn Rd	54.38	7.3	6,174	25	22.1	21	2	Local Road	700	0	0	0	2	A	1.4	20	0.3	0	1.04	1.0
096654Y	Winkerman Rd S	54.1	7.3	6,174	25	22.1	42	2	Local Road	700	1	1	1	2	A	1.4	20	0.3	0	1.04	1.1
096652K	Monte Brady Rd	53.33	7.3	6,174	25	22.1	1,046	2	Collector	900	22	25	16	2	A	1.4	20	0.3	11	1.04	1.1
096650W	Foss Av-Monte Elma	51.98	7.3	6,174	25	22.2	4,770	2	Collector	900	99	125	73	2	A	1.6	100	0.4	50	1.05	1.2
096649C	Hewitt St	51.85	7.3	6,174	25	22.1	345	2	Local Road	700	7	8	5	2	A	1.4	20	0.3	4	1.04	1.1
096648V	Moore Rd	51.53	7.3	6,174	25	22.0	502	2	Local Road	700	10	12	8	2	A	1.4	20	0.3	5	1.04	1.1
096646G	Oniel Rd	51.03	7.3	6,174	25	21.1	565	2	Local Road	700	12	12	8	1	A	1.3	20	0.3	5	0.97	0.9
096644T	Newman Creek Rd	50.56	7.3	6,174	25	22.1	858	2	Local Road	700	18	20	13	2	A	1.4	20	0.3	9	1.04	1.1
096643L	Hurd Rd	50.08	7.3	6,174	25	19.0	1,370	2	Local Road	700	29	24	18	1	A	1.1	20	0.4	11	0.82	0.7
096642E	Calder Rd	49.36	7.3	6,174	25	22.2	596	2	Local Road	700	12	14	9	2	A	1.4	20	0.3	6	1.05	1.1
096641X	N 17th St	48.93	7.3	6,174	25	20.2	115	2	Local Road	700	2	2	2	1	A	1.2	20	0.3	1	0.91	0.8

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
096640R	N 13th St	48.7	7.3	6,174	25	20.6	649	2	Local Road	700	14	13	9	1	A	1.2	20	0.3	6	0.94	0.9
096639W	N 11th St	48.57	7.3	6,174	24	21.0	1,914	2	Local Road	700	40	42	28	2	A	1.3	40	0.4	18	0.96	1.0
096638P	N 10th St	48.51	7.3	6,174	23	22.2	272	2	Local Road	700	6	6	4	2	A	1.4	20	0.5	3	0.97	0.9
096636B	N 6th St	48.32	7.3	6,174	23	23.1	146	2	Local Road	700	3	4	2	2	A	1.5	20	0.5	1	0.99	1.0
096635U	N 5th St	48.26	7.3	6,174	23	23.2	73	2	Local Road	700	2	2	1	2	A	1.5	20	0.5	1	1.00	1.0
096634M	N 3rd St	48.12	7.3	6,174	23	24.9	617	2	Local Road	700	13	19	11	2	A	1.8	20	0.7	6	1.04	1.1
096525J	N 2d St	48.06	7.3	6,174	24	23.3	471	2	Local Road	700	10	12	8	2	A	1.6	20	0.5	5	1.03	1.1
096519F	Tridwell Rd	46.71	7.2	6,237	25	22.9	115	2	Local Road	700	2	3	2	2	A	1.5	20	0.4	1	1.05	1.1
096518Y	Blockhouse Rd W	46.33	7.2	6,237	25	22.2	220	2	Local Road	700	5	5	3	2	A	1.4	20	0.4	2	1.05	1.1
096515D	Blockhouse Rd E	45.26	7.2	6,237	25	22.4	42	2	Local Road	700	1	1	1	2	A	1.4	20	0.4	0	1.06	1.1
096510U	Dunlap Rd	44.19	7.2	6,237	25	22.1	188	2	Local Road	700	4	4	3	2	A	1.4	20	0.4	2	1.04	1.1
092603A	Porter Creek Rd	41.5	7.2	6,237	25	22.1	805	2	Collector	900	17	19	12	2	A	1.4	20	0.4	8	1.04	1.1
092595K	Elma Gare Rd W	38.46	7.2	6,237	25	21.8	94	2	Local Road	700	2	2	1	2	A	1.4	20	0.4	1	1.02	1.0
092593W	Shelton Rd	36.71	7.2	6,237	25	22.1	52	2	Local Road	700	1	1	1	2	A	1.4	20	0.4	1	1.04	1.1
92587T	Scheaffer St	33.95	7.2	6,237	25	21.4	42	2	Local Road	700	1	1	1	1	A	1.3	20	0.4	0	0.99	1.0
092586L	Newton St	33.65	7.2	6,237	25	21.7	178	2	Local Road	700	4	4	3	2	A	1.4	20	0.4	2	1.01	1.0
092585E	Murray St	33.39	7.2	6,237	25	22.0	178	2	Local Road	700	4	4	3	2	A	1.4	20	0.4	2	1.04	1.1
092584X	Merry Rd	33.04	7.2	6,237	25	22.1	52	2	Local Road	700	1	1	1	2	A	1.4	20	0.4	1	1.04	1.1
092583R	Blockhouse Rd	32.45	7.2	6,237	25	22.1	42	2	Local Road	700	1	1	1	2	A	1.4	20	0.4	0	1.04	1.1
092577M	Moon Rd SW	28.71	7.2	6,237	25	22.2	262	2	Local Road	700	5	6	4	2	A	1.4	20	0.4	3	1.05	1.1
092576F	Owings St	13.28	7.2	6,237	25	22.1	324	2	Local Road	700	7	8	5	2	A	1.4	20	0.4	3	1.05	1.1
092574S	Little Rock Rd	10.95	7.2	6,237	25	22.1	1,004	2	Local Road	700	21	24	15	2	A	1.4	20	0.4	10	1.04	1.1
092573K	183rd Ave SW	10.05	7.2	6,237	25	22.1	785	2	Collector	900	16	19	12	2	A	1.4	20	0.4	8	1.04	1.1
092569V	Joselyn Ave	8.45	7.2	6,237	25	22.1	209	2	Local Road	700	4	5	3	2	A	1.4	20	0.4	2	1.04	1.1
092567G	Tea St	7.18	7.2	6,237	25	22.2	513	2	Local Road	700	11	12	8	2	A	1.4	20	0.4	5	1.05	1.1
092566A	Grand Mound SW	6.84	7.2	6,237	25	22.3	345	2	Local Road	700	7	8	5	2	A	1.4	20	0.4	4	1.05	1.1

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
092565T	Old Hwy 99 SW	6.07	7.2	6,237	21	29.5	10,157	2	Collector	900	212	555	208	3	A	3.3	280	0.5	155	1.53	2.8
092563E	216th Ave SW	5.37	7.2	6,237	13	45.8	94	2	Local Road	700	2	9	3	3	A	6.0	20	1.2	2	2.25	4.8
092561R	222d Ave SW	4.72	7.2	6,237	10	53.6	178	2	Local Road	700	4	25	7	4	A	8.3	20	2.1	4	2.53	6.2
922981P	Hoss Rd	4.44	7.2	6,237	10	53.7	1,151	2	Local Road	700	24	165	43	4	A	8.6	60	2.1	29	2.53	6.5
922982W	Robert Thompson Rd	4.26	7.2	6,237	10	54.9	575	2	Collector	900	12	84	22	4	A	8.8	40	2.1	15	2.61	6.7
922980H	Kuper Rd	3.92	7.2	6,237	10	55.6	471	2	Local Road	700	10	71	18	4	A	9.0	20	2.3	12	2.61	6.7
092559P	Fordon Rd	3.53	7.2	6,237	10	54.8	188	2	Local Road	700	4	27	7	4	A	8.7	20	2.3	5	2.55	6.4
092554F	W Reynolds Ave	2.14	7.2	6,237	10	52.7	6,381	2	Arterial	1,400	133	939	234	4	A	8.8	320	2.3	157	2.45	6.5
092552S	J St	1.28	7.2	6,237	8	65.0	345	2	Local Road	700	7	71	16	5	B	12.3	20	3.7	10	2.92	8.6
092551K	H St	1.15	7.2	6,237	7	66.5	879	2	Local Road	700	18	191	41	5	B	13.1	60	4.3	26	2.91	8.8
092550D	G St	1.09	7.2	6,237	7	68.9	345	2	Local Road	700	7	79	17	5	B	13.8	20	4.7	10	2.98	9.1
092549J	F St	1.03	7.2	6,237	7	67.3	241	2	Local Road	700	5	53	11	5	B	13.1	20	4.5	7	2.91	8.6
092548C	E St	0.95	7.2	6,237	7	67.4	345	2	Local Road	700	7	76	16	5	B	13.2	20	4.6	10	2.91	8.6
092547V	D St	0.89	7.2	6,237	7	67.5	13,755	2	Collector	900	287	4412	645	7	B	19.2	900	6.7	401	2.91	12.6
092546N	Tower St	0.82	7.2	6,237	7	67.7	8,023	2	Collector	900	167	2163	377	6	B	16.2	520	5.6	234	2.92	10.6
092543T	B St	54.28	7.2	6,237	7	67.4	690	2	Local Road	700	14	153	32	5	B	13.3	40	4.5	20	2.94	8.9

Table 27. Grade Crossing Delay of Proposed Cumulative Train Traffic with Baseline Traffic for Switching Movements (2017)

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
808714B	Port Industrial Rd (30th St)		1.2	6,319	8	14.01	6,391	2	Local Road	700	133	431	62	7	A	4.0	500	0.6	51	0.80	3.4
808711F	Myrtle		1.2	6,319	6	12.92	3,703	2	Arterial	1,400	77	182	33	5	A	2.9	260	0.5	27	0.72	2.4
808712M	Maple		1.2	6,319	6	11.39	805	2	Local Road	700	17	30	6	5	A	2.2	60	0.5	5	0.62	1.7
922990N	Industrial Rd	71.04	6.1	2,298	5	186.22	5,795	2	Arterial	1,400	121	12600	749	17	F	130.5	1240	14.6	579	9.99	115.9
AA	Myrtle St	70.85	1.4	718	2	6.95	73	2	Arterial	1,400	2	1	0	2	A	0.7	20	0.7	0	0.00	-
BB	N Maple St	70.55	6.1	2,298	7	148.31	805	2	Local Road	700	17	1040	83	13	E	77.5	140	4.7	69	8.57	72.8
808713U	W 1St St	70.41	7.3	4,309	6	131.98	4,623	2	Collector	900	96	4280	424	10	E	55.5	580	2.5	365	7.89	53.0
096711K	Port Industrial Rd	70.06	8.1	2,687	7	122.31	17,845	2	Arterial	1,400	372	15491	1516	10	D	52.1	1860	1.9	1318	7.38	50.2
096710D	Division St	69.82	8.1	2,687	7	118.87	21	2	Local Road	700	0	13	2	7	D	36.2	20	1.2	2	7.20	34.9
096709J	Heron St	69.81	8.1	2,687	6	122.82	167	2	Local Road	700	3	108	14	8	D	38.8	20	1.4	12	7.42	37.4
808707R	Monroe St	69.63	9.2	4,189	6	128.10	21	2	Local Road	700	0	13	2	7	D	37.2	20	2.0	2	7.38	35.2
096706N	Washington St	69.49	9.2	4,189	5	130.73	669	2	Local Road	700	14	441	61	7	D	39.6	60	2.1	51	7.55	37.5
092551K	H Street	68.8	7.4	4,281	5	241.48	879	2	Local Road	700	18	2462	147	17	F	168.1	200	32.4	105	11.95	135.8
096695D	E Heron St	68.5	7.4	4,281	5	199.90	3,452	1	Local Road	700	144	8125	479	17	F	141.2	1300	41.8	308	8.94	99.4
096693P	Newell St	68.44	7.4	4,281	6	196.16	649	2	Local Road	700	14	1191	88	13	F	110.2	120	32.3	57	8.79	77.9
096691B	S Chehalis St	68.36	7.4	4,281	6	172.05	4,906	4	Local Road	700	51	7332	586	13	F	89.7	400	21.0	400	8.16	68.6
096689A	Dairy Queen Entrance	68.34	7.4	4,281	6	170.07	157	2	Local Road	700	3	213	19	12	F	81.6	20	19.0	13	8.08	62.6
096690U	McDonalds Entrance	68.31	7.4	4,281	6	168.67	1,067	2	Local Road	700	22	1467	125	12	F	82.5	160	19.1	86	8.02	63.4
096029N	Tyler St	68.23	7.4	4,281	6	165.02	4,048	4	Local Road	700	42	5490	464	12	F	81.4	320	18.6	319	7.87	62.8
096688T	Fleet St	68.16	7.4	4,281	7	161.83	1,611	2	Local Road	700	34	2074	181	11	E	77.3	240	17.4	125	7.75	59.8

Table 28. Grade Crossing Delay of Proposed Cumulative Train Traffic with Baseline Traffic (2037)

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
096687L	Junction City Rd	67.14	7.3	6,174	12	47.6	1,596	2	Collector	900	33	178	53	3	A	6.7	80	1.5	40	2.52	5.2
096682C	Central Park Dr	61.8	7.3	6,174	11	48.9	379	2	Collector	900	8	43	13	3	A	6.8	20	1.6	10	2.57	5.2
096680N	Aldergrove Dr	59.72	7.3	6,174	25	23.3	514	2	Local Road	700	11	13	8	2	A	1.6	20	0.3	6	1.24	1.2
096679U	Heikkinen Rd	59.43	7.3	6,174	25	23.3	271	1	Local Road	700	11	7	4	2	A	1.6	20	0.3	3	1.24	1.2
096678M	Devonshire Rd	58.91	7.3	6,174	25	22.9	1,366	2	Collector	900	28	35	22	2	A	1.5	20	0.3	17	1.21	1.2
096677F	County Farm Rd	58.73	7.3	6,174	25	22.7	338	2	Local Road	700	7	8	5	2	A	1.5	20	0.3	4	1.20	1.1
096672W	Main Street	57.72	7.3	6,174	25	22.7	2,029	2	Collector	900	42	52	32	2	A	1.5	40	0.4	24	1.20	1.2
400107G	Sylvia St	57.59	7.3	6,174	25	22.7	162	2	Local Road	700	3	4	3	2	A	1.5	20	0.3	2	1.20	1.1
096659H	Old Beacon Rd	56.02	7.3	6,174	25	22.1	122	2	Local Road	700	3	3	2	2	A	1.4	20	0.3	1	1.15	1.1
096658B	Monte Brady Rd	55.71	7.3	6,174	25	22.6	1,015	2	Collector	900	21	25	16	2	A	1.5	20	0.3	12	1.19	1.1
096657U	Glenn Rd	55.42	7.3	6,174	25	22.3	27	2	Local Road	700	1	1	0	2	A	1.4	20	0.3	0	1.17	1.1
096655F	Fairbairn Rd	54.38	7.3	6,174	25	22.7	27	2	Local Road	700	1	1	0	2	A	1.5	20	0.3	0	1.19	1.1
096654Y	Winkerman Rd S	54.1	7.3	6,174	25	22.7	54	2	Local Road	700	1	1	1	2	A	1.5	20	0.3	1	1.19	1.1
096652K	Monte Brady Rd	53.33	7.3	6,174	25	22.6	1,353	2	Collector	900	28	34	21	2	A	1.5	20	0.3	16	1.19	1.2
096650W	Foss Av-Monte Elma	51.98	7.3	6,174	25	22.7	6,168	2	Collector	900	129	176	97	2	A	1.7	140	0.4	74	1.20	1.3
096649C	Hewitt St	51.85	7.3	6,174	25	22.6	446	2	Local Road	700	9	11	7	2	A	1.5	20	0.3	5	1.19	1.1
096648V	Moore Rd	51.53	7.3	6,174	25	22.6	649	2	Local Road	700	14	16	10	2	A	1.5	20	0.3	8	1.19	1.1
096646G	Oniel Rd	51.03	7.3	6,174	25	21.6	730	2	Local Road	700	15	17	11	2	A	1.4	20	0.3	8	1.12	1.0
096644T	Newman Creek Rd	50.56	7.3	6,174	25	22.6	1,109	2	Local Road	700	23	28	17	2	A	1.5	20	0.3	13	1.19	1.2
096643L	Hurd Rd	50.08	7.3	6,174	25	19.5	1,772	2	Local Road	700	37	34	24	1	A	1.1	40	0.4	17	0.98	0.8
096642E	Calder Rd	49.36	7.3	6,174	25	22.7	771	2	Local Road	700	16	19	12	2	A	1.5	20	0.3	9	1.20	1.2
096641X	N 17th St	48.93	7.3	6,174	25	20.8	149	2	Local Road	700	3	3	2	1	A	1.2	20	0.3	2	1.06	0.9
096640R	N 13th St	48.7	7.3	6,174	25	21.2	839	2	Local Road	700	17	18	12	1	A	1.3	20	0.3	9	1.09	1.0
096639W	N 11th St	48.57	7.3	6,174	24	21.5	2,475	2	Local Road	700	52	59	37	2	A	1.4	60	0.4	27	1.11	1.1

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
096638P	N 10th St	48.51	7.3	6,174	23	22.8	352	2	Local Road	700	7	9	6	2	A	1.5	20	0.5	4	1.14	1.0
096636B	N 6th St	48.32	7.3	6,174	23	23.6	189	2	Local Road	700	4	5	3	2	A	1.6	20	0.5	2	1.17	1.1
096635U	N 5th St	48.26	7.3	6,174	23	23.8	95	2	Local Road	700	2	3	2	2	A	1.6	20	0.5	1	1.18	1.1
096634M	N 3rd St	48.12	7.3	6,174	23	25.5	798	2	Local Road	700	17	25	14	2	A	1.9	20	0.7	10	1.24	1.2
096525J	N 2d St	48.06	7.3	6,174	24	23.8	609	2	Local Road	700	13	17	10	2	A	1.6	20	0.5	7	1.20	1.2
096519F	Tridwell Rd	46.71	7.2	6,237	25	23.5	149	2	Local Road	700	3	4	2	2	A	1.6	20	0.4	2	1.21	1.2
096518Y	Blockhouse Rd W	46.33	7.2	6,237	25	22.8	284	2	Local Road	700	6	7	4	2	A	1.5	20	0.4	3	1.20	1.2
096515D	Blockhouse Rd E	45.26	7.2	6,237	25	22.9	54	2	Local Road	700	1	1	1	2	A	1.5	20	0.4	1	1.21	1.2
096510U	Dunlap Rd	44.19	7.2	6,237	25	22.6	243	2	Local Road	700	5	6	4	2	A	1.5	20	0.4	3	1.19	1.1
092603A	Porter Creek Rd	41.5	7.2	6,237	25	22.7	1,042	2	Collector	900	22	26	16	2	A	1.5	20	0.4	12	1.19	1.2
092595K	Elma Gare Rd W	38.46	7.2	6,237	25	22.4	122	2	Local Road	700	3	3	2	2	A	1.4	20	0.4	1	1.17	1.1
092593W	Shelton Rd	36.71	7.2	6,237	25	22.6	68	2	Local Road	700	1	2	1	2	A	1.5	20	0.4	1	1.19	1.1
92587T	Scheaffer St	33.95	7.2	6,237	25	22.0	54	2	Local Road	700	1	1	1	2	A	1.4	20	0.4	1	1.14	1.0
092586L	Newton St	33.65	7.2	6,237	25	22.3	230	2	Local Road	700	5	6	4	2	A	1.4	20	0.4	3	1.16	1.1
092585E	Murray St	33.39	7.2	6,237	25	22.6	230	2	Local Road	700	5	6	4	2	A	1.5	20	0.4	3	1.19	1.1
092584X	Merry Rd	33.04	7.2	6,237	25	22.7	68	2	Local Road	700	1	2	1	2	A	1.5	20	0.4	1	1.19	1.1
092583R	Blockhouse Rd	32.45	7.2	6,237	25	22.6	54	2	Local Road	700	1	1	1	2	A	1.5	20	0.4	1	1.19	1.1
092577M	Moon Rd SW	28.71	7.2	6,237	25	22.8	338	2	Local Road	700	7	9	5	2	A	1.5	20	0.4	4	1.20	1.2
092576F	Owings St	13.28	7.2	6,237	25	22.7	419	2	Local Road	700	9	10	7	2	A	1.5	20	0.4	5	1.20	1.1
092574S	Little Rock Rd	10.95	7.2	6,237	25	22.6	1,299	2	Local Road	700	27	33	20	2	A	1.5	20	0.4	15	1.19	1.2
092573K	183rd Ave SW	10.05	7.2	6,237	25	22.6	1,015	2	Collector	900	21	26	16	2	A	1.5	20	0.4	12	1.19	1.2
092569V	Joselyn Ave	8.45	7.2	6,237	25	22.6	271	2	Local Road	700	6	7	4	2	A	1.5	20	0.4	3	1.19	1.1
092567G	Tea St	7.18	7.2	6,237	25	22.7	663	2	Local Road	700	14	17	10	2	A	1.5	20	0.4	8	1.20	1.2
092566A	Grand Mound SW	6.84	7.2	6,237	25	22.8	446	2	Local Road	700	9	11	7	2	A	1.5	20	0.4	5	1.20	1.2
092565T	Old Hwy 99 SW	6.07	7.2	6,237	21	30.1	13,134	2	Collector	900	274	818	274	3	A	3.7	380	0.5	221	1.68	3.2
092563E	216th Ave SW	5.37	7.2	6,237	13	46.3	122	2	Local Road	700	3	13	4	3	A	6.2	20	1.2	3	2.50	4.9

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
092561R	222d Ave SW	4.72	7.2	6,237	10	54.2	230	2	Local Road	700	5	33	9	4	A	8.5	20	2.1	7	2.84	6.4
922981P	Hoss Rd	4.44	7.2	6,237	10	54.3	1,488	2	Local Road	700	31	220	56	4	A	8.9	80	2.1	42	2.84	6.7
922982W	Robert Thompson Rd	4.26	7.2	6,237	10	55.4	744	2	Collector	900	15	111	29	4	A	9.0	40	2.1	22	2.92	6.9
922980H	Kuper Rd	3.92	7.2	6,237	10	56.2	609	2	Local Road	700	13	94	24	4	A	9.2	40	2.3	18	2.93	7.0
092559P	Fordon Rd	3.53	7.2	6,237	10	55.3	243	2	Local Road	700	5	36	9	4	A	8.9	20	2.3	7	2.87	6.6
092554F	W Reynolds Ave	2.14	7.2	6,237	10	53.3	8,251	2	Arterial	1,400	172	1280	305	4	A	9.3	420	2.3	228	2.77	7.0
092552S	J St	1.28	7.2	6,237	8	65.6	446	2	Local Road	700	9	93	20	5	B	12.5	20	3.7	15	3.32	8.8
092551K	H St	1.15	7.2	6,237	7	67.1	1,136	2	Local Road	700	24	254	53	5	B	13.4	80	4.3	38	3.34	9.1
092550D	G St	1.09	7.2	6,237	7	69.5	446	2	Local Road	700	9	105	22	5	B	14.1	20	4.7	15	3.43	9.3
092549J	F St	1.03	7.2	6,237	7	67.8	311	2	Local Road	700	6	69	15	5	B	13.4	20	4.5	10	3.35	8.9
092548C	E St	0.95	7.2	6,237	7	67.9	446	2	Local Road	700	9	100	21	5	B	13.5	20	4.6	15	3.35	8.9
092547V	D St	0.89	7.2	6,237	7	68.1	17,788	2	Collector	900	371	6721	841	8	C	22.7	1160	6.7	597	3.35	16.0
092546N	Tower St	0.82	7.2	6,237	7	68.2	10,375	2	Collector	900	216	3047	491	6	B	17.6	680	5.6	349	3.36	12.0
092543T	B St	54.28	7.2	6,237	7	67.9	893	2	Local Road	700	19	203	42	5	B	13.6	60	4.5	30	3.37	9.2

Table 29. Grade Crossing Delay of Proposed Cumulative Train Traffic with Baseline Traffic for Switching Movements (2037)

Crossing ID	Street	Milepost	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)	Number of lanes in both directions	Road type	Departure rate (veh/hour.lane)	Arrival rate (veh/hour.lane)	Total Delay (min)	Number of vehicles delayed per day (veh/day)	Ave Delay/Veh During Gate Down Time (min/veh)	Level of service	Average delay per vehicle in a 24-hour period (sec/veh)	Ave Queue Length per lane in Each Direction (feet)	No Action Avg. Delay per Vehicle in 24-hr Period (sec/veh)	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
808714B	Port Industrial Rd (30th St)		1.2	6,319	5	14.01	8,265	2	Local Road	700	172	602	80	7	A	4.4	640	0.7	66	0.80	3.7
808711F	Myrtle		1.2	6,319	2	12.92	4,788	2	Arterial	1,400	100	241	43	6	A	3.0	340	0.6	35	0.72	2.5
808712M	Maple		1.2	6,319	7	11.39	1,042	2	Local Road	700	22	39	8	5	A	2.2	60	0.5	6	0.62	1.7
922990N	Industrial Rd	71.04	6.1	2,298	5	186.22	7,494	2	Arterial	1,400	156	16758	969	17	F	134.2	1600	15.0	749	9.99	119.1
AA	Myrtle St	70.85	1.4	718	2	6.95	95	2	Arterial	1,400	2	1	0	2	A	0.7	20	0.7	0	0.00	-
BB	N Maple St	70.55	6.1	2,298	7	148.31	1,042	2	Local Road	700	22	1355	107	13	E	78.0	180	4.7	89	8.57	73.3
808713U	W 1St St	70.41	7.3	4,309	6	131.98	5,979	2	Collector	900	125	5734	548	10	E	57.5	740	2.6	472	7.89	54.9
096711K	Port Industrial Rd	70.06	8.1	2,687	7	121.79	23,076	2	Arterial	1,400	481	22218	1952	11	E	57.8	2400	2.1	1696	7.35	55.7
096710D	Division St	69.82	8.1	2,687	7	117.68	27	2	Local Road	700	1	16	2	7	D	35.4	20	1.2	2	7.12	34.2
096709J	Heron St	69.81	8.1	2,687	6	121.60	216	2	Local Road	700	5	137	18	8	D	38.1	20	1.4	16	7.33	36.7
808707R	Monroe St	69.63	9.2	4,189	6	126.38	27	2	Local Road	700	1	16	2	7	D	36.3	20	2.0	2	7.26	34.3
096706N	Washington St	69.49	9.2	4,189	5	128.62	866	2	Local Road	700	18	556	77	7	D	38.5	80	2.1	64	7.41	36.4
092551K	H Street	68.8	7.4	4,281	6	231.46	1,136	2	Local Road	700	24	2949	183	16	F	155.7	240	29.4	131	11.51	126.4
096695D	E Heron St	68.5	7.4	4,281	5	170.79	4,464	1	Local Road	700	186	8299	529	16	F	111.6	1420	26.5	360	8.08	85.0
096693P	Newell St	68.44	7.4	4,281	6	166.93	839	2	Local Road	700	17	1122	97	12	F	80.3	140	18.4	67	7.96	61.8
096691B	S Chehalis St	68.36	7.4	4,281	6	140.61	6,344	4	Local Road	700	66	6482	619	10	E	61.3	420	10.2	454	7.16	51.2
096689A	Dairy Queen Entrance	68.34	7.4	4,281	6	138.75	216	2	Local Road	700	5	196	21	9	D	54.4	20	8.8	15	7.09	45.6
096690U	McDonalds Entrance	68.31	7.4	4,281	6	137.52	1,380	2	Local Road	700	29	1274	132	10	E	55.4	180	8.8	97	7.05	46.6
096029N	Tyler St	68.23	7.4	4,281	6	134.11	5,235	4	Local Road	700	55	4779	488	10	D	54.8	320	8.7	360	6.89	46.1
096688T	Fleet St	68.16	7.4	4,281	7	129.89	2,083	2	Local Road	700	43	1754	188	9	D	50.5	260	8.2	138	6.64	42.3

Grade-Crossing Safety

Methods

Assumptions and Data Sources for Calculations

The data sources and assumptions used to characterize grade-crossing safety conditions were similar to those described for Grade-Crossing Delay above.

Calculation of Accident Frequency

For grade crossings not included in the GradeDec.net model (including private at-grade crossings), the FRA accident prediction formula was used to calculate a total predicted annual accident rate. Because grade-separated crossings do not pose a collision safety hazard, they are not included in the analysis.

Below is the accident prediction formula. The remaining values are summarized in Table 30.

a = K * EI *DT *MS *MT *HP *HL

Where:

K = the basic accident prediction constant

EI = the exposure index factor based on the product of the number of roadway vehicles and trains per day

DT = the factor for the number of through trains per day during daylight

MS = the factor for maximum timetable speed

MT = the factor for number of main tracks

HP = the factor for paved roadway

HL = the factor for number of roadway lanes

The exposure index factor (EI) is calculated using:

((c*t)+0.2/0.2)^0.37

Where:

c=number of vehicles (AADT)

t=number of trains per day

Table 30. FRA Accident Prediction Formula Constants

Formula Constant	Equation or Description	Formula Value
Passive Protection (i.e. signs and crossbucks)		
K =	Basic accident prediction constant	0.0006938
EI=	((c*t)+0.2/0.2)^0.3334	
DT =	((d+0.2)/0.2)^0.1396	
	0 train per day	1
	1 train per day	1.27
	2 train per day	1.38
	3 train per day	1.45
	4 train per day	1.5
	5 train per day	1.55
	6 train per day	1.58
	7 train per day	1.61
	8 train per day	1.64
	9 trains per day	1.67
MS =		e^0.0077ms
	0 mph	1
	5 mph	1.04
	10 mph	1.08
	15 mph	1.12
	20 mph	1.17
	25 mph	1.21
MT=	Number of main tracks	1
HP =	Paved/Unpaved	1/0.55
HL =	roadway lanes	1
Gates		
K =	Basic accident prediction constant	0.001088
EI=	((c*t)+0.2/0.2)^0.3116	
DT =	0 train per day	1
	1 train per day	1
	2 train per day	1
	3 train per day	1
	4 train per day	1
	5 train per day	1
	6 train per day	1
	7 train per day	1
MS =	0 mph	1
	5 mph	1
	10 mph	1
	15 mph	1
	20 mph	1
	25 mph	1
MT=	e^0.1512mt	1.16
HP =		1
HL =	e^0.1093(hl-1)	1.15

Formula Constant	Equation or Description	Formula Value
Flashing Lights		
K =	Basic accident prediction constant	0.003646
EI=	((c*t)+0.2/0.2)^0.2953	
DT =	((d+0.2)/0.2)^0.0470	
	0 train per day	1
	1 train per day	1
	2 train per day	1
	3 train per day	1
	4 train per day	1
	5 train per day	1
	6 train per day	1
	7 train per day	1
MS =	0 mph	1
	5 mph	1
	10 mph	1
	15 mph	1
	20 mph	1
MT=	e^0.1512mt	1.16
HP =		1
HL =	e^0.1390(hl-1)	1.15

Notes:
mph = miles per hour
Source: Federal Railroad Administration 1987

The crossings that required manual calculations using the accident prediction formula are as shown in Table 31.

Table 31. Additional Information for Manual Safety Calculations

FRA Crossing ID	Street	Milepost	Crossing Protection	Road Type
922981P	Hoss Rd	4.44	gates	paved
922982W	Robert Thompson Rd	4.26	gates	paved
Switching				
922990N	Industrial Rd	71.04	gates	paved
096710D	Division St	69.82	No signs or signals	paved
096709J	Heron St	69.81	No signs or signals	paved
808707R	Monroe St	69.63	Stop signs	paved
096706N	Washington St	69.49	No signs or signals	paved
096689A	Dairy Queen Entrance	68.34	Crossbucks	paved
096690U	McDonald's Entrance	68.31	No signs or signals	paved

The FRA GradeDec.Net model was used to calculate the total annual predicted accident frequency for existing grade crossings along PS&P. The analysis of this segment accounted for accident history and frequency of trains at grade crossings, volume of vehicle traffic, existing safety devices at grade crossings, and other factors to determine the potential impacts of an increase in rail traffic.

The potential change in the predicted accident frequency (accidents per year) was estimated from the no-action alternative to the expected train traffic levels under proposed action. The predicted accident frequency was calculated using the FRA GradeDec.Net model (Federal Railroad Administration 2014b). This free and open-source model was released in January 2003 and integrates several modeling capabilities into a single package. It analyzes the following components.

- Grade-crossing safety
- Cost-benefit for future investments
- High-speed rail corridors
- GradeDec.Net allows the user to import up to 600 grade crossings and accepts the following data to calculate the annual accident prediction rate.
- Number of freight and passenger trains
- AADT
- Train length
- Train speed
- Crossing devices

GradeDec.Net uses two safety prediction models, the U.S. Department of Transportation Accident Prediction and Severity Model and the Volpe National Transportation System Center High-Speed Rail Accident Severity Model. The results of the accident prediction and severity model were used, which reports accident prediction rates for injuries, fatalities, property damage only, and total accidents (Federal Railroad Administration 2013).

Each at-grade crossing is then analyzed by an estimated future accident frequency and the corresponding predicted interval between accidents using the general accident prediction formula (Federal Railroad Administration 1987). The FRA GradeDec.Net Model was used to analyze public highway-rail grade crossings (Federal Railroad Administration 2014b) and the general accident prediction formula was used to analyze private highway-rail grade crossings. The GradeDec.Net model accounts for accident history and frequency of trains at existing at-grade crossings, volume of vehicle traffic, existing safety devices at the at-grade crossings, and other factors to determine the potential impacts of an increase in rail traffic. The model also considers the existing rail traffic volumes provided by FRA's grade-crossing database (2014c) and the additional proposed rail traffic. Estimates of AADT for vehicles at each road crossing were calculated for 2012, 2017, and 2037. The general accident prediction formula used was based on FRA's *Rail-Highway Crossing Resource Allocation Procedure User's Guide* taking into account the crossings protection, train speed, number of trains per day, road surface, and number of roadway lanes (Federal Railroad Administration 1987).

Crossing protection upgrades were identified by WSDOT in 2017 to have crossing protection upgrades at crossing 092546N, Tower St, and crossing 092547V, D Street (also known as Pearl Street), where protection would be upgraded from flashing lights to early warning systems and crossing gates (Stemkoski pers. comm.). WSDOT is currently in the planning phase to have several crossing protection upgrades by 2037 including: crossings 096642E, Calder Road, and 096644T, Newman Creek Rd, protection would be upgraded from stop signs to signs and gates; Devonshire Road, 096678M, crossing would have concrete crossing, gates, and signs installed on top of the

existing flashing lights; and the Glenn Road crossing, 096657U, would be removed and a new access road and cul-de-sac would be built (Washington State Department of Transportation 2014).

Tables 32 through 35 show the results of the grade-crossing delay analysis for the No Action Alternative; Tables 36 through 39 show the results of the grade-crossing delay analysis for the proposed action. Tables 40 through 43 show the results of the grade-crossing delay analysis for the cumulative scenario.

No-Action Alternative

Table 32. Predicted Accident Frequency and Interval, No-Action Alternative (2017)

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)
096687L	Junction City Rd	2	1,249	12	4,472	3.1	0.000329	0.003716	0.011662	0.015707	63.7
096682C	Central Park Dr	2	291	11	4,472	3.1	0.000097	0.001011	0.002447	0.003554	281.4
096680N	Aldergrove Dr	2	398	25	4,472	3.1	0.000710	0.003743	0.007424	0.011877	84.2
096679U	Heikkinen Rd	1	215	25	4,472	3.1	0.000333	0.001757	0.003484	0.005574	179.4
096678M	Devonshire Rd	2	1,066	25	4,472	3.1	0.000973	0.005126	0.010167	0.016266	61.5
096677F	County Farm Rd	2	258	25	4,472	3.1	0.000616	0.003245	0.006435	0.010296	97.1
096672W	Main Street	2	1,583	25	4,472	3.1	0.000403	0.002123	0.004211	0.006737	148.4
400107G	Sylvia St	2	129	25	4,472	3.1	0.000347	0.002168	0.005638	0.008154	122.6
096659H	Old Beacon Rd	2	86	25	4,472	3.1	0.000132	0.000695	0.001378	0.002205	453.5
096658B	Monte Brady Rd	2	797	25	4,472	3.1	0.000312	0.001646	0.003264	0.005222	191.5
096657U	Glenn Rd	2	22	25	4,472	3.1	0.000264	0.001390	0.002757	0.004412	226.7
096655F	Fairbairn Rd	2	22	25	4,472	3.1	0.000271	0.001427	0.002830	0.004528	220.8
096654Y	Winkerman Rd S	2	43	25	4,472	3.1	0.000334	0.001759	0.003489	0.005582	179.1
096652K	Monte Brady Rd	2	1,055	25	4,472	3.1	0.000955	0.005033	0.009982	0.015970	62.6
096650W	Foss Av-Monte Elma	2	4,813	25	4,472	3.1	0.000669	0.003525	0.006992	0.011186	89.4
096649C	Hewitt St	2	345	25	4,472	3.1	0.000678	0.003572	0.007084	0.011334	88
096648V	Moore Rd	2	506	25	4,472	3.1	0.000768	0.004047	0.008027	0.012841	78
096646G	Oniel Rd	2	571	25	4,472	3.1	0.000798	0.004208	0.008345	0.013351	75
096644T	Newman Creek Rd	2	861	25	4,472	3.1	0.000910	0.004795	0.009510	0.015215	66
096643L	Hurd Rd	2	1,378	25	4,472	3.1	0.001053	0.005548	0.011005	0.017606	57
096642E	Calder Rd	2	603	25	4,472	3.1	0.000812	0.004282	0.008493	0.013587	74
096641X	N 17th St	2	118	25	4,472	3.1	0.000473	0.002493	0.004944	0.007910	126
096640R	N 13th St	2	646	25	4,472	3.1	0.000831	0.004377	0.008682	0.013890	72
096639W	N 11th St	2	1,916	24	4,472	3.1	0.001112	0.006072	0.012147	0.019332	52

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)
096638P	N 10th St	2	280	22	4,472	3.1	0.000549	0.003230	0.006583	0.010362	97
096636B	N 6th St	2	140	22	4,472	3.1	0.000435	0.002559	0.005214	0.008208	122
096635U	N 5th St	2	75	22	4,472	3.1	0.000351	0.001891	0.004384	0.006627	151
096634M	N 3rd St	2	624	21	4,472	3.1	0.000679	0.004150	0.008546	0.013375	75
096525J	N 2d St	2	474	24	4,472	3.1	0.000719	0.003592	0.008178	0.012488	80
096519F	Tridwell Rd	2	118	24	4,472	3.0	0.000452	0.002467	0.004935	0.007854	127
096518Y	Blockhouse Rd W	2	226	25	4,568	3.0	0.000589	0.003105	0.006158	0.009851	102
096515D	Blockhouse Rd E	2	43	25	4,568	3.0	0.000334	0.001759	0.003489	0.005582	179
096510U	Dunlap Rd	2	194	25	4,568	3.0	0.000560	0.002950	0.005851	0.009360	107
092603A	Porter Creek Rd	2	803	25	4,568	3.0	0.000415	0.002185	0.004333	0.006933	144
092595K	Elma Gare Rd W	2	86	25	4,568	3.0	0.000424	0.002237	0.004437	0.007098	141
092593W	Shelton Rd	2	54	25	4,568	3.0	0.000204	0.001077	0.002137	0.003419	292
092587T	Scheaffer St	2	43	25	4,568	3.0	0.000188	0.000993	0.001970	0.003152	317
092586L	Newton St	2	172	25	4,568	3.0	0.000308	0.001487	0.003359	0.005154	194
092585E	Murray St	2	172	25	4,568	3.0	0.000308	0.001624	0.003222	0.005154	194
092584X	Merry Rd	2	43	25	4,568	3.0	0.000188	0.000993	0.001970	0.003152	317
092583R	Blockhouse Rd	2	43	25	4,568	3.0	0.000188	0.000993	0.001970	0.003152	317
092577M	Moon Rd SW	2	258	25	4,568	3.0	0.000355	0.001561	0.004023	0.005940	168
092576F	Owings St	2	323	25	4,568	3.0	0.000663	0.003200	0.007227	0.011091	90
092574S	Little Rock Rd	2	1,004	25	4,568	3.0	0.000506	0.002443	0.005517	0.008465	118
092573K	183rd Ave SW	2	785	25	4,568	3.0	0.000412	0.002171	0.004307	0.006890	145
092569V	Joselyn Ave	2	215	25	4,568	3.0	0.000579	0.003053	0.006056	0.009688	103
092567G	Tea St	2	517	25	4,568	3.0	0.000773	0.004075	0.008083	0.012931	77
092566A	Grand Mound SW	2	345	25	4,568	3.0	0.000678	0.003572	0.007084	0.011334	88
092565T	Old Hwy 99 SW	2	10,250	24	4,568	3.0	0.000742	0.004050	0.008102	0.012894	78
092563E	216th Ave SW	2	86	13	4,568	3.0	0.000209	0.001901	0.004402	0.006512	154
092561R	222nd Ave SW	2	172	10	4,568	3.0	0.000219	0.002463	0.006122	0.008804	114
922981P	Hoss Rd	2	1,152	10	4,568	3.0				0.018384	54
922982W	Robert Thompson Rd	2	571	10	4,568	3.0				0.014771	114

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)
922980H	Kuper Rd	2	474	10	4,568	3.0	0.000107	0.001200	0.002982	0.004288	233
092559P	Fordon Rd	2	183	10	4,568	3.0	0.000052	0.000677	0.002238	0.002967	337
092554F	W Reynolds Ave	2	6,449	10	4,568	3.0	0.000442	0.005238	0.019563	0.025243	40
092552S	J St	2	345	8	4,568	3.0	0.000121	0.001707	0.006799	0.008627	116
092551K	H St	2	894	7	4,568	3.0	0.000169	0.002626	0.010876	0.013671	73
092550D	G St	2	345	7	4,568	3.0	0.000124	0.002117	0.007771	0.010011	100
092549J	F St	2	237	7	4,568	3.0	0.000109	0.001695	0.007022	0.008826	113
092548C	E St	2	345	7	4,568	3.0	0.000124	0.002117	0.007771	0.010011	100
092547V	D St	2	13,878	7	4,568	3.0	0.000205	0.003196	0.013237	0.016638	60
092546N	Tower St	2	8,097	7	4,568	3.0	0.000158	0.002705	0.009929	0.012791	78
092543T	B St	2	700	7	4,568	3.0	0.000156	0.002427	0.010052	0.012635	79
092521T	Maple St M1	2	3628	40	4,568	40.0	0.002478	0.007366	0.021074	0.030918	32
092520L	E Main St M1	2	2756	40	4,568	40.0	0.002344	0.006966	0.019931	0.029241	34
092519S	E Locust St M1	2	2885	40	4,568	40.0	0.002366	0.007032	0.020118	0.029516	34

Notes:
Hoss Road (922981P) and Robert Thompson Road (922982W) were calculated using the predicted accident frequency formula. The rest were calculated using the GradeDec.Net model.
D Street (092547V) and Tower Street (092546N) are proposed to receive a crossing protection upgrade to gates by 2017 (Washington State Department of Transportation 2014).

Table 33. Predicted Accident Frequency and Interval, No-Action Alternative (2017)–Switching Movements

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)
922990N	Industrial Rd	2	5,803	4	718	2.8				0.029777	33.6
808711F	Myrtle St	2	75	2	718	1.4	0.000004	0.000209	0.001135	0.001348	741.8
808712M	N Maple St	2	808	6	718	2.8	0.000073	0.001804	0.006863	0.008739	114.4
808713U	W 1St St	2	4,296	6	3,409	3.1	0.000074	0.001832	0.006969	0.008875	112.7
096711K	Port Industrial Rd	2	18,002	8	1,018	3.9	0.000183	0.003718	0.012924	0.016825	59.4
096710D	Division St	2	22	7	1,018	3.9				0.015569	64.2
096709J	Heron St	2	172	6	1,018	3.9				0.031035	32.2
808707R	Monroe St	2	22	6	4,022	4.9				0.017386	57.5
096706N	Washington St	2	678	5	4,022	4.9				0.054754	18.3
092551K	H Street	2	894	5	3,551	3.2	0.000063	0.001610	0.007307	0.008980	111.4
096695D	E Heron St	2	205	5	3,551	3.2	0.000018	0.000514	0.002073	0.002606	383.7
096693P	Newell St	2	366	6	3,551	3.2	0.000046	0.000941	0.004548	0.005536	180.6
096691B	S Chehalis St	4	7,504	6	3,551	3.2	0.000097	0.002401	0.009136	0.011634	86.0
096689A	W Mall Entrance	2	172	6	3,551	3.2				0.028009	35.7
096690U	E Mall Entrance	2	172	6	3,551	3.2				0.028009	35.7
096029N	Tyler St	4	5,502	7	3,551	3.2	0.000136	0.003008	0.010906	0.014051	71.2
096688T	Fleet St	2	2,810	7	3,551	3.2	0.000129	0.002844	0.010311	0.013284	75.3

Notes:
Industrial Road (922990N), Division Street (110912), Heron Street (096709J), Monroe Street (860101), Washington Street (110912), W Mall Entrance (096689A), and E Mall Entrance (096690U) were calculated using the predicted accident frequency formula. The rest were calculated using the GradeDec.Net model.

Table 34. Predicted Accident Frequency and Interval, No-Action Alternative (2037)

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)
096687L	Junction City Rd	2	1,605	12	4,472	3.1	0.000356	0.004017	0.012606	0.016979	59
096682C	Central Park Dr	2	374	11	4,472	3.1	0.000107	0.001113	0.002695	0.003915	255
096680N	Aldergrove Dr	2	512	25	4,472	3.1	0.000771	0.004062	0.008057	0.012890	78
096679U	Heikkinen Rd	1	277	25	4,472	3.1	0.000364	0.001919	0.003806	0.006089	164
096678M	Devonshire Rd	2	1,370	25	4,472	3.1	0.000479	0.002526	0.005010	0.008015	125
096677F	County Farm Rd	2	332	25	4,472	3.1	0.000669	0.003527	0.006995	0.011192	89
096672W	Main Street	2	2,034	25	4,472	3.1	0.000441	0.002326	0.004613	0.007381	135
400107G	Sylvia St	2	166	25	4,472	3.1	0.000378	0.002362	0.006141	0.008882	113
096659H	Old Beacon Rd	2	111	25	4,472	3.1	0.000146	0.000769	0.001524	0.002439	410
096658B	Monte Brady Rd	2	1,024	25	4,472	3.1	0.000346	0.001823	0.003616	0.005785	173
096657U	Glenn Rd	2	28	25	4,472	3.1	0.000000	0.000000	0.000000	0.000000	0
096655F	Fairbairn Rd	2	28	25	4,472	3.1	0.000299	0.001575	0.003125	0.004999	200
096654Y	Winkerman Rd S	2	55	25	4,472	3.1	0.000364	0.001917	0.003801	0.006082	164
096652K	Monte Brady Rd	2	1,356	25	4,472	3.1	0.001048	0.005521	0.010951	0.017519	57
096650W	Foss Av-Monte Elma	2	6,184	25	4,472	3.1	0.000714	0.003762	0.007461	0.011936	84
096649C	Hewitt St	2	443	25	4,472	3.1	0.000735	0.003876	0.007688	0.012299	81
096648V	Moore Rd	2	650	25	4,472	3.1	0.000832	0.004386	0.008699	0.013917	72
096646G	Oniel Rd	2	733	25	4,472	3.1	0.000865	0.004557	0.009038	0.014460	69
096644T	Newman Creek Rd	2	1,107	25	4,472	3.1	0.000452	0.002384	0.004729	0.007566	132
096643L	Hurd Rd	2	1,771	25	4,472	3.1	0.001136	0.005987	0.011875	0.018998	53
096642E	Calder Rd	2	775	25	4,472	3.1	0.000411	0.002164	0.004291	0.006866	146
096641X	N 17th St	2	152	25	4,472	3.1	0.000515	0.002717	0.005389	0.008621	116
096640R	N 13th St	2	830	25	4,472	3.1	0.000899	0.004740	0.009401	0.015040	66
096639W	N 11th St	2	2,462	24	4,472	3.1	0.001198	0.006542	0.013086	0.020826	48
096638P	N 10th St	2	360	22	4,472	3.1	0.000597	0.003510	0.007153	0.011260	89
096636B	N 6th St	2	180	22	4,472	3.1	0.000474	0.002786	0.005678	0.008937	112
096635U	N 5th St	2	97	22	4,472	3.1	0.000384	0.002067	0.004790	0.007241	138

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)
096634M	N 3rd St	2	802	21	4,472	3.1	0.000735	0.004497	0.009259	0.014491	69
096525J	N 2d St	2	609	24	4,472	3.1	0.000779	0.003894	0.008866	0.013540	74
096519F	Tridwell Rd	2	152	24	4,472	3.0	0.000493	0.002689	0.005379	0.008560	117
096518Y	Blockhouse Rd W	2	291	25	4,568	3.0	0.000641	0.003377	0.006698	0.010715	93
096515D	Blockhouse Rd E	2	55	25	4,568	3.0	0.000364	0.001917	0.003801	0.006082	164
096510U	Dunlap Rd	2	249	25	4,568	3.0	0.000608	0.003207	0.006360	0.010175	98
092603A	Porter Creek Rd	2	1,039	25	4,568	3.0	0.000445	0.002344	0.004648	0.007437	134
092595K	Elma Gare Rd W	2	111	25	4,568	3.0	0.000463	0.002441	0.004842	0.007747	129
092593W	Shelton Rd	2	69	25	4,568	3.0	0.000223	0.001176	0.002332	0.003731	268
092587T	Scheaffer St	2	55	25	4,568	3.0	0.000206	0.001085	0.002151	0.003441	291
092586L	Newton St	2	221	25	4,568	3.0	0.000336	0.001624	0.003667	0.005628	178
092585E	Murray St	2	221	25	4,568	3.0	0.000336	0.001773	0.003518	0.005628	178
092584X	Merry Rd	2	55	25	4,568	3.0	0.000206	0.001085	0.002151	0.003441	291
092583R	Blockhouse Rd	2	55	25	4,568	3.0	0.000206	0.001085	0.002151	0.003441	291
092577M	Moon Rd SW	2	332	25	4,568	3.0	0.000388	0.001704	0.004392	0.006484	154
092576F	Owings St	2	415	25	4,568	3.0	0.000720	0.003474	0.007846	0.012041	83
092574S	Little Rock Rd	2	1,299	25	4,568	3.0	0.000542	0.002617	0.005910	0.009069	110
092573K	183rd Ave SW	2	1,015	25	4,568	3.0	0.000442	0.002329	0.004619	0.007390	135
092569V	Joselyn Ave	2	277	25	4,568	3.0	0.000630	0.003322	0.006589	0.010542	95
092567G	Tea St	2	664	25	4,568	3.0	0.000838	0.004416	0.008759	0.014012	71
092566A	Grand Mound SW	2	443	25	4,568	3.0	0.000735	0.003876	0.007688	0.012299	81
092565T	Old Hwy 99 SW	2	13,169	24	4,568	3.0	0.000804	0.004390	0.008782	0.013977	72
092563E	216th Ave SW	2	111	13	4,568	3.0	0.000228	0.002076	0.004807	0.007111	141
092561R	222nd Ave SW	2	221	10	4,568	3.0	0.000219	0.002463	0.006122	0.008804	114
922981P	Hoss Rd	2	1,480	10	4,568	3.0				0.019877	50
922982W	Robert Thompson Rd	2	733	10	4,568	3.0				0.015970	63
922980H	Kuper Rd	2	609	10	4,568	3.0	0.000117	0.001320	0.003280	0.004717	212
092559P	Fordon Rd	2	235	10	4,568	3.0	0.000057	0.000747	0.002467	0.003271	306

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)
092554F	W Reynolds Ave	2	8,286	10	4,568	3.0	0.000474	0.005612	0.020958	0.027044	37
092552S	J St	2	443	8	4,568	3.0	0.000154	0.002167	0.008631	0.010953	91
092551K	H St	2	1,148	7	4,568	3.0	0.000183	0.002843	0.011777	0.014803	68
092550D	G St	2	443	7	4,568	3.0	0.000134	0.002300	0.008443	0.010878	92
092549J	F St	2	304	7	4,568	3.0	0.000118	0.001843	0.007635	0.009597	104
092548C	E St	2	443	7	4,568	3.0	0.000134	0.002300	0.008443	0.010878	92
092547V	D St	2	17,831	7	4,568	3.0	0.000218	0.003396	0.014065	0.017679	57
092546N	Tower St	2	10,403	7	4,568	3.0	0.000158	0.002705	0.009929	0.012791	78
092543T	B St	2	899	7	4,568	3.0	0.000169	0.002630	0.010896	0.013695	73
092521T	Maple St M1	2	4,662	40	4,568	40	0.002604	0.007741	0.022147	0.032492	31
092520L	E Main St M1	2	3,541	40	4,568	40	0.002466	0.007330	0.020972	0.030768	33
092519S	E Locust St M1	2	3,707	40	4,568	40	0.002489	0.007398	0.021165	0.031052	32

Notes:
Hoss Road (922981P) and Robert Thompson Road (922982W) were calculated using the predicted accident frequency formula. The rest were calculated using the GradeDec.Net model.
D Street (092547V) and Tower Street (092546N) are proposed to receive a crossing protection upgrade to gates by 2017. Devonshire Road (096678M), Newman Creek Road (096644T), Calder Road (096642E) are proposed to receive a crossing protection upgrade to gates and signs by 2037 and the Glenn Road crossing (096657U) is proposed to close by 2037 (Washington State Department of Transportation 2014).

Table 35. Predicted Accident Frequency and Interval, No-Action Alternative (2037)–Switching Movements

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)
922990N	Industrial Rd	2	7,456	6	718	2.8				0.032196	31.1
808711F	Myrtle St	2	97	6	718	1.4	0.000013	0.000308	0.001173	0.001494	669.3
808712M	N Maple St	2	1,038	6	718	2.8	0.000079	0.001963	0.007467	0.009508	105.2
110912	W 1St St	2	5,520	7	3,409	3.1	0.000102	0.002245	0.008142	0.010489	95.3
110912	Port Industrial Rd	2	23,129	14	1,018	3.9	0.000341	0.004510	0.013266	0.018117	55.2
110912	Division St	2	28	14	1,018	3.9				0.017562	56.9
096709J	Heron St	2	221	14	1,018	3.9				0.035034	28.5
860101	Monroe St	2	28	15	4,022	4.9				0.020341	49.2
110912	Washington St	2	872	15	4,022	4.9				0.064104	15.6
110912	H Street	2	1,148	23	3,551	3.2	0.000345	0.002738	0.007978	0.011060	90.4
096695D	E Heron St	2	263	23	3,551	3.2	0.000090	0.000780	0.002004	0.002874	347.9
110912	Newell St	2	470	23	3,551	3.2	0.000189	0.001367	0.004520	0.006076	164.6
110912	S Chehalis St	4	9,642	23	3,551	3.2	0.000394	0.003429	0.008816	0.012639	79.1
096689A	W Mall Entrance	2	221	23	3,551	3.2				0.035423	28.2
096690U	E Mall Entrance	2	221	23	3,551	3.2				0.035423	28.2
096029N	Tyler St	4	7,069	23	3,551	3.2	0.000474	0.004124	0.010604	0.015201	65.8
100111	Fleet St	2	3,611	23	3,551	3.2	0.000498	0.004336	0.011149	0.015983	65.8

Notes:
Industrial Road (922990N), Division Street (110912), Heron Street (096709J), Monroe Street (860101), Washington Street (110912), W Mall Entrance (096689A), and E Mall Entrance (096690U) were calculated using the predicted accident frequency formula. The rest were calculated using the GradeDec.Net model.

Proposed Action

Table 36. Predicted Accident Frequency and Interval, Proposed Action (2017)

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
096687L	Junction City Rd	2	1,249	12	5,323	4.4	0.000381	0.004220	0.013265	0.017866	56.0	7.7
096682C	Central Park Dr	2	291	11	5,323	4.4	0.000110	0.001127	0.002734	0.003971	251.8	29.5
096680N	Aldergrove Dr	2	398	25	5,323	4.4	0.000828	0.004269	0.008496	0.013593	73.6	10.6
096679U	Heikkinen Rd	1	215	25	5,323	4.4	0.000392	0.002024	0.004028	0.006444	155.2	24.2
096678M	Devonshire Rd	2	1,066	25	5,323	4.4	0.001126	0.005805	0.011554	0.018485	54.1	7.4
096677F	County Farm Rd	2	258	25	5,323	4.4	0.000719	0.003710	0.007384	0.011813	84.7	12.5
096672W	Main Street	2	1,583	25	5,323	4.4	0.000456	0.002349	0.004675	0.007480	133.7	14.7
400107G	Sylvia St	2	129	25	5,323	4.4	0.000407	0.002489	0.006492	0.009388	106.5	16.1
096659H	Old Beacon Rd	2	86	25	5,323	4.4	0.000150	0.000776	0.001544	0.002470	404.9	48.7
096658B	Monte Brady Rd	2	797	25	5,323	4.4	0.000354	0.001826	0.003635	0.005815	172.0	19.5
096657U	Glenn Rd	2	22	25	5,323	4.4	0.000311	0.001604	0.003193	0.005109	195.7	30.9
096655F	Fairbairn Rd	2	22	25	5,323	4.4	0.000311	0.001604	0.003193	0.005109	195.7	25.1
096654Y	Winkerman Rd S	2	43	25	5,323	4.4	0.000393	0.002026	0.004033	0.006453	155.0	24.2
096652K	Monte Brady Rd	2	1,055	25	5,323	4.4	0.001106	0.005702	0.011349	0.018157	55.1	7.5
096650W	Foss Av-Monte Elma	2	4,813	25	5,323	4.4	0.000765	0.003946	0.007853	0.012564	79.6	9.8
096649C	Hewitt St	2	345	25	5,323	4.4	0.000791	0.004077	0.008115	0.012982	77	11.2
096648V	Moore Rd	2	506	25	5,323	4.4	0.000894	0.004608	0.009172	0.014673	68	9.7
096646G	Oniel Rd	2	571	25	5,323	4.4	0.000928	0.004787	0.009528	0.015244	66	9.3
096644T	Newman Creek Rd	2	861	25	5,323	4.4	0.001055	0.005439	0.010826	0.017320	58	8.0
096643L	Hurd Rd	2	1,378	25	5,323	4.4	0.001216	0.006270	0.012479	0.019965	50	6.7
096642E	Calder Rd	2	603	25	5,323	4.4	0.000944	0.004870	0.009693	0.015507	64	9.1

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
096641X	N 17th St	2	118	25	5,323	4.4	0.000555	0.002861	0.005695	0.009111	110	16.7
096640R	N 13th St	2	646	25	5,323	4.4	0.000965	0.004976	0.009904	0.015845	63	8.9
096639W	N 11th St	2	1,916	24	5,323	4.4	0.001281	0.006844	0.013737	0.021862	46	6.0
096638P	N 10th St	2	280	23	5,323	4.4	0.000642	0.003694	0.007552	0.011888	84	12.4
096636B	N 6th St	2	140	23	5,323	4.4	0.000510	0.002936	0.006003	0.009449	106	16.0
096635U	N 5th St	2	75	23	5,323	4.4	0.000413	0.002175	0.005059	0.007648	131	20.1
096634M	N 3rd St	2	624	23	5,323	4.4	0.000789	0.004724	0.009757	0.015270	65	9.3
096525J	N 2nd St	2	474	24	5,323	4.4	0.000837	0.004091	0.009350	0.014278	70	10.0
096519F	Tridwell Rd	2	118	25	5,411	4.3	0.000530	0.002832	0.005685	0.009047	111	16.8
096518Y	Blockhouse Rd W	2	226	25	5,411	4.3	0.000689	0.003552	0.007070	0.011311	88	13.1
096515D	Blockhouse Rd E	2	43	25	5,411	4.3	0.000393	0.002026	0.004033	0.006453	155	24.2
096510U	Dunlap Rd	2	194	25	5,411	4.3	0.000655	0.003378	0.006723	0.010756	93	13.9
092603A	Porter Creek Rd	2	803	25	5,411	4.3	0.000477	0.002460	0.004897	0.007835	128	16.6
092595K	Elma Gare Rd W	2	86	25	5,411	4.3	0.000499	0.002571	0.005117	0.008186	122	18.7
092593W	Shelton Rd	2	54	25	5,411	4.3	0.000242	0.001246	0.002479	0.003966	252	40.3
092587T	Scheaffer St	2	43	25	5,411	4.3	0.000223	0.001149	0.002286	0.003658	273	43.9
092586L	Newton St	2	172	25	5,411	4.3	0.000363	0.001714	0.003886	0.005963	168	26.3
092585E	Murray St	2	172	25	5,411	4.3	0.000363	0.001873	0.003727	0.005963	168	26.3
092584X	Merry Rd	2	43	25	5,411	4.3	0.000223	0.001149	0.002286	0.003658	273	43.9
092583R	Blockhouse Rd	2	43	25	5,411	4.3	0.000223	0.001149	0.002286	0.003658	273	43.9
092577M	Moon Rd SW	2	258	25	5,411	4.3	0.000418	0.001796	0.004649	0.006863	146	22.6
092576F	Owings St	2	323	25	5,411	4.3	0.000774	0.003653	0.008282	0.012709	79	11.5
092574S	Little Rock Rd	2	1,004	25	5,411	4.3	0.000581	0.002744	0.006221	0.009546	105	13.4
092573K	183rd Ave SW	2	785	25	5,411	4.3	0.000474	0.002445	0.004867	0.007787	128	16.7
092569V	Joselyn Ave	2	215	25	5,411	4.3	0.000678	0.003494	0.006955	0.011127	90	13.3
092567G	Tea St	2	517	25	5,411	4.3	0.000900	0.004640	0.009234	0.014774	68	9.6

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
092566A	Grand Mound SW	2	345	25	5,411	4.3	0.000791	0.004077	0.008115	0.012982	77	11.2
092565T	Old Hwy 99 SW	2	10,250	21	5,411	4.3	0.000829	0.004427	0.008886	0.014142	71	6.8
092563E	216th Ave SW	2	86	13	5,411	4.3	0.000245	0.002190	0.005081	0.007517	133	20.5
092561R	222nd Ave SW	2	172	10	5,411	4.3	0.000236	0.002600	0.006474	0.009311	107	6.2
922981P	Hoss Rd	2	1,152	10	5,411	4.3				0.020499	49	5.6
922982W	Robert Thompson Rd	2	571	10	5,411	4.3				0.016469	61	52.9
922980H	Kuper Rd	2	474	10	5,411	4.3	0.000121	0.001336	0.003327	0.004784	209	24.2
092559P	Fordon Rd	2	183	10	5,411	4.3	0.000059	0.000757	0.002504	0.003319	301	35.7
092554F	W Reynolds Ave	2	6,449	10	5,411	4.3	0.000505	0.005859	0.021918	0.028282	35	4.3
092552S	J St	2	345	8	5,411	4.3	0.000166	0.002286	0.009118	0.011571	86	29.5
092551K	H St	2	894	7	5,411	4.3	0.000196	0.002993	0.012412	0.015601	64	9.0
092550D	G St	2	345	7	5,411	4.3	0.000145	0.002427	0.008920	0.011492	87	12.9
092549J	F St	2	237	7	5,411	4.3	0.000128	0.001947	0.008076	0.010150	99	14.8
092548C	E St	2	345	7	5,411	4.3	0.000145	0.002427	0.008920	0.011492	87	12.9
092547V	D St	2	13,878	7	5,411	4.3	0.000233	0.003557	0.014753	0.018543	54	6.2
092546N	Tower St	2	8,097	7	5,411	4.3	0.000180	0.003028	0.011126	0.014334	70	8.4
092543T	B St	2	700	7	5,411	4.3	0.000182	0.002770	0.011490	0.014442	69	9.9
092521T	Maple St M1	2	3,628	40	5,411	41.3	0.002503	0.007420	0.021241	0.031164	32	0.3
092520L	E Main St M1	2	2,756	40	5,411	41.3	0.002367	0.007018	0.020093	0.029479	34	0.3
092519S	E Locust St M1	2	2,885	40	5,411	41.3	0.002390	0.007084	0.020282	0.029756	34	0.3

Notes:

Hoss Road (922981P) and Robert Thompson Road (922982W) were calculated using the predicted accident frequency formula. The rest were calculated using the GradeDec.Net model.

D Street (092547V) and Tower Street (092546N) are proposed to receive a crossing protection upgrade to gates by 2017 (Washington State Department of Transportation 2014).

Table 37. Predicted Accident Frequency and Interval, Proposed Action (2017)–Switching Movements

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
922990N	Industrial Rd	2	5,803	4	3,892	4.1				0.033432	29.9	3.7
808711F	Myrtle St	2	75	2	0	1.4	N/A	N/A	N/A	N/A	N/A	N/A
808712M	N Maple St	2	808	6	3,892	4.1	0.000079	0.001989	0.007560	0.009628	103.9	10.6
808713U	W 1St St	2	4,296	6	3,652	4.3	0.000080	0.002027	0.007705	0.009812	101.9	10.8
096711K	Port Industrial Rd	2	18,002	8	3,459	5.2	0.000192	0.003975	0.013806	0.017972	55.6	3.8
096710D	Division St	2	22	7	3,459	5.2				0.017643	56.7	7.5
096709J	Heron St	2	172	6	3,459	5.2				0.035198	28.4	3.8
808707R	Monroe St	2	22	6	3,508	6.2				0.019104	52.3	5.2
096706N	Washington St	2	678	5	3,508	6.2				0.060202	16.6	1.7
092551K	H Street	2	894	5	5,326	4.4	0.000068	0.001775	0.008048	0.009890	101.1	10.2
096695D	E Heron St	2	205	5	5,326	4.4	0.000020	0.000576	0.002321	0.002917	342.8	40.9
096693P	Newell St	2	366	6	5,326	4.4	0.000050	0.001049	0.005062	0.006161	162.3	18.3
096691B	S Chehalis St	4	7,504	6	5,326	4.4	0.000105	0.002642	0.010045	0.012793	78.2	7.8
096689A	W Mall Entrance	2	172	6	5,326	4.4				0.032382	30.9	4.8
096690U	E Mall Entrance	2	172	6	5,326	4.4				0.032382	30.9	4.8
096029N	Tyler St	4	5,502	7	5,326	4.4	0.000146	0.003295	0.011935	0.015377	65.0	6.1
096688T	Fleet St	2	2,810	7	5,326	4.4	0.000139	0.003120	0.011303	0.014562	65.0	10.2

Notes:
Industrial Road (922990N), Division Street (110912), Heron Street (096709J), Monroe Street (860101), Washington Street (110912), W Mall Entrance (096689A), and E Mall Entrance (096690U) were calculated using the predicted accident frequency formula. The rest were calculated using the GradeDec.Net model.

Table 38. Predicted Accident Frequency and Interval, Proposed Action (2037)

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
096687L	Junction City Rd	2	1,605	12	5,323	4.4	0.000411	0.004552	0.014310	0.019274	52	7
096682C	Central Park Dr	2	374	11	5,323	4.4	0.000121	0.001241	0.003010	0.004372	229	27
096680N	Aldergrove Dr	2	512	25	5,323	4.4	0.000897	0.004625	0.009206	0.014728	68	10
096679U	Heikkinen Rd	1	277	25	5,323	4.4	0.000428	0.002209	0.004396	0.007033	142	22
096678M	Devonshire Rd	2	1,370	25	5,323	4.4	0.000551	0.002840	0.005653	0.009044	111	14
096677F	County Farm Rd	2	332	25	5,323	4.4	0.000781	0.004027	0.008015	0.012822	78	11
096672W	Main Street	2	2,034	25	5,323	4.4	0.000498	0.002570	0.005115	0.008184	122	13
400107G	Sylvia St	2	166	25	5,323	4.4	0.000443	0.002708	0.007062	0.010213	98	15
096659H	Old Beacon Rd	2	111	25	5,323	4.4	0.000166	0.000858	0.001707	0.002731	366	44
096658B	Monte Brady Rd	2	1,024	25	5,323	4.4	0.000392	0.002021	0.004022	0.006435	155	17
096657U	Glenn Rd	2	28	25	5,323	4.4	0.000000	0.000000	0.000000	0.000000	0	0
096655F	Fairbairn Rd	2	28	25	5,323	4.4	0.000356	0.001835	0.003652	0.005843	171	29
096654Y	Winkerman Rd S	2	55	25	5,323	4.4	0.000428	0.002206	0.004391	0.007025	142	22
096652K	Monte Brady Rd	2	1,356	25	5,323	4.4	0.001210	0.006240	0.012420	0.019870	50	7
096650W	Foss Av-Monte Elma	2	6,184	25	5,323	4.4	0.000816	0.004206	0.008371	0.013393	75	9
096649C	Hewitt St	2	443	25	5,323	4.4	0.000857	0.004418	0.008792	0.014067	71	10
096648V	Moore Rd	2	650	25	5,323	4.4	0.000967	0.004986	0.009923	0.015876	63	9
096646G	Oniel Rd	2	733	25	5,323	4.4	0.001004	0.005176	0.010301	0.016481	61	8
096644T	Newman Creek Rd	2	1,107	25	5,323	4.4	0.000520	0.002683	0.005340	0.008542	117	15
096643L	Hurd Rd	2	1,771	25	5,323	4.4	0.001309	0.006751	0.013437	0.021497	47	6
096642E	Calder Rd	2	775	25	5,323	4.4	0.000473	0.002437	0.004850	0.007760	129	17
096641X	N 17th St	2	152	25	5,323	4.4	0.000604	0.003115	0.006199	0.009918	101	15
096640R	N 13th St	2	830	25	5,323	4.4	0.001043	0.005378	0.010704	0.017125	58	8
096639W	N 11th St	2	2,462	24	5,323	4.4	0.001377	0.007356	0.014764	0.023497	43	5

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
096638P	N 10th St	2	360	22	5,323	4.4	0.000697	0.004008	0.008195	0.012899	78	11
096636B	N 6th St	2	180	22	5,323	4.4	0.000555	0.003193	0.006528	0.010277	97	15
096635U	N 5th St	2	97	22	5,323	4.4	0.000451	0.002375	0.005523	0.008348	120	18
096634M	N 3rd St	2	802	21	5,323	4.4	0.000853	0.005109	0.010552	0.016515	61	8
096525J	N 2nd St	2	609	24	5,323	4.4	0.000906	0.004428	0.010120	0.015454	65	9
096519F	Tridwell Rd	2	152	24	5,411	4.3	0.000577	0.003083	0.006189	0.009849	102	15
096518Y	Blockhouse Rd W	2	291	25	5,411	4.3	0.000748	0.003858	0.007679	0.012286	81	12
096515D	Blockhouse Rd E	2	55	25	5,411	4.3	0.000428	0.002206	0.004391	0.007025	142	22
096510U	Dunlap Rd	2	249	25	5,411	4.3	0.000711	0.003667	0.007298	0.011676	86	13
092603A	Porter Creek Rd	2	1,039	25	5,411	4.3	0.000511	0.002637	0.005249	0.008398	119	15
092595K	Elma Gare Rd W	2	111	25	5,411	4.3	0.000544	0.002803	0.005579	0.008925	112	17
092593W	Shelton Rd	2	69	25	5,411	4.3	0.000263	0.001359	0.002704	0.004327	231	37
092587T	Scheaffer St	2	55	25	5,411	4.3	0.000243	0.001254	0.002495	0.003992	251	40
092586L	Newton St	2	221	25	5,411	4.3	0.000396	0.001870	0.004240	0.006506	154	24
092585E	Murray St	2	221	25	5,411	4.3	0.000396	0.002043	0.004066	0.006506	154	24
092584X	Merry Rd	2	55	25	5,411	4.3	0.000243	0.001254	0.002495	0.003992	251	40
092583R	Blockhouse Rd	2	55	25	5,411	4.3	0.000243	0.001254	0.002495	0.003992	251	40
092577M	Moon Rd SW	2	332	25	5,411	4.3	0.000456	0.001959	0.005070	0.007485	134	21
092576F	Owings St	2	415	25	5,411	4.3	0.000839	0.003960	0.008978	0.013776	73	10
092574S	Little Rock Rd	2	1,299	25	5,411	4.3	0.000622	0.002937	0.006659	0.010218	98	12
092573K	183rd Ave SW	2	1,015	25	5,411	4.3	0.000508	0.002621	0.005217	0.008346	120	16
092569V	Joselyn Ave	2	277	25	5,411	4.3	0.000736	0.003797	0.007557	0.012090	83	12
092567G	Tea St	2	664	25	5,411	4.3	0.000973	0.005019	0.009989	0.015982	63	9
092566A	Grand Mound SW	2	443	25	5,411	4.3	0.000857	0.004418	0.008792	0.014067	71	10
092565T	Old Hwy 99 SW	2	13,169	24	5,411	4.3	0.000897	0.004789	0.009612	0.015297	65	6
092563E	216th Ave SW	2	111	13	5,411	4.3	0.000268	0.002389	0.005543	0.008201	122	19

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
092561R	222nd Ave SW	2	221	10	5,411	4.3	0.000256	0.002828	0.007041	0.010125	99	15
922981P	Hoss Rd	2	1,480	10	5,411	4.3				0.022163	45	5
922982W	Robert Thompson Rd	2	733	10	5,411	4.3				0.017807	56	6
922980H	Kuper Rd	2	609	10	5,411	4.3	0.000133	0.001469	0.003657	0.005259	190	22
092559P	Fordon Rd	2	235	10	5,411	4.3	0.000065	0.000833	0.002758	0.003657	273	32
092554F	W Reynolds Ave	2	8,286	10	5,411	4.3	0.000540	0.006259	0.023415	0.030214	33	4
092552S	J St	2	443	8	5,411	4.3	0.000180	0.002481	0.009893	0.012554	80	12
092551K	H St	2	1,148	7	5,411	4.3	0.000212	0.003235	0.013416	0.016862	59	8
092550D	G St	2	443	7	5,411	4.3	0.000157	0.002634	0.009679	0.012469	80	12
092549J	F St	2	304	7	5,411	4.3	0.000139	0.002115	0.008770	0.011023	91	13
092548C	E St	2	443	7	5,411	4.3	0.000157	0.002634	0.009679	0.012469	80	12
092547V	D St	2	17,831	7	5,411	4.3	0.000247	0.003774	0.015652	0.019674	51	6
092546N	Tower St	2	10,403	7	5,411	4.3	0.000192	0.003223	0.011844	0.015258	66	13
092543T	B St	2	899	7	5,411	4.3	0.000197	0.002998	0.012434	0.015628	64	9
092521T	Maple St M1	2	4,662	40	5,411	41.3	0.002630	0.007796	0.022318	0.032744	31	0.2
092520L	E Main St M1	2	3,541	40	5,411	41.3	0.002491	0.007384	0.021139	0.031013	32	0.3
092519S	E Locust St M1	2	3,707	40	5,411	41.3	0.002514	0.007451	0.021333	0.031298	32	0.3

Notes:
Hoss Road (922981P) and Robert Thompson Road (922982W) were calculated using the predicted accident frequency formula. The rest were calculated using the GradeDec.Net model.
D Street (092547V) and Tower Street (092546N) are proposed to receive a crossing protection upgrade to gates by 2017. Devonshire Road (096678M), Newman Creek Road (096644T), Calder Road (096642E) are proposed to receive a crossing protection upgrade to gates and signs by 2037 and the Glenn Road crossing (096657U) is proposed to close by 2037 (Washington State Department of Transportation 2014).

Table 39. Predicted Accident Frequency and Interval, Proposed Action (2037)–Switching Movements

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
922990N	Industrial Rd	2	7,456	6	3,892	4.1				0.036148	27.7	3.4
808711F	Myrtle St	2	97		0	1.4	N/A	N/A	N/A	N/A	N/A	N/A
808712M	N Maple St	2	1,038	6	3,892	4.1	0.000086	0.002162	0.008219	0.010466	95.5	9.6
808713U	W 1st St	2	5,520	7	3,652	4.3	0.000110	0.002477	0.008972	0.011559	86.5	8.8
096711K	Port Industrial Rd	2	23,129	11	3,459	5.2	0.000283	0.004582	0.014450	0.019315	51.8	3.4
096710D	Division St	2	28	12	3,459	5.2				0.019905	50.2	6.7
096709J	Heron St	2	221	12	3,459	5.2				0.039734	25.2	3.4
808707R	Monroe St	2	28	12	3,508	6.2				0.021556	46.4	2.8
096706N	Washington St	2	872	12	3,508	6.2				0.067965	14.7	0.9
092551K	H Street	2	1,148	18	5,326	4.4	0.000283	0.002796	0.008669	0.011748	85.1	5.3
096695D	E Heron St	2	263	19	5,326	4.4	0.000082	0.000847	0.002287	0.003215	311.0	36.9
096693P	Newell St	2	470	20	5,326	4.4	0.000180	0.001489	0.005086	0.006755	148.0	16.5
096691B	S Chehalis St	4	9,642	19	5,326	4.4	0.000352	0.003653	0.009864	0.013870	72.1	7.0
096689A	W Mall Entrance	2	221	19	5,326	4.4				0.037908	26.4	1.9
096690U	E Mall Entrance	2	221	19	5,326	4.4				0.037908	26.4	1.9
096029N	Tyler St	4	7,069	20	5,326	4.4	0.000443	0.004411	0.011744	0.016598	60.2	5.5
096688T	Fleet St	2	3,611	20	5,326	4.4	0.000458	0.004554	0.012127	0.017138	58.3	7.4

Notes:
Industrial Road (922990N), Division Street (110912), Heron Street (096709J), Monroe Street (860101), Washington Street (110912), W Mall Entrance (096689A), and E Mall Entrance (096690U) were calculated using the predicted accident frequency formula. The rest were calculated using the GradeDec.Net model.

Cumulative Impacts

Table 40. Predicted Accident Frequency and Interval, Cumulative Impacts (2017)

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
096687L	Junction City Rd	2	1,249	12	6,174	7.3	0.000506	0.005355	0.016897	0.022758	43.9	19.7
096682C	Central Park Dr	2	291	11	6,174	7.3	0.000142	0.001390	0.003384	0.004916	203.4	78.0
096680N	Aldergrove Dr	2	398	25	6,174	7.3	0.001111	0.005473	0.010976	0.017560	56.9	27.2
096679U	Heikkinen Rd	1	215	25	6,174	7.3	0.000540	0.002657	0.005330	0.008527	117.3	62.1
096678M	Devonshire Rd	2	1,066	25	6,174	7.3	0.001487	0.007324	0.014689	0.023500	42.6	18.9
096677F	County Farm Rd	2	258	25	6,174	7.3	0.000971	0.004784	0.009595	0.015351	65.1	32.0
096672W	Main Street	2	1,583	25	6,174	7.3	0.000578	0.002845	0.005706	0.009128	109.6	38.9
400107G	Sylvia St	2	129	25	6,174	7.3	0.000555	0.003239	0.008504	0.012299	81.3	41.3
096659H	Old Beacon Rd	2	86	25	6,174	7.3	0.000195	0.000959	0.001923	0.003076	325.1	128.4
096658B	Monte Brady Rd	2	797	25	6,174	7.3	0.000452	0.002227	0.004466	0.007145	140.0	51.5
096657U	Glenn Rd	2	22	25	6,174	7.3	0.000430	0.002116	0.004243	0.006789	147.3	79.4
096655F	Fairbairn Rd	2	22	25	6,174	7.3	0.000430	0.002116	0.004243	0.006789	147.3	73.6
096654Y	Winkerman Rd S	2	43	25	6,174	7.3	0.000540	0.002661	0.005336	0.008537	117.1	62.0
096652K	Monte Brady Rd	2	1,055	25	6,174	7.3	0.001462	0.007202	0.014444	0.023108	43.3	19.3
096650W	Foss Av-Monte Elma	2	4,813	25	6,174	7.3	0.000993	0.004889	0.009806	0.015688	63.7	25.7
096649C	Hewitt St	2	345	25	6,174	7.3	0.001064	0.005238	0.010504	0.016806	60	28.7
096648V	Moore Rd	2	506	25	6,174	7.3	0.001195	0.005887	0.011807	0.018889	53	24.9
096646G	Oniel Rd	2	571	25	6,174	7.3	0.001240	0.006104	0.012243	0.019586	51	23.8
096644T	Newman Creek Rd	2	861	25	6,174	7.3	0.001399	0.006888	0.013815	0.022102	45	20.5
096643L	Hurd Rd	2	1,378	25	6,174	7.3	0.001599	0.007872	0.015789	0.025260	40	17.2
096642E	Calder Rd	2	603	25	6,174	7.3	0.001260	0.006204	0.012443	0.019907	50	23.4
096641X	N 17th St	2	118	25	6,174	7.3	0.000756	0.003723	0.007467	0.011947	84	42.7

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
096640R	N 13th St	2	646	25	6,174	7.3	0.001286	0.006332	0.012700	0.020318	49	22.8
096639W	N 11th St	2	1,916	24	6,174	7.3	0.001675	0.008543	0.017273	0.027491	36	15.4
096638P	N 10th St	2	280	23	6,174	7.3	0.000867	0.004766	0.009812	0.015445	65	31.8
096636B	N 6th St	2	140	23	6,174	7.3	0.000695	0.003819	0.007862	0.012376	81	41.0
096635U	N 5th St	2	75	23	6,174	7.3	0.000566	0.002845	0.006667	0.010078	99	51.7
096634M	N 3rd St	2	624	23	6,174	7.3	0.001054	0.006029	0.012536	0.019618	51	23.8
096525J	N 2nd St	2	474	24	6,174	7.3	0.001121	0.005231	0.012051	0.018403	54	25.7
096519F	Tridwell Rd	2	118	25	6,237	7.2	0.000723	0.003687	0.007456	0.011866	84	43.0
096518Y	Blockhouse Rd W	2	226	25	6,237	7.2	0.000932	0.004589	0.009203	0.014723	68	33.6
096515D	Blockhouse Rd E	2	43	25	6,237	7.2	0.000540	0.002661	0.005336	0.008537	117	62.0
096510U	Dunlap Rd	2	194	25	6,237	7.2	0.000888	0.004371	0.008767	0.014026	71	35.5
092603A	Porter Creek Rd	2	803	25	6,237	7.2	0.000628	0.003092	0.006201	0.009921	101	43.4
092595K	Elma Gare Rd W	2	86	25	6,237	7.2	0.000681	0.003356	0.006730	0.010767	93	48.0
092593W	Shelton Rd	2	54	25	6,237	7.2	0.000335	0.001649	0.003308	0.005292	189	103.5
092587T	Scheaffer St	2	43	25	6,237	7.2	0.000309	0.001523	0.003054	0.004885	205	112.6
092586L	Newton St	2	172	25	6,237	7.2	0.000500	0.002253	0.005150	0.007903	127	67.5
092585E	Murray St	2	172	25	6,237	7.2	0.000500	0.002463	0.004940	0.007903	127	67.5
092584X	Merry Rd	2	43	25	6,237	7.2	0.000309	0.001523	0.003054	0.004885	205	112.6
092583R	Blockhouse Rd	2	43	25	6,237	7.2	0.000309	0.001523	0.003054	0.004885	205	112.6
092577M	Moon Rd SW	2	258	25	6,237	7.2	0.000574	0.002352	0.006143	0.009068	110	58.1
092576F	Owings St	2	323	25	6,237	7.2	0.001042	0.004694	0.010731	0.016466	61	29.4
092574S	Little Rock Rd	2	1,004	25	6,237	7.2	0.000761	0.003428	0.007837	0.012026	83	35.0
092573K	183rd Ave SW	2	785	25	6,237	7.2	0.000624	0.003073	0.006164	0.009862	101	43.7
092569V	Joselyn Ave	2	215	25	6,237	7.2	0.000917	0.004517	0.009059	0.014492	69	34.2
092567G	Tea St	2	517	25	6,237	7.2	0.001203	0.005925	0.011883	0.019011	53	24.7
092566A	Grand Mound SW	2	345	25	6,237	7.2	0.001064	0.005238	0.010504	0.016806	60	28.7

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
092565T	Old Hwy 99 SW	2	10,250	21	6,237	7.2	0.001024	0.005223	0.010560	0.016807	59	18.1
092563E	216th Ave SW	2	86	13	6,237	7.2	0.000337	0.002874	0.006699	0.009909	101	52.6
092561R	222nd Ave SW	2	172	10	6,237	7.2	0.000322	0.003395	0.008484	0.012201	82	31.6
922981P	Hoss Rd	2	1,152	10	6,237	7.2				0.024191	41	13.1
922982W	Robert Thompson Rd	2	571	10	6,237	7.2				0.019435	51	62.1
922980H	Kuper Rd	2	474	10	6,237	7.2	0.000156	0.001642	0.004104	0.005902	169	63.8
092559P	Fordon Rd	2	183	10	6,237	7.2	0.000077	0.000936	0.003107	0.004120	243	94.3
092554F	W Reynolds Ave	2	6,449	10	6,237	7.2	0.000648	0.007192	0.027002	0.034842	29	10.9
092552S	J St	2	345	8	6,237	7.2	0.000225	0.002965	0.011859	0.015049	66	49.5
092551K	H St	2	894	7	6,237	7.2	0.000262	0.003830	0.015929	0.020021	50	23.2
092550D	G St	2	345	7	6,237	7.2	0.000196	0.003150	0.011604	0.014950	67	33.0
092549J	F St	2	237	7	6,237	7.2	0.000174	0.002538	0.010553	0.013264	75	37.9
092548C	E St	2	345	7	6,237	7.2	0.000196	0.003150	0.011604	0.014950	67	33.0
092547V	D St	2	13,878	7	6,237	7.2	0.000298	0.004353	0.018101	0.022752	44	16.2
092546N	Tower St	2	8,097	7	6,237	7.2	0.000233	0.003752	0.013820	0.017805	56	22.0
092543T	B St	2	700	7	6,237	7.2	0.000244	0.003559	0.014802	0.018605	54	25.4
092521T	Maple St M1	2	3,628	40	6237	47.4	0.002641	0.007719	0.022179	0.032540	31	1.6
092520L	E Main St M1	2	2,756	40	6237	47.4	0.002501	0.007310	0.021004	0.030816	32	1.7
092519S	E Locust St M1	2	2,885	40	6237	47.4	0.002524	0.007377	0.021197	0.031099	32	1.7

Notes:
Hoss Road (922981P) and Robert Thompson Road (922982W) were calculated using the predicted accident frequency formula. The rest were calculated using the GradeDec.Net model.
D Street (092547V) and Tower Street (092546N) are proposed to receive a crossing protection upgrade to gates by 2017 (Washington State Department of Transportation 2014).

Table 41. Predicted Accident Frequency and Interval, Cumulative Impacts (2017)–Switching Movements

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
922990N	Industrial Rd	2	5,803	5	5,406	6.1				0.037876	26.4	7.2
808711F	Myrtle St	2	75	2	718	1.4	0.000004	0.000209	0.001135	0.001348	741.8	0.0
808712M	N Maple St	2	808	7	5,406	6.1	0.000088	0.002278	0.008651	0.011017	90.8	23.7
808713U	W 1st St	2	4,296	6	4,309	7.3	0.000093	0.002454	0.009315	0.011862	84.3	28.4
096711K	Port Industrial Rd	2	18,002	7	4,907	8.1	0.000212	0.004549	0.015773	0.020534	48.7	10.7
096710D	Division St	2	22	7	4,907	8.1				0.021704	46.1	18.2
096709J	Heron St	2	172	6	4,907	8.1				0.043341	23.1	9.1
808707R	Monroe St	2	22	6	4,777	9.2				0.022995	43.5	14.0
096706N	Washington St	2	678	5	4,777	9.2				0.072522	13.8	4.5
092551K	H Street	2	894	5	6,167	7.4	0.000078	0.002138	0.009682	0.011899	84.0	27.3
096695D	E Heron St	2	205	5	6,167	7.4	0.000024	0.000717	0.002885	0.003627	275.7	108.0
096693P	Newell St	2	366	6	6,167	7.4	0.000059	0.001289	0.006210	0.007559	132.3	48.3
096691B	S Chehalis St	4	7,504	6	6,167	7.4	0.000120	0.003162	0.012002	0.015284	65.4	20.5
096689A	W Mall Entrance	2	172	6	6,167	7.4				0.041241	24.2	11.5
096690U	E Mall Entrance	2	172	6	6,167	7.4				0.041241	24.2	11.5
096029N	Tyler St	4	5,502	6	6,167	7.4	0.000166	0.003903	0.014116	0.018186	55.0	16.2
096688T	Fleet St	2	2,810	7	6,167	7.4	0.000159	0.003722	0.013460	0.017341	57.7	17.6

Notes:
Industrial Road (922990N), Division Street (110912), Heron Street (096709J), Monroe Street (860101), Washington Street (110912), W Mall Entrance (096689A), and E Mall Entrance (096690U) were calculated using the predicted accident frequency formula. The rest were calculated using the GradeDec.Net model.

Table 42. Predicted Accident Frequency and Interval, Cumulative Impacts (2037)

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
096687L	Junction City Rd	2	1,605	12	6,174	7.3	0.000543	0.005751	0.018145	0.024439	41	18
096682C	Central Park Dr	2	374	11	6,174	7.3	0.000156	0.001527	0.003719	0.005403	185	70
096680N	Aldergrove Dr	2	512	25	6,174	7.3	0.001200	0.005908	0.011849	0.018956	53	25
096679U	Heikkinen Rd	1	277	25	6,174	7.3	0.000588	0.002895	0.005806	0.009288	108	57
096678M	Devonshire Rd	2	1,370	25	6,174	7.3	0.000722	0.003556	0.007132	0.011410	88	37
096677F	County Farm Rd	2	332	25	6,174	7.3	0.001051	0.005176	0.010380	0.016607	60	29
096672W	Main Street	2	2,034	25	6,174	7.3	0.000630	0.003104	0.006225	0.009959	100	35
400107G	Sylvia St	2	166	25	6,174	7.3	0.000602	0.003514	0.009227	0.013343	75	38
096659H	Old Beacon Rd	2	111	25	6,174	7.3	0.000215	0.001059	0.002123	0.003397	294	116
096658B	Monte Brady Rd	2	1,024	25	6,174	7.3	0.000499	0.002458	0.004929	0.007886	127	46
096657U	Glenn Rd	2	28	25	6,174	7.3	0.000000	0.000000	0.000000	0.000000	0	0
096655F	Fairbairn Rd	2	28	25	6,174	7.3	0.000490	0.002414	0.004842	0.007746	129	71
096654Y	Winkerman Rd S	2	55	25	6,174	7.3	0.000587	0.002891	0.005798	0.009276	108	57
096652K	Monte Brady Rd	2	1,356	25	6,174	7.3	0.001591	0.007837	0.015718	0.025147	40	17
096650W	Foss Av-Monte Elma	2	6,184	25	6,174	7.3	0.001056	0.005199	0.010427	0.016681	60	24
096649C	Hewitt St	2	443	25	6,174	7.3	0.001148	0.005655	0.011341	0.018144	55	26
096648V	Moore Rd	2	650	25	6,174	7.3	0.001288	0.006344	0.012723	0.020356	49	23
096646G	Oniel Rd	2	733	25	6,174	7.3	0.001335	0.006573	0.013182	0.021089	47	22
096644T	Newman Creek Rd	2	1,107	25	6,174	7.3	0.000683	0.003364	0.006747	0.010794	93	40
096643L	Hurd Rd	2	1,771	25	6,174	7.3	0.001713	0.008434	0.016916	0.027063	37	16
096642E	Calder Rd	2	775	25	6,174	7.3	0.000622	0.003063	0.006143	0.009828	102	44
096641X	N 17th St	2	152	25	6,174	7.3	0.000821	0.004042	0.008107	0.012970	77	39
096640R	N 13th St	2	830	25	6,174	7.3	0.001384	0.006815	0.013669	0.021868	46	21

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
096639W	N 11th St	2	2,462	24	6,174	7.3	0.001790	0.009133	0.018467	0.029391	34	14
096638P	N 10th St	2	360	22	6,174	7.3	0.000938	0.005154	0.010611	0.016703	60	29
096636B	N 6th St	2	180	22	6,174	7.3	0.000753	0.004142	0.008527	0.013423	74	37
096635U	N 5th St	2	97	22	6,174	7.3	0.000616	0.003098	0.007261	0.010975	91	47
096634M	N 3rd St	2	802	21	6,174	7.3	0.001135	0.006494	0.013502	0.021131	47	22
096525J	N 2d St	2	609	24	6,174	7.3	0.001209	0.005640	0.012994	0.019843	50	23
096519F	Tridwell Rd	2	152	24	6,237	7.2	0.000785	0.004004	0.008095	0.012883	78	39
096518Y	Blockhouse Rd W	2	291	25	6,237	7.2	0.001009	0.004968	0.009964	0.015941	63	31
096515D	Blockhouse Rd E	2	55	25	6,237	7.2	0.000587	0.002891	0.005798	0.009276	108	57
096510U	Dunlap Rd	2	249	25	6,237	7.2	0.000961	0.004731	0.009489	0.015181	66	32
092603A	Porter Creek Rd	2	1,039	25	6,237	7.2	0.000672	0.003309	0.006636	0.010616	94	40
092595K	Elma Gare Rd W	2	111	25	6,237	7.2	0.000741	0.003650	0.007320	0.011710	85	44
092593W	Shelton Rd	2	69	25	6,237	7.2	0.000365	0.001797	0.003604	0.005766	173	95
092587T	Scheaffer St	2	55	25	6,237	7.2	0.000337	0.001660	0.003329	0.005326	188	103
092586L	Newton St	2	221	25	6,237	7.2	0.000545	0.002453	0.005609	0.008606	116	61
092585E	Murray St	2	221	25	6,237	7.2	0.000545	0.002682	0.005380	0.008606	116	61
092584X	Merry Rd	2	55	25	6,237	7.2	0.000337	0.001660	0.003329	0.005326	188	103
092583R	Blockhouse Rd	2	55	25	6,237	7.2	0.000337	0.001660	0.003329	0.005326	188	103
092577M	Moon Rd SW	2	332	25	6,237	7.2	0.000625	0.002560	0.006685	0.009869	101	53
092576F	Owings St	2	415	25	6,237	7.2	0.001126	0.005070	0.011591	0.017786	56	27
092574S	Little Rock Rd	2	1,299	25	6,237	7.2	0.000813	0.003662	0.008372	0.012847	78	32
092573K	183rd Ave SW	2	1,015	25	6,237	7.2	0.000668	0.003288	0.006595	0.010552	95	41
092569V	Joselyn Ave	2	277	25	6,237	7.2	0.000993	0.004892	0.009811	0.015697	64	31
092567G	Tea St	2	664	25	6,237	7.2	0.001296	0.006384	0.012804	0.020484	49	23
092566A	Grand Mound SW	2	443	25	6,237	7.2	0.001148	0.005655	0.011341	0.018144	55	26

Crossing ID	Street	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
092565T	Old Hwy 99 SW	2	13,169	24	6,237	7.2	0.001102	0.005624	0.011371	0.018098	55	16
092563E	216th Ave SW	2	111	13	6,237	7.2	0.000367	0.003128	0.007291	0.010786	93	48
092561R	222nd Ave SW	2	221	10	6,237	7.2	0.000349	0.003682	0.009201	0.013232	76	38
922981P	Hoss Rd	2	1,480	10	6,237	7.2				0.026155	38	12
922982W	Robert Thompson Rd	2	733	10	6,237	7.2				0.021014	48	15
922980H	Kuper Rd	2	609	10	6,237	7.2	0.000171	0.001802	0.004503	0.006475	154	58
092559P	Fordon Rd	2	235	10	6,237	7.2	0.000084	0.001030	0.003419	0.004533	221	85
092554F	W Reynolds Ave	2	8,286	10	6,237	7.2	0.000688	0.007637	0.028671	0.036996	27	10
092552S	J St	2	443	8	6,237	7.2	0.000243	0.003206	0.012825	0.016274	61	30
092551K	H St	2	1,148	7	6,237	7.2	0.000282	0.004123	0.017146	0.021551	46	21
092550D	G St	2	443	7	6,237	7.2	0.000212	0.003407	0.012550	0.016169	62	30
092549J	F St	2	304	7	6,237	7.2	0.000188	0.002748	0.011427	0.014363	70	35
092548C	E St	2	443	7	6,237	7.2	0.000212	0.003407	0.012550	0.016169	62	30
092547V	D St	2	17,831	7	6,237	7.2	0.000315	0.004603	0.019142	0.024061	42	15
092546N	Tower St	2	10,403	7	6,237	7.2	0.000248	0.003983	0.014672	0.018902	53	25
092543T	B St	2	899	7	6,237	7.2	0.000263	0.003837	0.015955	0.020054	50	23
092521T	Maple St M1	2	4,662	40	6,237	47.4	0.002772	0.008102	0.023279	0.034153	29	1
092520L	E Main St M1	2	3,541	40	6,237	47.4	0.002629	0.007683	0.022074	0.032386	31	2
092519S	E Locust St M1	2	3,707	40	6,237	47.4	0.002653	0.007752	0.022273	0.032677	31	2

Notes:
Hoss Road (922981P) and Robert Thompson Road (922982W) were calculated using the predicted accident frequency formula. The rest were calculated using the GradeDec.Net model.
D Street (092547V) and Tower Street (092546N) are proposed to receive a crossing protection upgrade to gates by 2017. Devonshire Road (096678M), Newman Creek Road (096644T), Calder Road (096642E) are proposed to receive a crossing protection upgrade to gates and signs by 2037 and the Glenn Road crossing (096657U) is proposed to close by 2037 (Washington State Department of Transportation 2014).

Table 43. Predicted Accident Frequency and Interval, Cumulative Impacts (2037)–Switching Movements

Crossing ID	Street	Milepost	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains per Day	Fatality Rate	Injury Rate	PDO Rate	Total Rate	Predicted Intervals Between Accidents (years)	Decrease between Predicted Intervals from No-Action Alternative
922990N	Industrial Rd	71.04	2	7,456	7	5,406	6.1				0.040953	24.4	6.6
808711F	Myrtle St	70.85	2	97	4	718	1.4	0.000013	0.000308	0.001173	0.001494	669.3	0.0
808712M	N Maple St	70.55	2	1,038	6	5,406	6.1	0.000095	0.002474	0.009393	0.011961	83.6	21.6
808713U	W 1St St	70.41	2	5,520	7	4,309	7.3	0.000127	0.002979	0.010772	0.013878	72.1	23.3
096711K	Port Industrial Rd	70.06	2	23,129	10	4,907	8.1	0.000283	0.005117	0.016572	0.021972	45.5	9.7
096710D	Division St	69.82	2	28	10	4,907	8.1				0.024492	40.8	16.1
096709J	Heron St	69.81	2	221	10	4,907	8.1				0.048928	20.4	8.1
808707R	Monroe St	69.63	2	28	10	4,777	9.2				0.025951	38.5	10.6
096706N	Washington St	69.49	2	872	10	4,777	9.2				0.081873	12.2	3.4
092551K	H Street	68.8	2	1,148	13	6,167	7.4	0.000229	0.003054	0.010333	0.013616	73.4	17.0
096695D	E Heron St	68.5	2	263	15	6,167	7.4	0.000077	0.001010	0.002904	0.003992	250.5	97.4
096693P	Newell St	68.44	2	470	15	6,167	7.4	0.000160	0.001735	0.006372	0.008267	121.0	43.6
096691B	S Chehalis St	68.36	4	9,642	15	6,167	7.4	0.000320	0.004176	0.012005	0.016501	60.6	18.5
096689A	W Mall Entrance	68.34	2	221	15	6,167	7.4				0.048281	20.7	7.5
096690U	E Mall Entrance	68.31	2	221	15	6,167	7.4				0.048281	20.7	7.5
096029N	Tyler St	68.23	4	7,069	16	6,167	7.4	0.000403	0.005006	0.014128	0.019537	51.2	14.6
096688T	Fleet St	68.16	2	3,611	16	6,167	7.4	0.000409	0.005073	0.014317	0.019799	50.5	15.3

Notes:
Industrial Road (922990N), Division Street (110912), Heron Street (096709J), Monroe Street (860101), Washington Street (110912), W Mall Entrance (096689A), and E Mall Entrance (096690U) were calculated using the predicted accident frequency formula. The rest were calculated using the GradeDec.Net model.

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Appendix M

Risk Assessment Technical Report

WESTWAY AND IMPERIUM EXPANSION PROJECTS RISK ASSESSMENT TECHNICAL REPORT

PREPARED FOR:

City of Hoquiam, Washington
609 8th Street
Hoquiam, WA 98550
Contact: Brian Shay
(360) 538-3983

Washington State Department of Ecology
300 Desmond Drive SE
Lacey, WA 98503
Contact: Sally Toteff
(360) 407-0271

PREPARED BY:

ICF International
317 SW Alder Street, Suite 200
Portland, Oregon 97205
Contact: Kim Marcotte
(503) 525-6196

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Acronyms and Abbreviations

AAR	American Association of Railroads
BNSF	BNSF Railway Company
Ecology	Washington State Department of Ecology
Imperium	Imperium Terminal Services
FRA	Federal Railroad Administration
mph	miles per hour
PS&P	Puget Sound & Pacific Railroad
RPI	Railway Progress Institute
USDOT	U.S. Department of Transportation
Westway	Westway Terminal Company LLC

Chapter 1
Introduction

Risk management involves the systematic identification, evaluation, and control of potential losses that may arise from uncertain future events—such as spills, fires, explosions, or natural disasters. This includes recognition of possible hazards, evaluation of the frequency of adverse events and the magnitude of their potential impacts, and a determination of appropriate measures for prevention or reduction of these risks considering cost/benefit tradeoffs.

This report addresses the first part of the risk management process. It provides information and evaluates the potential for the Westway Terminal Company LLC (Westway) and Imperium Terminal Services (Imperium) Expansion Projects (proposed actions) to result in increased risks of releasing crude oil (or the other proposed bulk liquids) into the environment. More information about the proposed actions can be found in Chapter 2, *Proposed Action and Alternatives*, of each Draft Environmental Impact Statement. Chapter 2, *Methods*, describes the general approach and assumptions used for completing the risk assessment. Chapter 3, *Terminal (Onsite) Evaluation*, Chapter 4, *Rail Transport Evaluation*, and Chapter 5, *Vessel Transport Evaluation*, presents the methods for and estimates of increased risks of releasing crude oil or other bulk liquids into the environment related to the proposed actions for onsite activities, rail transport, and vessel transport, respectively. The primary mechanisms by which increased risks could occur include onsite handling and storage (e.g., rail unloading, storage tank use, and vessel loading at each facility). Operation of the proposed actions would also result in increased rail and vessel traffic related to the transport of crude oil or the other proposed bulk liquids to and from the site. Chapter 6, *Risk of Fire or Explosion*, addresses the likelihood of fire or explosion resulting from a spill related to the risk scenarios addressed in Chapters 3, 4, and 5. Chapter 7, *Existing Risks (No-Action Alternative)*, characterizes the current baseline for risks in the study area associated with current operations.

Chapter 2
Methods

2.1 General Approach

Risk assessment is the part of risk management that identifies hazards or undesirable events and determines both the likelihood of occurrence (the frequency) and the potential impacts of these undesirable events, including spills of materials such as crude oil or other bulk liquids as may occur related to the proposed actions. Risk assessment results allow decision makers to consider both the potential severity of such an event and its likelihood of occurrence, not just the upper bound of potential impacts. A semiquantitative risk assessment was conducted for the proposed actions to develop representative frequencies and potential impacts associated with a set of potential release scenarios in the study area.

In general, this risk assessment considers the implementation of the proposed actions over a 20-year analysis period from 2017 (anticipated start of operations) to 2037. This analysis assumes that the proposed actions would be built and would achieve 100% throughput (i.e., would handle and store the maximum permitted volume of bulk liquids) beginning in 2017. In reality, a slower ramp-up to 100% throughput is more likely.

Because the baseline risks do not currently include the handling, storage, or transport of large amounts of crude oil, the risk assessment evaluates the additional risks that would result from implementation of the proposed actions beyond existing risks. In general, baseline risks represent the no-action alternative; however, where the factor of time influences the outcome of the analysis (i.e., the existing condition would change over the 20-year analysis period), a distinction is made.

Additionally, Imperium is proposing to handle and store additional bulk liquids. Because it is assumed crude oil would be handled, stored, and transported in the largest volumes, this risk assessment focuses primarily on crude oil; however, differences in the consequences are noted as appropriate.

The risk assessment considers the following parameters in the analysis of the proposed actions.

- Terminal (onsite) operational activities (e.g., rail unloading, bulk liquids storage, and vessel loading) under the proposed actions and the baseline activities that would continue that could result in the risk of crude oil or other hazardous materials releases.
- The identified routes and transportation movements of concern within the study area (e.g., the Puget Sound & Pacific Railroad [PS&P] rail line and Grays Harbor Navigation Channel) related to offsite rail and vessel transport.
- The appropriate accident or failure rates for onsite handling and storage and offsite rail and vessel transport (based on historical accident data and previous analyses).
- The potential for ignition (related to the operational activity and chemical properties of the spilled material).

Using information for the parameters discussed above, the risk assessment determines the frequency of various release sizes given the occurrence of an accident for each operational activity (e.g., onsite handling and storage and offsite rail or vessel transport).

The risk assessment considers the combination of all of these data to develop approximate estimates of different release scenarios compared to baseline risk levels (the no-action alternative). The resulting estimates are most meaningful when compared to each other, as opposed to considering them as predicting absolute frequencies or potential impacts.

2.2 Development of Risk Scenarios

Because of the numerous factors that can affect the environmental outcomes (e.g., extent of a spill, potential for ignition, persistence of released materials in the environment over time), the risk assessment focuses on a specific set of scenarios to frame the discussion of the relative changes in frequencies of occurrence and the potential outcome of each event. The release volumes are based on a combination of regulatory-based response planning cases and the maximum volumes that either are currently or would be handled or stored by Westway or Imperium or transported by rail and vessel operators related to the proposed actions. The scenarios are further informed by the past occurrence of accidents in the study area and across the United States and represent a mix of events that are statistically more probable with those that are theoretically possible but extremely unlikely to occur in the study area. The approach, particularly the data, used to determine the frequencies of various scenarios for the proposed actions and current operations varied by the nature of the activity evaluated. These are first summarized below and then explained in detail in Chapters 3, 4, and 5, as appropriate.

- Terminal (onsite). Operational information, including the number of rail car unloadings, vessel loadings, and storage tanks in use, was combined with historical information on failure rates to predict order-of-magnitude frequencies for a limited number of scenarios, particularly those with the potential to release material off site.
- Rail. Information on the number of rail transits was combined with Federal Railroad Administration (FRA) data on accidents on the PS&P rail line and across the country, coupled with numerous peer-reviewed analyses of the number of rail cars derailing and failing in accidents. Notably, only half of these events would involve loaded rail cars.
- Vessel. Information on the number of vessel transits was combined with available data and analyses on accident rates for vessels maneuvering and in transit. Half of these accidents would involve loaded vessels and half unloaded vessels

In all cases, the purpose of the risk assessment is to demonstrate the relative likelihoods of different releases and to estimate possible impacts, not to make precise estimates of the chance of various impacts occurring in specific locations.

Chapter 3
Terminal (Onsite) Evaluation

3.1 Basis of Analysis

Westway currently has four storage tanks on the northern portion of the project site. Each tank has the capacity to hold approximately 33.6 million gallons (80,000 barrels). Under the proposed action, up to five 8.4-million-gallon (200,000-barrel) tanks would be added to store crude oil. Imperium currently has eight primary tanks, each with a capacity of up to almost 2.0 million gallons (48,000 barrels). Six smaller tanks are used for storing materials such as methanol, sulfuric acid, and sodium methylate. Under the proposed action, up to nine 3.6-million-gallon (80,000-barrel) tanks would be added to store crude oil but could also eventually be used to store other bulk liquids.

While the proposed tanks would be located in containment areas to collect any releases—up to the loss of a full tank plus an additional volume related to storm overflow—that containment could fail, particularly in a catastrophic event that would also affect the containment structure or as a result of a massive tank failure. Smaller failures and piping leaks would remain in the containment and would be collected for disposal.

Onsite operations under the proposed actions would consist of unloading rail cars and loading vessels with crude oil or the other proposed bulk liquids. The vessel loading activities (up to approximately 119 loadings for Westway and 173 to 200 for Imperium, annually) could cause releases directly to the water depending on the extent of the release. Most loading activities involving releases would be shut down very quickly, but there is a chance that the resulting spill would not be fully contained. The rail unloading activities (27,594 cars for Westway and 43,800 cars for Imperium, annually on average) would involve the greatest number of active transfers of oil or other materials given the number of rail cars that must be unloaded on a daily basis. Thus, there is a greater potential for releases because of unloading hose or connection failures during rail unloading compared to the vessel loading, because it takes many more rail cars to fill just one tanker or tank barge.

3.2 Approach and Data

No spillage of oil or hazardous materials into the water has been reported from facility operations since Westway and Imperium began activities in Grays Harbor. One explosion at Imperium was reported on December 2, 2009, when a 10,000-gallon tank containing heated glycerin exploded because of over pressurization (U.S. Environmental Protection Agency 2009; Butorac pers.comm.). The tank was roughly half-full of neutralized glycerin and spread black glycerin compound and metal tank shards over the ground, in and around parts of the tank farm. An adjoining 5,000-gallon tank containing sulfuric acid was also damaged by the explosion, and sulfuric acid spilled into a secondary containment and perimeter walkway around the tank, releasing vapor as it reacted with rainwater and debris within the containment area. No one was injured and no sulfuric acid or

glycerin reached the water because of the accident. Air monitoring results were all negative for any sulfuric acid in the air directly over the spill area and in the adjoining neighborhood and businesses.

Predicted release rates for the identified scenarios were based on a number of past studies that analyzed historical data along with guidance published by the United Kingdom's Health and Safety Executive for use in risk assessments (2012; Atherton and Ash 2014). This source is based on a definitive compilation and analysis of numerous databases and past studies. To determine accident frequencies for rail unloading, a combination of historical data and previous analyses, as captured by the Health and Safety Executive, were used to determine the likelihood of a larger release. The failure data for the larger release during vessel loading (10,000 gallons) were based on Health and Safety Executive data as well; smaller loading releases (e.g., 2,100 gallons) were based on the *Vessel Traffic and Risk Assessment Study* for the Gateway Pacific Terminal (Glosten Associates 2014).

The failure rate data applied for each scenario are given in Table 1. These rates are not multiplied by the number of tanks or the number of loadings or unloadings that are anticipated to occur each year related to the proposed actions—that occurs in the next step of the assessment. They are based on historical data and not detailed evaluations of each tank's specific design and safety features.

Table 1. Failure Rate Assumptions for Terminal (Onsite) Operations

Failure Event and Associated Releases	Rate of Occurrence	Notes
Rail unloading release (2,100 gallons [50 barrels])	0.000004 per unloading	Assumes one connection; based on road tanker hoses at average facilities[a] and comparison with other detailed risk assessments
Vessel loading release (2,100 gallons [50 barrels])	0.001 per loading	Per Gateway study (Glosten Associates 2014)
Major vessel loading release (10,000 gallons [238 barrels])	0.000062 per loading	Assumes three loading arms[a]
Pipeline or storage tank release (50,400 gallons [1,200 barrels])	0.0001 per year per tank	Based on large tanks[a]
Catastrophic storage tank failure (3.4 million gallons [80,000 barrels] for Westway) and (2 million gallons [48,000 barrels] for Imperium)	0.000005 per year per tank	Based on large tanks[a]

[a] Health and Safety Executive 2012

The number of storage tanks associated with each proposed action was then multiplied by the failure rate to obtain an estimate of the frequency of a catastrophic failure on site. Because the hazards of seismic and tsunami-related events have been taken into account in the design of the tanks, both existing and proposed, the historical failure rates were not adjusted for these specific hazards. Similarly, the number of tanks was multiplied by the rate for smaller failures to determine the overall estimate of a release each year, and the number of unloadings and loadings were multiplied by the appropriate failure rates to determine the chance of a release from those scenarios.

3.3 Results

Table 2 summarizes the predicted number of releases per year generated for each scenario for the additional number of tanks and loading/unloading activities associated with the proposed actions. Risks attributable to existing operations are not included in these estimates; they may be found in Chapter 7, *Existing Risks.* In other words, these risks are only associated with the proposed actions and are in additional to baseline risks associated with operations at the existing facilities.

Table 2. Predicted Increases in Releases for Proposed Actions—Terminal (Onsite) Operations

Failure Event	Potential Associated Release	Predicted Increases in Frequency of Release (events/year)		
		Westway	Imperium	Cumulative[a]
Rail unloading release due to equipment failure or human error	2,100 gallons (50 barrels)	0.11	0.18	0.38
Vessel loading release due to adverse weather, human error, or equipment failure that affects pipelines or loading arm connections	2,100 gallons (50 barrels)	0.12	0.2	0.38
Major vessel loading release from loading arm failure(s)	10,000 gallons (238 barrels)	0.0074	0.012	0.023
Pipeline or storage tank release due to seismic event with moderate damage or equipment failures and human errors	50,400 gallons (1,200 barrels)	0.0005	0.0009	0.0022
Catastrophic failure of storage tank due to seismic event, tsunami, or construction or material failure	8,400,000 gallons (200,000 barrels) for Westway 3,360,000 gallons (80,000 barrels) for Imperium	0.000025	0.000045	0.00011

[a] Cumulative projects include the proposed Westway, Imperium, and Grays Harbor Rail Terminal projects.

As shown in Table 2, the potential for a catastrophic event substantial enough to result in the release equivalent to the volume of an entire new tank would only very slightly increase by 0.000025 events per year for Westway and 0.000045 events per year for Imperium. The potential for any event that might lead to smaller volume releases (e.g., 50,400 gallons [1,200 barrels]) would also only increase very slightly by 0.0005 (Westway) or 0.0009 (Imperium) events per year. As noted above, the increase in frequency is primarily due to the increased number of tanks on the project site. These estimates assume the tanks are always full. In actual operations, the tanks would slowly be filled from the rail cars and then would be used to fill vessels for delivery off site. Thus, the actual amount of time a tank is completely full would be less than 100% of the time.

As presented in Table 2, implementation of the proposed actions would mean that an event resulting in a 2,100-gallon (50-barrel) release during rail transfers could occur 0.11 (Westway) or 0.18 (Imperium) times per year. Events resulting in a similarly sized release during vessel transfers could occur 0.12 (Westway) and 0.17 (Imperium) times per year. Events resulting in major vessel transfer

release (10,000 gallons [238 barrels]) could occur 0.0074 (Westway) and 0.012 (Imperium) times per year.

An alternate way of expressing this is given below. As mentioned previously, the likelihood these events could occur is additional to baseline risks associated with current operations.

- A rail transfer release would be expected to occur once in 9 (Westway) or 6 (Imperium) years but would be expected to remain on site.
- A vessel transfer release[1] cwould be expected to occur once in 8 (Westway) or 5 (Imperium) years. A major vessel transfer release would be expected to occur once in 136 (Westway) or 83 (Imperium) years.
- A 50,400-gallon (1,200-barrel) pipeline or storage tank release into the containment areas (not including very minor leaks) would be expected to occur once in 2,000 (Westway) or 1,100 (Imperium) years.
- Catastrophic failure of a storage tank is quite unlikely, with a release predicted once in 40,000 or 22,000 years, for Westway and Imperium, respectively.

These estimates are based on generic historical data, not detailed examinations of the specific equipment and protective features on site, and are likely to overestimate the chance of release for the equipment mentioned. As noted earlier, they are not inclusive of all the equipment on site, just the largest storage and active transfer (loading and unloading) points.

Cumulative risks from the Imperium, Westway, and Grays Harbor Rail Terminal proposals (referred to as the *cumulative projects*) are listed in the third column of Table 2. These risk reflect implementation of all three projects.

- A rail transfer release would be more likely than a vessel transfer release, once every 3 years but would be expected to remain on site.
- A smaller vessel transfer release could be expected every 3 years, and a major release every 43 years. As noted earlier, most small spills are actually 200 gallons or fewer.
- A 50,400-gallon (1,200-barrel) pipeline or storage tank release would be expected to occur once in 460 years.
- Catastrophic failure of the storage tanks is quite unlikely, with a release predicted every 9,000 years for all three projects combined.

[1] While this smaller release could be up to 2,100 gallons, recent data show that most such spills are actually 200 gallons or fewer.

Chapter 4
Rail Transport Evaluation

4.1 Basis of Analysis

As noted previously, operation of the proposed actions would result in increased rail traffic to and from the project sites. An increase in rail traffic (1.25 trips per day for Westway and 2.0 for Imperium on average) would occur related to the proposed actions and could increase the potential for accidental releases during transit along the PS&P rail line in the study area. Accidents could also occur during switching; however, the speeds are typically so low that the chance of a puncture and release are much lower than during transport. If a release were to occur during switching, it would most likely be a relatively slow release from one rail car. Therefore, release scenarios during switching activities are not considered further in this analysis, except as otherwise built into the accident rates.

The PS&P rail line in the study area covers 59 miles of Track Class 2 lines. All traffic in the study area moves at 25 miles per hour (mph) or less, as per Track Class 2 standards. Several key bridges and areas have lower speed limits: 10 mph over Devonshire Bridge (Wynoochee River) because of bridge condition and 5 mph over the moveable bridges over the Wishkah and Hoquiam Rivers. For conservatism and to match the official designation, this analysis is based on PS&P historical data as well as data for other Class 2 track operations nationwide.

To analyze the potential increase in accidents related to the proposed actions, Table 3 provides the predicted increases in unit trains for Westway and Imperium related to the proposed actions. Table 3 also lists the baseline train traffic levels (i.e., no-action alternative), which include a combination of freight and unit trains. Table 3 also considers the cumulative projects.

Table 3. Existing and Anticipated Rail Traffic Volumes in the Study Area—Cumulative Projects

Facility	Current Number of Trains/Day[a]	Current Number of Cars/Train, (Not Including Locomotives)	Proposed Oil Trains/Day 50% Are Loaded	Proposed Number of Oil Cars/Train (On Average, Not Including Locomotives)
Baseline	3.0–3.1	69.4–69.47[b]	--	--
Westway	Part of existing traffic	Part of existing traffic (approximately 10 cars/day)	1.25	120
Imperium	Part of existing traffic	Part of existing traffic (approximately 12 cars/day)	2.0	120
Westway, Imperium, and Grays Harbor Rail Terminal (cumulative projects)	--	--	4.2	120

[a] There is a minor reduction in the number of trains in the baseline contributions close to the project sites because a few of the baseline trains go to other facilities and do not travel the last few segments to the project sites. This is the reason for the range presented.

Crude oil has typically been transported in DOT-111 rail cars, which are nonpressure tank cars designed to carry a wide range of products, including both hazardous and nonhazardous materials. A somewhat enhanced car, the CPC-1232, is also in service today.

The U.S. Department of Transportation (USDOT) issued a final rule for new tank car design (DOT-117) standards in May 2015, which addressed thickening the walls of the tank car and adding jackets to minimize the chance of side penetrations, the provision of 0.5-inch-thick, full-height head shields to minimize the chance of end penetrations, thermal protection, better relief valves, and better bottom outlet valves. A replacement or retrofit schedule was also provided for the DOT-111 and CPC-1232 cars currently in service. This schedule has been considered when looking at the mix of cars likely to be used for the proposed actions in 2017 versus 2037.

The risk assessment assumed a mix of 50% current jacketed CPC-1232 rail cars (no upgraded CPC-1232s yet, but also no DOT-111s) and 50% new DOT-117s for 2017 conditions, and all DOT-117s under 2037 conditions.

4.2 Approach and Data

Estimating the chance of a release from a rail accident is a two-part process. The first part is to estimate the chance that a train will be involved in an accident, particularly derailments and collisions. The second (nonsequential) part is to estimate the chance of a release given the occurrence of the accident, including both the probability that one or more tank cars will be damaged or derailed and that those cars will release some or all of their cargo. The number of cars derailing and releasing product determines the ultimate spill size.

4.2.1 Spill Sizes and Release Probabilities

In the past, rail accidents involving crude oil or other harmful materials typically resulted in small releases. For example the average petroleum release size of 738 gallons (17.6 barrels), from 2001 to 2012, is based on nationwide spills as reported by in the *Rail Transportation Impact Analysis for Imperium* (WorleyParsons 2014:146) using Association of American Railroads data. However, recent accidents in Lac-Mégantic, Québec; Casselton, North Dakota; Aliceville, Alabama; and Lynchburg, Virginia (Table 4) have been more significant and generated additional attention on crude by rail transportation. A number of additional accidents from late 2014-2015 that resulted in fires or explosions are described in each EIS.

Table 4. Recent and Significant Crude Oil Rail Accidents

Event/Source	Description
Lac-Mégantic, Québec (http://www.tsb.gc.ca/eng/rapports-reports/rail/2013/r13d0054/r13d0054-r-es.pdf)	July 6, 2013: After hand and air brakes on a parked train failed, train rolled downhill reaching a speed of 65 mph before derailing. Almost all of the 63 derailed tank cars were damaged in some way; many had large failures. Roughly 1.6 million gallons (38,000 barrels) of oil were released. Fires and explosions caused 47 fatalities and massive property damage. All cars were DOT-111s.
Casselton, North Dakota (http://www.ntsb.gov/investigations/AccidentReports/Reports/Casselton_ND_Preliminary.pdf)	December 30, 2013: Crude oil train collided with a previously derailed grain car on an adjacent mainline track at roughly 42 mph. Twenty tank cars derailed and 18 were punctured, releasing more than 420,000 gallons (10,000 barrels) of crude oil. No injuries were reported.
Aliceville, Alabama (http://www.ntsb.gov/news/events/Documents/Panel%204_B_Magdy%20El-Sibaie.pdf and http://www.ntsb.gov/safety/safety-recs/RecLetters/R-14-001-003.pdf)	November 7, 2013: Derailment at 38 mph, with 26 cars derailed, Loss of 630,000 gallons (15,000 barrels) with some wetlands contamination.
Lynchburg, Virginia (http://www.politico.com/story/2014/05/oil-train-safety-department-of-transportation-106460.html and Final_EO_on_Transport_of_Bakken_Crude_Oi_05_07_2014.pdf)	April 30, 2014: Derailment of 17 cars, with one car failing, which led to a fire. Three of the derailed crude oil cars ended up in the James River, spilling up to 30,000 gallons (714 barrels) of crude into the river. Later clarification noted that the fire involved a CPC-1232 rail car.

mph = miles per hour

A detailed hazardous materials rail transportation model develop by Arthur D. Little, Inc. for the American Association of Railroads (AAR), the Railway Progress Institute (RPI), and the then Chemical Manufacturers Association considered a range of release sizes to try and bracket the potential range of consequences and allow for the frequencies of different size releases to be determined (Arthur D. Little 1996). That model used data from the RPI-AAR Railroad Tank Car Safety Research and Test Project on the relative frequencies of various release sizes from individual cars as a function of the number of cars derailed in an incident. It then considered the possible combination of releases from multiple cars in order to select representative spill sizes for the model.

In particular, the following spill sizes were used—eliminating the very small releases, as they do not contribute much to overall risk.

- 30 gallons per minute for 10 minutes (300 gallons)
- 300 gallons per minute for 10 minutes (3,000 gallons)
- Single rail car volume spilled instantaneously
- Three rail cars spilled instantaneously
- Five rail cars spilled instantaneously

Given the uncertainty over the likely spill size, this analysis considers a range of potential release sizes and their associated chance of occurrence using the same ranges of spill sizes listed above; however, the first two categories were combined into one spill size of 1,000 gallons (23.8 barrels). Additionally, an extreme case of 450,000 to 900,000 gallons (10,714 to 21,429 barrels) was added, to put such extreme spills in perspective, even though most recent extreme spills occurred at much higher speeds than would be experienced on the PS&P rail line.

In terms of the number of cars derailed, the *Marine & Rail Oil Transportation Study* (Washington State Department of Ecology 2015) found that the number of derailed tank cars per major crude oil accident in 2013 and 2014 ranged from 6 to 30 in the United States and 4 to 63 in Canada. The number of cars that spilled their contents was 1 to 20 in the United States and 0 to 5 in Canada. When looking at derailments, a larger set of accidents can be examined to understand the outcomes because the specific cargo type does not generally affect the chance of a train accident. Also, in general, slower speeds result in fewer cars derailed (Liu et al. 2014).

In addition, the number of cars derailed is not the same as the number of cars releasing, as not all derailed cars will fail, and some will only lose a portion of their cargo. The chance of a release is dependent on the type of rail car, which is more closely related to the cargo (although DOT-111 cars are also used for other liquid cargoes besides crude oil). Thus, detailed risk assessments tend to look at spills in terms of an equivalent number of cars releasing. This was the approach taken in the previously mentioned study and this risk assessment.

Data from the RPI-AAR Railroad Tank Car Safety Research and Test Project also provided information on the probabilities of release for rail cars of different designs and the detailed analysis to determine the chance of different numbers of cars derailing and releasing different quantities of the product carried. Liu et al. (2014) provides a recent description of this approach and gives some representative results. For Class I railroads, 24% of derailments involved one car, 50% involved five or fewer cars, and the overall average was about nine cars. As a group, the Class I railroads operate largely on Class 4 or 5 track, with the associated higher speeds. The same article provided an example of an analysis of DOT-111 rail cars versus the enhanced CPC-1232 design. For the scenario that was modeled (a specific configuration and track class, with a mixed cargo train involving 10 cars of concern) the average conditional probability of release from a DOT-111 car was 0.266, while for a CPC-1232 the same probability was 0.064. The change in chance of release per car also changes the number of cars releasing and therefore the relative likelihood of the spills of different sizes.

This analysis used a combination of these and other data to determine representative distributions of release sizes for the two types of rail cars addressed in the assessment of the proposed actions, given that a derailment or collision has occurred on the PS&P rail line. Table 5 presents these data, which are applicable to both proposed actions. Data are also provided for the existing

conditions/no-action alternative, which uses DOT-111 cars and has many fewer cars of interest per train. This limits the potential for the events with many cars derailed and releasing.

Table 5. Representative Probabilities of Different Release Sizes during Rail Transport

Failure Event and Potential Associated Release	No-Action Alternative[a]	2017 Operations[b]	2037 Operations[c]
Minor spill from collision/derailment (1,000 gallons or 23.8 barrels)	0.02	0.08	0.07
Collision/derailment with release equivalent to contents of one rail car (30,000 gallons or 714 barrels)	0.035	0.21	0.17
Collision/derailment with release equivalent to three rail cars (90,000 gallons or 2,143 barrels—equivalent to three rail cars)	0.00054	0.03	0.02
Collision/derailment with release equivalent to five rail cars[d]	Not evaluated	0.0015	0.00066
Extreme collision/derailment leads to release equivalent to 15–30 rail cars[d]	Not applicable	0.0001	0.00005

[a] The release probabilities associated with the no-action alternative assume fewer rail cars of interest per train.
[b] 2017 Operations assumes a mix of 50% current jacketed CPC-1232 rail cars (no upgraded CPC-1232s yet, but also no DOT-111s) and 50% new DOT-117s.
[c] 2037 Operations assume use of all DOT-117 rail cars.
[d] For the proposed operations in 2017 and 2037, the associated release volumes for a five-car release is 150,000 gallons (3,571 barrels) and for the extreme release is 450,000 to 900,000 gallons (10,710 to 21,420 barrels).

4.2.2 Accident Rates

The determination of the chance of a derailment or collision is based on accident rates derived from FRA data finalized through October 2014 (Federal Railroad Administration 2015). Train accident rates were collected for all operations on Class 2 track nationwide, both for mainline operations and for all track including main lines, industry tracks, yards, and sidings. The same data were collected specific to the PS&P rail line.

The PS&P rail line had four derailments in April and May 2014.

- On April 29, two cars derailed at 5 mph at South Washington Street in Aberdeen due to wide gage (track separation).
- On May 9, seven cars derailed at 6 mph at Heron Street in Aberdeen due to wide gage.
- On May 15, 10 cars derailed at 10 mph near Montesano due to thermal track misalignment.
- On May 21, 11 cars derailed at 5 mph at Blakeslee Junction due to a combination of train make-up and track geometry design.

These recent accidents led to an increase in the accident rate on the PS&P rail line in 2014, and for the 4-year average, as shown in Table 6.

Table 6. Accident Rates (per million train miles) for Track Class 2

Subset of Accident Database	2011	2012	2013	2014 (through October 2014)	4-Year Average
PS&P main line only			14.64	49.16	15.95
PS&P total (main, industry, yard, siding)	16.73		13.26	59.31	22.325
All mainline Class 2 track nationwide	0.98	0.78	0.86	0.77	0.8475
All Class 2 track nationwide total	2.82	2.4	2.43	2.25	2.475

Source: Federal Railroad Administration 2015
PS&P = Puget Sound & Pacific Railroad

Because sidings and industry track on site would be involved, the total rates were of greatest interest. The overall historical accident rates for PS&P are roughly ten times the national average, at 2.2E-5 per train mile. With the changes made by PS&P since the accidents in April and May 2014, and assuming the improvements that PS&P has planned prior to implementation of the proposed actions, a long-term rate of 1E-5 per train mile was applied in this analysis. This is still higher than the national average.

4.3 Results

Applying the distribution of release probabilities, the annual anticipated number of loaded train trips for each project (half of the overall number of trips), the length of the PS&P rail line (59 miles), and the accident rate of 1E-5 per train mile, the anticipated frequency of accidents resulting in the various release scenarios are presented in Table 7.

Related to the proposed action, the likelihood that an accident resulting in a relatively minor release of crude oil or bulk liquids (e.g., 1,000 gallons) would occur is 0.010 (Westway) or 0.016 (Imperium) times per year. Larger events, equivalent to release volumes of one, two, or three rail cars, have the potential to occur 0.028 (Westway) or 0.044 (Imperium), 0.0041 (Westway) or 0.0065 (Imperium), and 0.00021 (Westway) or 0.00033 (Imperium), times per year respectively. The likelihood that an extreme catastrophic events could occur is 0.000014 (Westway) or 0.000022 (Imperium) times per year. The frequency of occurrence would be lower for all scenarios with full implementation of the newer rail cars (shown in the 2037 columns).

Under the proposed actions, the chance of an accident resulting in the various release scenarios ranges from once every 98 (Westway) or 62 (Imperium) years for the smallest release (1,000 gallons) to once every 4,800 (Westway) or 3,000 (Imperium) years for the larger releases (e.g., 150,000 gallons). With the improvements in rail cars, these chances drop to roughly once every 105 (Westway) or 66 (Imperium) years and once every 11,000 (Westway) or 7,000 (Imperium) years, respectively. In addition, a case representative of the most extreme of the recent accidents was modeled. This showed that such an accident might occur within the study area once every 73,000 (Westway) or 46,000 (Imperium) years with the current rail cars, dropping to every 150,000 (Westway) or 93,000 (Imperium) years with the newer rail cars. These are very rough (i.e., higher uncertainty) estimates for the largest spills given the limited data available.

Table 7. Predicted Rail Transport Releases—Proposed Actions and Cumulative Projects

		Predicted Increase in Releases per Year					
		Westway		Imperium		Cumulative[a]	
Failure Event	Potential Associated Release	2017	2037	2017	2037	2017	2037
Minor collision/derailment	1,000 gallons (24 barrels) spill	0.010	0.0095	0.016	0.015	0.034	0.032
Collision/derailment with release equivalent to one rail car	30,000 gallons (714 barrels)	0.028	0.023	0.044	0.037	0.094	0.078
Collision/derailment with release equivalent to three rail cars	90,000 gallons (2,143 barrels)	0.0041	0.0027	0.0065	0.0043	0.014	0.0091
Collision/derailment with release equivalent to five rail cars	150,000 gallons (3,571 barrels)	0.00021	0.00009	0.00033	0.00014	0.0007	0.0003
Extreme collision/derailment with release equivalent to 15–30 rail cars	450,000 to 900,000 gallons (10,710 to 21,420 barrels)	0.000014	0.000007	0.000022	0.000011	0.000046	0.000023

[a] Cumulative projects include the proposed Westway, Imperium, and Grays Harbor Terminal projects.

For the cumulative projects, the chances of an event that would result in the following release scenarios would increase as follows.

- The chance of a minor collision/derailment resulting in the loss of 1,000 gallons (24 barrels) is once in 29 years, with a slight reduction to once in 31 years for 2037 with the full implementation of the more robust cars.
- The chance of a collision/derailment resulting in the loss of 30,000 gallons (714 barrels) is once in 11 years, dropping to once in 13 years.
- The chance of a collision/derailment resulting in the loss of 90,000 gallons (2,143 barrels) is lower, at once in 73 years for 2017 and once in 110 years for 2037.
- The chance of a collision/derailment resulting in the loss of 150,000 gallons (3,571 barrels) is lower, at once in 1,400 years for 2017 and once in 3,300 years for 2037.
- The chance of an extreme event involving a release from a large number of rail cars is predicted as once in 22,000 years for 2017 and once in 44,000 years for 2037.

Within the study area, a number of sensitive areas and habitats are identified. Table 8 lists some of these areas and gives an approximate number of miles for each, where an accident and release could affect the sensitive area. The percentage of the total route represented by each area is also given. This percentage can be applied to the estimated chances of a release size to determine the possibility that a specific release might occur in a particular area. This does not include any further consideration for the extent of the spread of the release, just the expected frequency that an event could occur in the area. For example, the chance of a release equal to one rail car (30,000 gallons) occurring anywhere along the line is once in 36 years for Westway or once in 23 years for Imperium. The likelihood of this occurring near the marbled murrelet critical habitat would be 5% of the total chance or once in 720 (Westway) or 450 (Imperium) years.

Another measure of interest is the increase in the total number of train collisions or derailments—with or without releases. This counts both the loaded and unloaded trains. For Westway there would be an increase of 0.27 accidents per year, and for Imperium there would be an increase of 0.43 accidents per year.

Table 8. Fraction of Route with Sensitive Habitats or Environments

Area of Concern	Approximate Length of Exposure	Percent of Total Route
Three marbled murrelet critical habitat areas	3 miles	5%
Three crossings of bull trout streams that are designated as critical habitat areas	2 miles (approximate exposure considering track leading to and from crossings)	3%
Chehalis River Surge Plain Natural Area	6 miles	10%
• Stretch of Chehalis River that is very close to the rail line and is designated as critical habitat for bull trout • Critical Habitat for the Oregon spotted frog along Black River • Locations adjacent to rail line of two sensitive plant species (multiple locations, but generally between US Route 12 and the Black River crossing area)	10 miles (includes all three areas)	17%

Chapter 5
Vessel Transport Evaluation

5.1 Basis of Analysis

Operation of the proposed actions would result in increased vessel traffic through Grays Harbor. Implementation of the proposed actions could result in up to 238 (Westway) or 346 to 400 (Imperium) additional one-way vessel trips per year, depending on the type of vessel used. This increase in vessel traffic could result in increased potential for accidental releases of oil and hazardous substances, pollutants, and contaminants during offsite transport.

A tank barge or tanker can suffer structural damage and a cargo as the result of a collision with another vessel (assuming the other vessel is sufficiently large); an allision with a fixed structure such as a seawall, jetty, pier, or bridge; or a grounding on a hard or rocky bottom. The evaluation of vessel transport risks considers all three events.

It is anticipated the vessels for the proposed actions would consistent primarily of tank barges but could also include the use of some tankers. For the purpose of the risk assessment, Table 9 gives the number of port calls and vessel transits that could be associated with the proposed actions.

Table 9. Anticipated Vessel Traffic Volumes in the Study Area—Cumulative Projects

Vessel Type	Design Draft (feet)	Vessel Calls to Transport Throughput	Vessel Transits (50% are loaded)
Westway—tank barges	27.5[a]–35	54–119[a]	108–238[a]
Imperium—tank barges	27.5[a] –35	91–200[a]	182–400[a]
Grays Harbor Rail Terminal (for cumulative)—Panamax crude oil tanker	39.5	60	120

* Based on operator's proposed vessel size.

The upward bounds of the predicted traffic volumes (bolded values) were used in this risk assessment; however, the lower draft of the smaller vessels would also help to minimize the grounding risk in the navigation channel. For Imperium, a mix of 35 tankers and 138 tank barges was also analyzed. The real concern is for grounding outside of the navigation channel where the damage potential is greater because of the rocky seabed. Thus, the estimated frequencies derived in the results section are considered conservative because there would likely be fewer trips if some of the trips were made by a tanker rather than a tank barge.

5.2 Approach and Data

Estimating the chance of a release from a vessel accident is a two-part process. The first part is to estimate the chance that the accident occurs; the second (nonsequential) part is to estimate the

chance of a release given the occurrence of the accident. There are two ways in which vessel accidents have been estimated in the past—the chance of a given vessel experiencing an accident per year, which is useful for large-scale trend analyses, and the chance of an accident for each port call or port/harbor transit or per vessel day. The latter approach was used in this evaluation to understand the increases in release frequencies attributable to the number of vessel calls.

5.2.1 Spill Sizes and Release Probabilities

The evaluation of spill sizes and release probabilities started with a review of local and regional data to understand the spill and accident history that might be applicable to the proposed actions. Table 10 shows a list of the commercial tank vessel incidents in Grays Harbor reported to the U.S. Coast Guard and the state and includes incidents during transfer and transit.

Table 10. Vessel Incidents near Terminal 1 Since 2008

Vessel Name	Year	Incident Type	Comments
T/V *Kohzan Maru II*	2011	200-gallon methanol spill during transfer	Spill went into containment and some spilled onto dock. Incident was reported to the U.S. Coast Guard. No methanol went into water.
T/V *Kokuka Glorius*	2011	Generator failed requiring tug escort to dock, but no release	Methanol tanker had equipment failure on its way into the harbor. Generator failed. The U.S. Coast Guard ordered two tug escort and transit into Grays Harbor in daylight. No material released.
T/V *Steam Voyager*	2008	Grounding without any release	Fully loaded biodiesel tanker grounded in Grays Harbor while turning in navigation channel (near Buoy 11). Vessel lost propulsion while at low speed. Vessel proceeded to anchorage for hull survey, and no damage was found. The vessel was double-hulled.

Reported oil spills reviewed for this analysis were typically from fueling operations associated with small pleasure craft or commercial fishing vessels or hydraulic oil from ruptured hoses. Sheens are also reported to the National Response Corporation, but the amount of oil associated with reported sheens on the water is difficult to estimate and not quantifiable. Overall, oil spills into the waters of Grays Harbor have been infrequent and of small amounts. National Response Corporation data from 2007 to 2014 reflect that the average annual amount of oil reported spilled in the harbor during that time has been approximately 112 gallons (U.S. Coast Guard 2014) (Table 11).

Table 11. Estimated Quantity of Oil Reported Spilled in Grays Harbor

Year	Amount of Oil Reported in Water (gallons)[a]
2007	4
2008	408
2009	20
2010	107
2011	0
2012	325
2013	30
2014	1
Average: 2007–2014	112

Source: U.S. Coast Guard 2014.
[a] Other than sheens

Oil spills from all types and sizes of commercial vessels transiting in the vicinity can pose a risk to Grays Harbor as well as provide an indication of the potential size of major releases. Since 1988, three significant incidents have caused oil contamination along shorelines and impacts on Pacific Northwest wildlife, including one near Grays Harbor. Table 12 summarizes the releases—all of which occurred more than 15 years ago, before double hulls were mandated for tank vessels.

Table 12. Incidents in the Pacific Northwest that Resulted in Major Oil Spills

Year	Vessel Name	Location	Estimated Amount Released into Environment
1988	*Barge Nestucca*	Grays Harbor, Washington	231,000 gallons (5,500 barrels) of bunker C fuel oil
1991	*Tenyo Maru*	Neah Bay, Washington	100,000 gallons (2,381 barrels)—a combination of heavy and light oils
1999	*New Carissa*	Off Oregon coast	70,000 gallons (1,667 barrels) of bunker C fuel oil

The report, *Oil Spill Risk in Industry Sectors Regulated by Washington State Department of Ecology Spills Program for Oil Spill Prevention and Preparedness* (Washington State Department of Ecology 2009), found 14 oil spills from tankers from 1995 to 2008, with a total of 13,709 gallons (326 barrels) of oil spilled. The report also found 14 oils spills from tank barges for a total of 7,002 gallons (167 barrels). Both of these data points indicate that most spills are far less than a full discharge of contents. To represent the distribution of potential spill sizes, only a fraction of the estimated releases were assumed the modeled greatest possible releases; the rest would be expected to be smaller.

The local and regional historical record did not provide the full set of representative spill sizes desired for the study. Working with the Washington State Department of Ecology (Ecology), it was determined that three scenarios and two release sizes would be considered.

- Collision with another vessel during transport causing a spill of 105,000 gallons (2,500 barrels).
- Allision with a fixed object causing a spill of up to 15.1 million gallons (360,000 barrels).
- Grounding with a release of up to 1.2 million gallons (29,000 barrels).

A collision severe enough to result in a release of 105,000 gallons (2,500 barrels) was considered most likely to occur at the Hoquiam Reach or North Channel Reach of the navigation channel based on the layout of the harbor and the nature of the navigation channel. Related to this scenario, it was assumed that only one tank in the vessel would be punctured, releasing some of the contents, but the entire vessel's cargo would not be released. Based on the study area, allisions would be most likely to occur at the jetty entrance and would be more likely to involve the release of the entire vessel over time.

Much of the historical data on release probabilities is not reflective of the required change to double hulls, which are designed to reduce the chance of a release given that an accident (collision, allusion, or grounding) occurs. A number of new studies have tried to estimate the long-term impact of double hulls, including *A Review of Double Hull Tanker Oil Spill Prevention Considerations*, Report to Prince William Sound RCAC (Nuka Research & Planning Group, LLC 2009). This study reviewed the tanker incident database maintained by Ecology for trends associated with the use of double hulls. The observations included a trend toward fewer oil spills, but the authors had difficulty quantifying the benefit of double hulls due to a limited data set. Yip et al. (2011) found that the expected average spill sizes for double-hull tank barges and tankers were 2,933 and 1,218 gallons (70 and 29 barrels), respectively, based on 2001 to 2008 data and their model. They concluded that a double-hull design reduces the size of oil spills in accidents by 62% for tankers and 20% for tank barges.

Glosten Associates (2014) developed release probabilities given the type of accident, as shown in Table 13. The data show that 13 to 22% of the incidents actually resulted in a spill. In the remaining 77 to 88% of the cases, there was no loss of cargo resulting from the accident.

Table 13. Spill Probabilities Given an Incident

	Type of Vessel	
Type of Accident	Tankers	Barges
Collisions	0.19	0.13
Allisions	0.19	0.13
Groundings	0.2	0.22
Glosten Associates 2014		

A spill probability of 0.2 was used for all types of vessels and accidents. However, as noted, most releases are much smaller than the release scenarios addressed in this analysis. Therefore, the chance of a major release (consistent with release scenarios addressed in this report) was considered to be 20% of the overall release rate presented in Table 13, or 0.04 per accident.

5.2.2 Accident Rates

Accident rate data were reviewed from a number of sources, including the U.S. Coast Guard, various ports, shipping companies, and data gathered for other studies, along with analyses of those data. For example, the Transportation Safety Board of Canada's *Statistical Summary*, *Marine Occurrences 2013* captured data on marine activity for Canadian commercial nonfishing vessels of more than 15 gross tons, excluding passenger vessels and cruise ships. This data yielded an accident rate of 3.3 accidents per 1,000 movements, down from the 5-year average of 3.9 per 1000. This rate is useful in calibrating U.S. analyses and rates, although it includes all types of accidents, not just those that

could potentially lead to an oil spill. No information on spills was provided (Government of Canada 2014).

The International Maritime Organization (2012) found a loss rate of 1.7 per 1,000 ships. As noted, this is more useful for looking at national and international trends. . The study also looked at the ratio of the annual quantity of oil released to the annual amount shipped, and noted significant year-to-year variations.

Glosten Associates' (2014) *Vessel Traffic and Risk Assessment Study* for Puget Sound determined both historical and adjusted accident rates (to account for instances with no historical data). The accident rates were expressed per vessel day and were determined for a number of geographic areas, but not Grays Harbor specifically. The rates for the grouping, including Cherry Point, were applied in this analysis and in the corresponding environmental impact statement after a comparison with other data sources for general consistency. Table 14 presents the rates from the *Vessel Traffic and Risk Assessment Study*. To apply the data, it was assumed that the vessels in Grays Harbor spent one day each way in transit and half of a day maneuvering, which is expected to be quite conservative compared to actual transit and maneuvering times.

Table 14. Failure Rates Assumptions per Vessel Day

Type of Vessel	Tankers	Barges	Tankers	Barges
Type of Accident	*Underway*		*Maneuvering*	
Collisions	1.50E-05	5.40E-04	4.30E-04	2.30E-03
Allisions	1.50E-05	4.10E-05	8.40E-04	1.10E-03
Groundings	6.50E-04	4.10E-05	4.30E-04	8.20E-04

Source: Glosten Associates 2014

5.3 Results

Table 15 presents the estimated increases in the frequencies of a release, using the data presented above for number of vessels per year, accident rates, and release probabilities. No differences between 2017 and 2037 assumptions would affect the results. As mentioned previously, the risk assessment evaluates the risks associated with the additional project-related traffic beyond existing risks.

Table 15. Predicted Vessel Releases—Proposed Actions and Cumulative Projects

Failure Event	Potential Associated Release[a]	Predicted Increases in Releases (Events/Year)		
		Westway	Imperium	Cumulative[b]
Collision with another vessel during transport	105,000 gallons (2,500 barrels) spill with some potential for ignition from collision	0.008	0.014	0.022
Allision with fixed object	Up to 15.1 million gallons (360,000 barrels)	0.0028	0.0047	0.0086
Grounding	Up to 1.2 million gallons (29,000 barrels)	0.0021	0.0036	0.0078

[a] Bakken crude oil, bitumen, ethanol, naphtha, gasoline, vacuum gas oil, jet fuel, No. 2 fuel oil, No. 6 fuel oil, kerosene, renewable jet fuel, renewable diesel, used cooking oil, and animal fat.
[b] Cumulative projects include the proposed Westway, Imperium, and Grays Harbor Rail Terminal projects.

As presented in Table 15, the predicted frequency that a collision resulting in a more substantial release of crude oil or bulk liquids during vessel transit (e.g., 105,000 gallons [2,500 barrels]) could occur is 0.008 for Westway 0.014 for Imperium per year. A more catastrophic event that could, in theory, lead to the release of the entire contents of a vessel plus the fuel (up to 15.1 million gallons [360,000 barrels]) could occur is 0.0028 for Westway or 0.0047 for Imperium per year. Vessel groundings have the potential to result in much smaller releases over time as the material seeps out of a tank and could occur 0.0021 times per year for Westway or 0.0036 times per year for Imperium.

Under the proposed actions, the chance of a collision with a very significant release is roughly once in 120 or 74 years for Westway and Imperium, respectively. The chance of an allision with a full loss of cargo is roughly once in 360 or 210 years for Westway and Imperium, respectively. A significant release from grounding might be approximately once in 470 or 280 years for Westway and Imperium, respectively.

Based on these results, significant releases of oil are not expected to be commonplace but are likely enough to be considered in the spill prevention and response planning. Accidents without a release are much more likely, as they could occur from either a loaded or unloaded vessel in an accident—and because most accidents involving a loaded vessel will not experience a release. The overall additional chance of an accident from the proposed actions (not necessarily involving a release) is estimated as 0.65 accidents per year for Westway and 0.9 to 1.1 for Imperium.

Looking at the predicted cumulative impact, the chance of a release each year increases as follows.

- Once in 45 years for a collision
- Once in 116 years for an allision
- Once in 128 years for a grounding

Chapter 6
Potential Risk of Fire or Explosion

Operation of the proposed actions would generally result in the potential for more frequent releases of bulk liquids relative to existing conditions (although the risk of very large releases remains relatively low). As indicated in the analysis, the likelihood of different release scenarios occurring can differ greatly depending on the specific circumstances of the event (onsite tank failure versus train derailment versus vessel collision).The likelihood of fires or explosions resulting from a spill also differ based on the scenario.

6.1 Terminal (Onsite)

Many of the materials to be handled under the proposed actions are flammable, but they are generally in a liquid and not gaseous form, so they will pool on the ground with only limited vapor generation—particularly compared to other common materials like propane.. The facilities are required to be designed to minimize the chance of fires or explosions of such flammable liquids if a release does occur. Numerous containment areas control or limit where the release can spread; these also minimize the chance of an ignited release impinging on other equipment or getting offsite, via land or water. Shutoffs help to limit the quantity of material that is released. In addition, ignition and possible explosions are limited through a broad range of physical and procedural precautions, as follows.

- Floating roofs to limit vapor generation in confined areas
- Elimination of ignition sources to limit ignition
- Use of nonsparking tools and explosion-proof equipment
- Appropriate separation distances between tanks
- Grounded equipment

Should a release occur, emergency response would address the roles, responsibilities, and actions to take, depending on how much was spilled and where, as well as whether or not ignition has already occurred and there is a fire or explosions to address. Fire suppression and firefighting equipment is located on site.

6.2 Rail

If an accident and release occurs along the PS&P rail line, possible outcomes include an unignited spill that may or may not enter a waterway, a fire that remains contained, or a fire that spreads to other cars and causes a larger fire or explosion or more extensive damage in the surrounding area. In general, the greater the potential for damage, the lower the likelihood such an event would occur.

For the smaller releases (e.g., minor collision/derailment or derailment with spills equivalent to one or three rail cars), there is a chance of ignition, but a greater fraction of releases are not expected to ignite.

Of those releases that do result in a fire or explosion, the fire could engulf or affect other rail cars. As the material in these adjacent rail cars heat up, the pressure would build and may eventually cause other rail cars to fail. This is dependent on the exact configuration of the release and the fire or explosion compared to the location of the other rail cars after the derailment, any fire suppression capabilities, and the timing and nature of response actions. Thus, there is a chance of a small spill escalating into a larger spill due to a fire or explosion.

For the larger spill scenarios—five or more rail car equivalents, the likelihood of the accident having sufficient energy to yield an ignition is greater; for example, closer to 50% or more. The additional number of cars that are derailed in the accident and the additional amount of material released increase the likelihood that ignited cars would affect other rail cars and cause an explosion.

Thus, the likelihood of an outcome involving an explosion or larger fire would be less than the spill frequencies provided earlier and would depend on the number of cars derailing and releasing. The frequencies of the larger spills are lower with more robust rail cars, and the exact specifications of the rail cars would determine just how much lower.

To put recent accidents in context, the chance of an extreme derailment where a more severe fire or explosion also occurs is limited in the study area. This is because the circumstances that would lead to such an event are less likely on the PS&P rail line, primarily because the speeds on the PS&P rail line are so low. Although the rates of accidents on this line are greater than the national average, the nature of the expected incidents are relatively small in magnitude (i.e., a single-car derailment) and are not of the magnitude that would result in multiple car derailments. In general, large derailments lead to releases from multiple rail cars. The energy involved in high-speed derailments and the resulting scatter of rail cars yield the greatest chance of a fire or explosion that is able to affect other rail cars. The energy involved in these larger derailments is what ignites the releases and the subsequent escalation of the event. Furthermore, an additional factor of safety would be provided with implementation of the stronger rail cars that also have thermal protection. The risk of a single event on an annual basis is the same for any given portion of the PS&P rail line. Table 16 restates the results of this analysis on a per-mile basis. These values provide an idea of the risk that an event might occur along any 1-mile segment between Centralia and the project sites. A given community might experience a multiple of this depending on the size of the community (such as a factor of 10 if a community spans 10 miles of track)—which is still less than the total risk for the entire study area.

The overall additional chance of an accident per mile per year for 2017 conditions is once per 440 years for loaded trains and once per 217 years for the combination of loaded and unloaded trains for Westway. For Imperium, the equivalent values are 270 and 140 years.

Table 16. Predicted Rail Transport Releases on Per Mile Per Year Basis—Proposed Actions and Cumulative Projects

		Predicted Increase in Releases per Mile per Year					
		Westway		Imperium		Cumulative[a]	
Scenario	Associated Release	2017	2037	2017	2037	2017	2037
Minor collision/ derailment	1,000 gallons (24 barrels) spill	1.7E-04	1.6E-04	2.7E-04	2.6E-04	5.8E-04	5.4E-04
Collision/derailment with release equivalent to rail car	30,000 gallons (714 barrels)	4.7E-04	3.9E-04	7.5E-04	6.2E-04	1.6E-03	1.3E-03
Collision/derailment with release equivalent to three rail cars	90,000 gallons (2,143 barrels)	6.9E-05	4.6E-05	1.1E-04	7.3E-05	2.3E-04	1.5E-04
Collision/derailment with release equivalent to five rail cars	150,000 gallons (3,571 barrels)	3.5E-6	1.5E-06	5.6E-06	2.4E-06	1.2E-05	5.1E-06
Extreme collision/ derailment with release equivalent to 15–30 rail cars	450,000 to 900,000 gallons (10,710 to 21,420 barrels)	2.3E-7	1.1E-07	3.7E-07	1.8E-07	7.7E-07	3.9E-07

[a] Cumulative projects include the proposed Westway, Imperium, and Grays Harbor Terminal projects.

6.3 Vessel

The outcome of a vessel release is dependent on the circumstances of the accident, particularly the forces involved, and any generation of sparks sufficient to ignite the release. Numerous safety precautions are taken on vessels as required by federal and state law related to spill prevention and safety in general. The precautions fall between those for a facility where the potential spill locations are known and some protective measures can be built into the design and others colocated at the site, and those for rail transportation where the potential spill locations cover a broad area and may have limited accessibility. Vessel accidents can occur anywhere along the transit, but are most likely in certain locations such as near the dock where other vessels may be maneuvering or near the jetties where it is possible to allide with fixed objects.

Vessel accidents that release flammable liquids may not confine vapors to the degree required to result in an explosion, but this depends on the location of the penetration and the proximity of any fire or explosion to other compartments on the barge or tanker.

Chapter 7
Existing Risks (No-Action Alternative)

7.1 Terminal (Onsite) Operations

7.1.1 Basis of Analysis

Westway Existing Operations

The analysis of potential releases for existing operations focused on the larger volumes associated with onsite storage tanks plus the loading/unloading of rail cars and vessels for each proposed action.

Westway receives, certifies, and loads methanol for transport to the end customer. Currently, approximately 36.0 million gallons of methanol are received and 33.3 million gallons of methanol are shipped annually; this will be increasing by roughly 12 million gallons in and out over the 20-year analysis period. Four existing 80,000-barrel (2 million gallons) storage tanks are on the northern portion of the project site. Under existing conditions, these tanks are used to store methanol. In general, methanol arrives at the project site by rail or vessel, is unloaded and stored, and then loaded into tanker trucks or rail cars for transport to the customer. The 2,700 or so truck round trips per year have not been analyzed due to the smaller volumes per truck and the local use of most of the shipments. Any releases during loading are expected to be contained on site.

Typically, there are one to two switch trips on and off the project site each day to deliver and remove an average of 10 rail cars, including the methanol shipped offsite by rail. Thus, there are roughly 1,000 one-way train transits each year, each with up to 10 loaded cars of methanol, for 10,000 loadings/unloadings of rail cars each year. The expansion of the methanol operation is expected to add seven loadings of a rail car per week to the existing trains. These loadings will not add appreciably to the number of loadings/unloadings (350 compared to approximately 10,000).

Expansion of the existing Westway methanol operations under the no-action alternative would increase traffic to 16 vessel calls in 2017 and 27 in 2037, for 16 and 27 loadings and unloadings, respectively.

Imperium Existing Operations

Imperium is permitted for the production of 100 million gallons of biodiesel per year, although actual annual throughput varies due to market conditions. This requires roughly the same volume of vegetable oil feedstock. Both biodiesel and vegetable oil are transported via vessel, rail, and truck. Imperium uses eight primary tanks to store biodiesel or vegetable oil, each with a capacity of up to almost 48,000 barrels. Six smaller tanks are used for storing materials such as methanol, sulfuric acid, and sodium methylate. The methanol reacts with vegetable oil to make biodiesel (when catalyzed by sodium methylate) and the small quantities needed are generally received by truck from Westway. These and other small shipments by truck have not been analyzed.

This process typically results in one to two switch trips onto and off the project site each day, to deliver and remove an average of 12 rail cars. There are roughly 1,000 one-way train transits each

year, half of them with 12 loaded rail cars of vegetable oil or sodium methylate. Thus, there are approximately 6,000 unloadings per year.

For Imperium, this analysis assumes that all the biodiesel is transported by vessel. Current projections are that there will be seven vessel loadings per year for both 2017 and 2037.

7.1.2 Approach and Data

The approach and data sources used for the proposed actions, as presented in Chapter 2, were also used for the existing operations with the specific numbers of tanks and rail and vessel transfers described above.

7.1.3 Results

Table 17 summarizes the potential for releases from the tanks and the loading/unloading operations.

Table 17. Predicted Terminal (Onsite) Releases for Existing Conditions

Failure Event	Potential Associated Release	Predicted Baseline/No Action Frequencies of Release (per year)	
		Westway	Imperium
Piping or smaller storage tank failures due to seismic event with moderate damage or equipment failures and human errors	50,400 gallons (1,200 barrels) spill	0.0004	0.0014
Catastrophic failure of storage tank due to seismic event, tsunami, or construction or material failure	80,000 barrel tanks (Westway); 48,000 barrel tanks plus smaller ones (Imperium)	0.00002	0.00007
Rail loading/unloading release due to equipment failure or human error	2,100 gallons (50 barrels) spill	0.04	0.024
Vessel transfer release due to adverse weather, human error, or equipment failure(s) that affects pipelines or loading arm connections	2,100 gallons (50 barrels) spill	2017: 0.016 2037: 0.027	0.007
Major transfer release during vessel loading/unloading	10,000 gallons (238 barrels) spill from loading arm failure(s)	2017: 0.00099 2037: 0.0017	0.00043

These results show that the most likely releases are those associated with the loading and unloading of rail cars and vessels, as was the case for the proposed actions. A release from the rail car loading and unloading for Westway could occur roughly once every 25 years, while for Imperium the corresponding value is every 42 years.

Compared with the proposed action for Imperium, there is a higher risk of an incident under current conditions because there are more tanks; however, the existing tanks are smaller and would therefore have a smaller spill quantity associated with them should a release occur.

7.2 Rail

7.2.1 Basis of Analysis

Under Westway's existing operations, approximately 60% of the incoming methanol arrives at the facility by rail as part of standard freight traffic on the PS&P rail line. Typically, there are one to two switch trips on and off the project site each day to deliver and remove an average of 10 rail cars, including the methanol shipped off site by rail. Thus, there are roughly 1,000 one-way train transits each year, each with up to 10 loaded cars of methanol. The expansion of the methanol operation is expected to add seven loadings of a rail car per week to the existing trains. Westway currently uses DOT-111 and CPC-1232 cars to ship methanol in and out of the terminal. Without implementation of the proposed action, although the number of rail cars received in the future related to the existing operations may increase slightly, they would be similar to existing conditions.

Under existing conditions for Imperium, most vegetable oil and all sodium methylate are transported to the project site by rail via the PS&P as part of the existing freight traffic using DOT-111 rail cars. Imperium typically has one to two switch trips onto and off the project site each day, to deliver and remove an average of 12 rail cars. Thus, there are roughly 1,000 one-way train transits each year, half of them with 12 loaded rail cars of vegetable oil or sodium methylate. Without implementation of the proposed action, although the number of rail cars received in the future related to the existing operations may increase slightly, it is anticipated the numbers would be similar to existing conditions.

7.2.2 Approach and Data

The approach and data sources used for the proposed actions, presented in Chapter 2, *Methods*, and detailed in Chapter 4, *Rail Transport Evaluation*, were also used to analyze the risks associated with existing rail transport and were applied to baseline PS&P rail line traffic related to each project's current operations as described above. As noted in Chapter 4, the accident rate used in this analysis was based on the historical accident rates for the PS&P rail line and considered improvements that have been most recently made to the PS&P rail line. Additionally, this analysis applies the release probabilities presented in Table 5 for the no-action alternative and considers only the relatively smaller releases (three rail cars or fewer). This is because, under existing conditions, the combination of the frequency of trains, the mix of cars per train (tanker cars versus other types of commodities), and the average number of Westway or Imperium tank cars per train (e.g., 10 to 12 cars for one site) makes the probability of greater releases extremely unlikely.

7.2.3 Results

Table 18 presents the expected frequencies of train accidents for existing conditions. It is possible (and likely) that some of the same trains could carry rail cars for both sites, which would reduce the combined chance of a train accident under existing operations; however, because the results were informed in part by the number of individual loaded cars delivered or shipped each day, the results

are shown separately. The main difference is that Westway both receives and ships loaded cars, while Imperium has empty rail cars leaving the site. The results for rail transportation are not expected to vary between 2017 and 2037.

Table 18. Predicted Rail Transport Releases for Existing Conditions

Failure Event	Potential Associated Release[a]	Current Risks (events per year)	
		Westway	Imperium
Minor collision/ derailment	Minor collision/derailment (1,000 gallons or 24 barrels)	0.012	0.0059
Collision/derailment with release equivalent to contents of one rail car	Collision/derailment with release equivalent to contents of one rail car (30,000 gallons or 714 barrels)	0.021	0.010
Collision/ derailment with release equivalent to three rail cars	Collision/derailment with release equivalent to three rail cars 90,000 gallons or 2,143 barrels)	0.00032	0.00016

[a] Primarily methanol for Westway and vegetable oil and biodiesel for Imperium as these are the only products currently stored and transported in large volumes.

Under existing conditions, Westway's operations could result in the release of methanol along the PS&P rail line as follows. These risks are higher for Westway, which transports methanol off-site by rail while Imperium mostly transfers its bulk liquids (biodiesel) off site by vessel.

- The chance of a minor collision/derailment resulting in the loss of 1,000 gallons (24 barrels) is once in 85 years.
- The chance of a collision/derailment resulting in the loss of 30,000 gallons (714 barrels) is once in 48 years.
- The chance of a collision/derailment resulting in the loss of 90,000 gallons (2,143 barrels) is once in 3,100 years.

Imperium' current operations could result in the release of vegetable oil or other bulk liquids along the PS&P rail line as follows.

- The chance of a minor collision/derailment resulting in the loss of 1,000 gallons (24 barrels) is once in 170 years.
- The chance of a collision/derailment resulting in the loss of 30,000 gallons (714 barrels) is once in 97 years.
- The chance of a collision/derailment resulting in the loss of 90,000 gallons (2,143 barrels) is once in 6,300 years.

The overall chance of an accident with loaded or unloaded cars (not necessarily a release) is once in 1.7 years on average for both Westway and Imperium. For Westway, all of these accidents could involve loaded cars; for Imperium, the chance of an accident with loaded cars is slightly lower at once in 3.4 years.

7.3 Vessel

7.3.1 Basis of Analysis

Westway currently unloads roughly 40% of its incoming methanol from tank vessels, places it into storage, and distributes it via truck and rail. Recent operations at the project site have resulted in approximately six vessel calls per year (Doucette pers. comm.). However, existing operations vary year to year and expansion of the existing methanol operations under the no-action alternative would increase to 16 vessel calls (32 vessel transits in 2017) and 27 in 2037. These tank vessels are expected to include a mix of tankers and barges.

Imperium is permitted to load finished biodiesel onto rail cars, tanker trucks, or vessels, with the mode of transportation depending on market conditions. Given the greatest potential for offsite potential impacts, this analysis assumes that all biodiesel is transported by vessel. Current projections are for 14 vessel transits (seven vessel calls) per year, similar to the 13 experienced in 2013, for both 2017 and 2037.

7.3.2 Approach and Data

The accident rates and release probabilities discussed in Chapter 2, *Methods*, were applied here for Westway's 16 vessel calls in 2017 and 27 in 2037 and Imperium' 7 vessel calls in both periods. While there may be a mix of tankers and barges, all movements were analyzed using the barge rates, which are higher for all accident types except groundings.

7.3.3 Results

Table 19 provides the expected frequencies of release. Only the Westway results vary from 2017 to 2037. In addition to the expected frequency of a release, the total number of accidents was also estimated. These were 0.087 per year for Westway in 2017 and 0.15 in 2037, and 0.038 for Imperium for both periods. Therefore, while a vessel accident might be predicted to occur every 11 to 23 years for Westway and every 26 years for Imperium, the chance of a release in these accidents is only 10% and the chance of a large release is much smaller as shown in the table.

Table 19. Predicted Vessel Transport Releases for Existing Conditions

		Predicted Frequency of Release (Events/Year)		
		Westway		Imperium
Failure Event	Potential Associated Release	2017	2037	2017/2037
Collision with another vessel during transport	Spill of bulk liquids and potential for ignition	0.0011	0.0018	0.00047
Allision with fixed object	Spill of bulk liquids and potential for ignition	0.00038	0.00064	0.00017
Grounding of vessel	Spill of bulk liquids	0.00029	0.00049	0.00013

Under existing conditions, Westway's operations could result in the release of methanol in the harbor as follows. These risks are higher than would occur related to Imperium because Westway's

operations currently have more vessel transport movements of methanol than Imperium does of its bulk liquids (biodiesel).

- The chance of a collision with another vessel resulting in a release during transport is once in 920 years.
- The chance of a vessel allision resulting in a release is once in 2,600 years.
- The chance of a vessel grounding resulting in a release is once in 3,500 years.

Imperium' current operations could result in the release of biodiesel in Grays Harbor as follows.

- The chance of a collision with another vessel resulting in a release during transport is once in 2,100 years.
- The chance of a vessel allision resulting in a release is once in 6,000 years.
- The chance of a vessel grounding resulting in a release is once in 7,900 years.

The overall chance of a vessel accident (with or without release and while loaded or not) is once in 11 years for Westway (2017 conditions) and once in 26 years for Imperium. Accidents involving loaded vessels, not necessarily with a release, occur half as often.

Chapter 8
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Appendix N

Oil Spill Modeling

WESTWAY EXPANSION PROJECT
OIL SPILL MODELING

PREPARED FOR:

City of Hoquiam, Washington
609 8th Street
Hoquiam, WA 98550
Contact: Brian Shay
(360) 538-3983

Washington State Department of Ecology
300 Desmond Drive SE
Lacey, WA 98503
Contact: Sally Toteff
(360) 407-0271

PREPARED BY:

ICF International
317 SW Alder Street, Suite 200
Portland, OR 97205
Contact: Kim Marcotte
(503) 525-6196

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Figure 6. Trajectory of an Instantaneous Release from Tank Vessel during Transit—Winter Winds/Currents to the North N-11

Figure 7. Chehalis River near Porter Creek Road West N-16

Figure 8. Wynochee Bridge N-16

Introduction

The purpose of this analysis is to provide perspective on the surface movement and behavior of crude oil spilled into the project environment, specifically into Grays Harbor and the Chehalis River. Such perspective will allow planners and decision makers to understand the range of consequences that could occur after a spill and the potential variation in those consequences based on how much oil is spilled, the type of oil spilled, the direction of currents at the time of the spill, and the direction and speed of the wind. The resulting modeled trajectories represent possible outcomes, not specific predictions. The information herein illustrates how spilled oil may travel and behave in the marine environment based on the assumptions described below.

Spills into Grays Harbor and the Chehalis River were analyzed separately using different modeling tools appropriate for each unique environment.

Movement of Oil in Grays Harbor

Methods

Trajectory analyses and oil concentration contours for three different release scenarios occurring within Grays Harbor were developed using the General NOAA Oil Modeling Environment (GNOME™) software, Location Files for Grays Harbor, and GNOME Analyst. The *GNOME™ User's Manual* describes these tools as follows (National Oceanic and Atmospheric Administration 2002: 1, 45).

> GNOME is a publicly available oil spill trajectory model that simulates oil movement due to winds, currents, tides, and spreading. GNOME was developed by the Hazardous Materials Response Division (HAZMAT) of the National Oceanic and Atmospheric Administration Office (NOAA) of Response and Restoration.
>
> Location Files load predeveloped location data, such as an area map with shoreline contours and dominant current patterns.
>
> GNOME Analyst converts the 'best guess' splots[1] displayed in GNOME to oil concentration contours, and the 'minimum regret' splots to a bounding contour.[2]

The GNOME trajectory analysis was completed to provide a model of how spilled oil for each release scenario—varying by release quantity, location, and set of weather and sea state conditions—would move across the water surface and which surface areas could be affected by spilled oil in the selected timeframes (24 and 48 hours after release).

The resulting trajectories are not specific predictions, but models that demonstrate how various climatological conditions influence spill outcomes. They depict the movement of oil on the water's

[1] Splots are point information showing movement of the individual elements used in GNOME.
[2] Further information about GNOME is available at http://response.restoration.noaa.gov/gnome.

surface (*spreading*) and shoreline oiling without considering how oil in the environment changes in its physical characteristics and chemical composition over time. Those changes are considered *weathering*, which includes oil evaporation, oil droplet/fragment dispersion in the water column, oil emulsification, and, eventually, biodegradation. All of these changes can affect how much oil remains in the environment and how the remaining oil spreads and moves on the water's surface. Numerous environmental factors that affect oil weathering (e.g., water salinity, the presence of microbes, the extent of sun exposure, and sediment concentrations) cannot be fully considered in the GNOME analysis. In the event of an actual spill, wind speed and direction, sea state, and currents could result in the same quantity of spilled oil moving in a different direction or farther away from the source of the release.

GNOME Analyst was used to convert the modeled trajectories into an estimate of relative oil density contours (light, medium, and heavy) for the oil remaining at the surface.[3] This output was depicted graphically for the selected scenarios using a *geographical information system (GIS*) to show the surface location for the modeled oil over the selected timeframes.

The properties of the spilled oil were further evaluated using the trajectory mass balance estimates from GNOME and the Automated Data Inquiry for Oil Spills (ADIOS)[4] for a comparison of the behavior of different types of crude oils in the environment. The mass balance estimates and ADIOS output predict how long different types of oil are likely to persist (i.e., weather) in the environment and how their properties change over time.

Trajectory Model Limitations

GNOME was selected to complete the trajectory analyses because it is a National Oceanic and Atmospheric Administration (NOAA) tool familiar to oil spill contingency planners and responders nationwide.[5] A Grays Harbor Location File was already developed by NOAA for use with GNOME during development of the Geographic Response Plan (GRP) for Grays Harbor, which facilitated implementation of the trajectory modeling.

Although GNOME was determined to be best suited for the purposes of this study, there are limitations (beyond those inherent in selecting specific modeled scenario conditions), as with all models.

The GNOME model requires selecting the specific type of oil for the modeled trajectories from a predetermined list of pollutants. Bakken crude oil and diluted bitumen, which are the two most likely types of oil under the proposed action, are not included in this list. Therefore, the GNOME model cannot fully reflect how these types of oils would behave or persist in the environment when spilled. The GNOME mass balance output and ADIOS were used to perform additional analysis to account for this, allowing a comparison of the behavior of different types of oil in the environment.

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[3] These terms refer to the relative density of the oil on the surface of the water and should not be confused with the terms used to refer to different grades of crude oil (also referred to as light, medium, and heavy).
[4] ADIOS is an oil spill response tool, also developed by NOAA, which models how different types of oil undergo physical and chemical changes in the marine environment.
[5] During real spills, NOAA's response team uses GNOME in its advanced Diagnostic Mode, and all of the data entered into the model is carefully examined to determine if it applies to the scenario at hand (National Oceanic and Atmospheric Administration 2002:4).

The trajectory analysis assumes *medium crude oil* (a pollutant choice available in GNOME) as the best proxy for Bakken and diluted bitumen. Bakken crude oil has "lighter" components that act like diesel oil in the environment (by evaporating at a faster rate than heavier oils); however, there are aspects to Bakken that make it a "heavier" oil. Diesel oil is also a pollutant choice in GNOME; however, a diesel oil spill would primarily evaporate over time, and using diesel would not accurately portray how the more persistent characteristics of Bakken would behave in the environment. Bitumen, although a much heavier oil when extracted from the ground, also has a lighter component because of the way it is prepared for transport (hence the term *diluted* Bitumen). The use of a medium crude oil within the GNOME pollutant list, rather than a heavier oil, provides a set of characteristics that blends the lighter components in Bakken and diluted bitumen with the more persistent characteristics of a crude oil. Moreover, medium crude is the only crude oil selection available in the pollutant list.

The Grays Harbor Location Files used in the GNOME trajectory analysis were developed to address hydrodynamic conditions within the harbor and are not meant to model accurately the movement of oil outside of Grays Harbor. Consequently, because model variables such as winds and currents are spatially constant within GNOME, they are reliable for harbor conditions but are less reliable as the distance from the harbor increases and the influence of other currents, winds, rivers (e.g., the Columbia River has a very large effect on offshore currents south of Grays Harbor), and associated climatic variables come into play. This means that graphical depictions of the modeled trajectories are limited to the geographic extent of the Location Files when, during an actual spill, oil could continue to spread over time and travel beyond the immediate vicinity of the harbor depending on the existing current and wind conditions at the time of the spill. For a discussion of factors influencing movement along the coast, see Attachment A.

It is also important to note that lacking reliable discharge data for the Chehalis River, NOAA model developers made an informed estimate of river flow conditions for the Location Files based on estimated flow data for rivers of similar size.[6] The river flow has an impact on currents within Grays Harbor, and these estimates provide a reasonable approximation of the degree of impact.

Finally, Location Files for Grays Harbor do not include the Rennie Island shoreline; however, most of the environmental conditions associated with the island are included in the model. For example, the currents in the shipping channel that adjoins Rennie Island are believed to be the strongest influence on the movement of oil in the harbor and therefore oil would most likely go around either side of the island unless directly pushed onto the shoreline by strong winds (Watabayshi pers. comm.).

[6] High river flows are scaled to 0.5 meters/second and low river flows are scaled to -.03 meters/second. These speeds are scaled at the following reference point: 46.9575 N and -123.8383 W. High and low river speeds were selected to bracket the distance that oil could travel between the two river flow extremities.

Modeled Scenarios

Trajectory analyses and oil concentration contours for surface oiling were developed for the following hypothetical spill scenarios at 24 hours and 48 hours post-spill.[7] All scenarios assume instantaneous release of crude oil and no response actions taken.

- A release of 10,000 gallons (238 barrels) during vessel loading at the Terminal 1 berth.
- A release of 8.4 million gallons (200,000 barrels) from a storage tank at the project site.
- A release of 15.1 million gallons (360,000 barrels) of crude oil and vessel fuel from a vessel at the entrance to Grays Harbor.

The storage tank and vessel releases were modeled assuming an instantaneous release of all tank/vessel contents into the water to provide an extreme representation of these release scenarios. As discussed in Appendix M, *Risk Assessment Technical Report*, these are very unlikely scenarios. Moreover, the information displayed on Figures 1 through 6 represents oil spills that are unmitigated by response efforts such as boom placement or removal of oil by vacuum trucks and skimmers. This is also unlikely in light of federal and state preparedness and response requirements.

As discussed earlier, the GNOME Location Files provide the ability to model oil spill trajectories under oceanographic (currents and river flow) and atmospheric conditions (winds) within Grays Harbor. For this analysis the hypothetical spill scenarios were modeled as if they occurred under average seasonal conditions for the harbor; that is, oceanographic and atmospheric conditions were selected to approximate average winter and summer conditions.

Results

GNOME Trajectory Results

GNOME modeling results for each hypothetical oil spill scenario are presented for both summer and winter conditions within Grays Harbor. Although there is no single “typical” weather pattern in the Grays Harbor area, historically there are seasonal shifts in wind direction and ocean currents. In the summer, ocean currents are typically to the south and winds from the west–southwest; in the winter, ocean currents are typically to the north and winds from the east–northeast.[8] The Chehalis River is also subject to variations in river flow.

Trajectory models were developed using four sets of hydrodynamic conditions to represent these seasonal and river influences on water movement within Grays Harbor, as described in Table 1. These models depict potential surface oil movement for hypothetical spill scenarios occurring under average or typical seasonal weather patterns combined with estimates of low or high river flows.

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[7] Scenarios (quantity of oil spilled and location) were selected based on state contingency planning criteria and took into account GRP potential spill origin points and proposed project activity.

[8] Different GNOME modeling dates were chosen to obtain accurate historical weather data for depicting summer and winter seasonal conditions.

Prevailing winds and the associated sea state have a significant effect on the movement of oil spilled on the water's surface.

Table 1. Four Sets of Hydrodynamic Conditions

Season Depicted	Seasonal Winds[a,b] Direction (from)	Seasonal Winds[a,b] Average Speed (mph)	Ocean[c] Currents (to)	River Flow[c]
Summer	WSW	8	South	High
Summer	WSW	8	South	Low
Winter	ENE	10	North	High
Winter	ENE	10	North	Low

[a] Historical wind data was generated from the Iowa State University of Science and technology website using the Washington State Automated Surface Observing Systems network data collected at Hoquiam/Bowerman Airport.

[b] A review of 18 years of historical wind data was conducted to identify average or typical wind speeds and directions during the summer (July) and winter (January). Based on this review, a representative set of wind speeds and direction were selected for a 24-hour period for each season (summer and winter). The same wind conditions are repeated for the second 24 hours to achieve a full 48-hour trajectory.

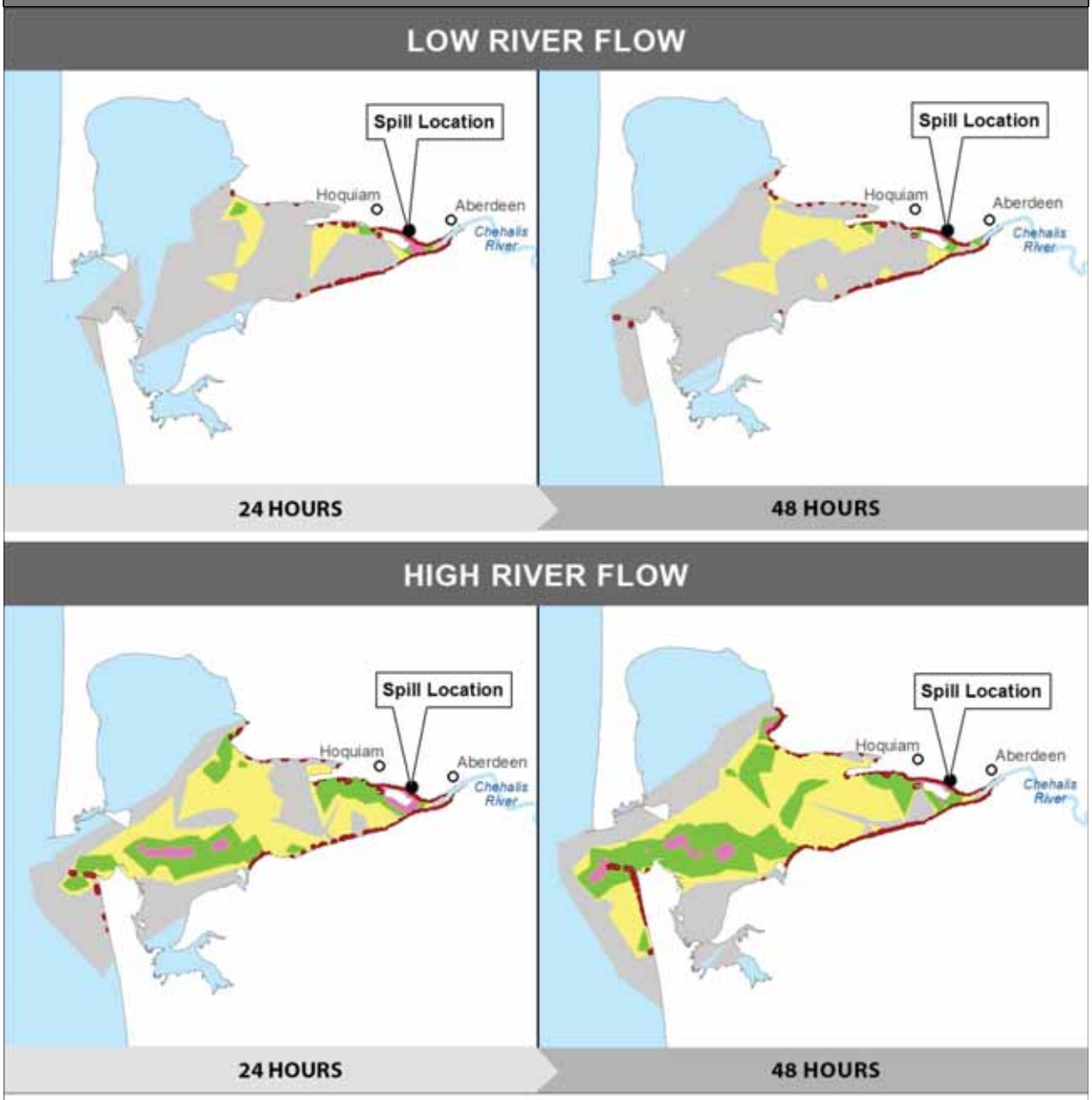
[c] Ocean currents and river flow conditions are applied from Location Files for Grays Harbor prepared by NOAA. They are developed from climatological information and are not designed to model real spills accurately.

WSW = west–southwest; ENE = east–northeast; mph = miles per hour

The modeled trajectory results are presented for each release scenario in Figures 1 through 6. Trajectories for each release scenario show surface and shoreline oiling for two separate seasonal currents (e.g., summer winds/currents to the south and winter winds/currents to the north). For each seasonal current depiction, the trajectories are shown at 24 hours and at 48 hours after the release. Trajectories for high and low flows in the Chehalis River are also shown. For each modeled condition (Figures 1 through 6), the *bounding contour*, or confidence limit (represented as light gray on the figures), represents the "minimum regret" solution that accounts for uncertainty in the trajectory model.[9]

[9] According to the *GNOME User's Manual*, "As a very rough rule of thumb—assuming a 'typical' degree of uncertainty in the wind and current information you use in modeling a spill scenario—the chance that the spilled oil will remain within the area covered by the red splots is on the order of 90%" (National Oceanic and Atmospheric Administration 20002:28) In the trajectory maps used for this analysis the red splots are represented by the bounding contour/confidence limit – the gray shading.

Figure 1. Trajectory of an Instantaneous Release during Vessel Loading at Terminal 1—Summer Winds/Currents to the South



Legend

- Beached Oil

Relative Distribution

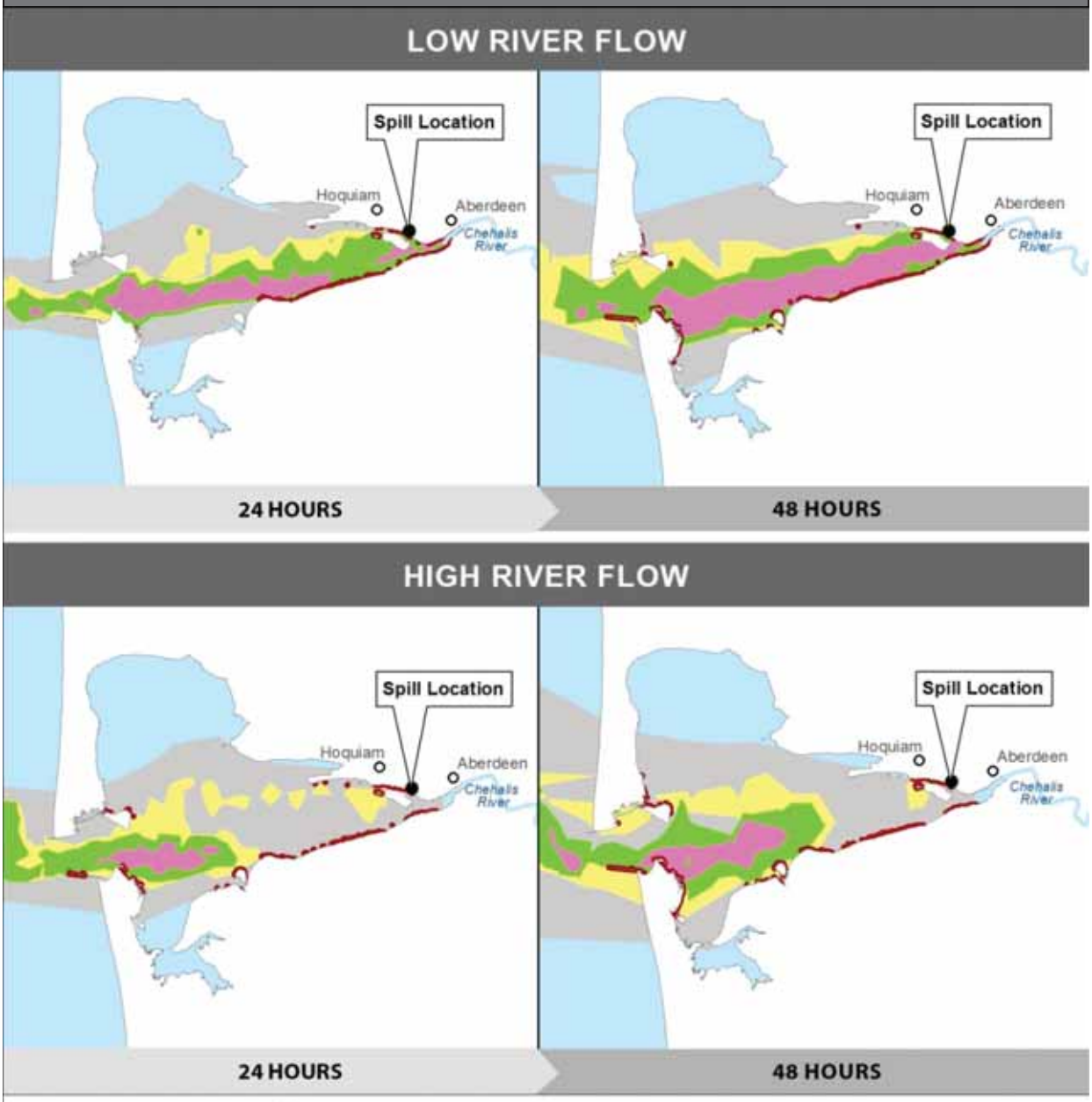
- Light
- Medium
- Heavy
- Confidence Limit

Model reflects trajectory (direction and extent) of oil spill during low (top) and high (bottom) river flows at 24 hours (left) and 48 hours (right) if no response actions were taken.

Release Location:	Grays Harbor at Terminal 1 Dock
Release Volume:	238 Barrels of Crude Oil
Winds:	Variable, Predominantly from the West South West (8 mph average)
Currents:	to the South

Distribution contours are modeled results obtained from the NOAA GNOME Analyst software

Figure 2. Trajectory of an Instantaneous Release during Vessel Loading at Terminal 1—Winter Winds/Currents to the North



Legend

- Beached Oil

Relative Distribution

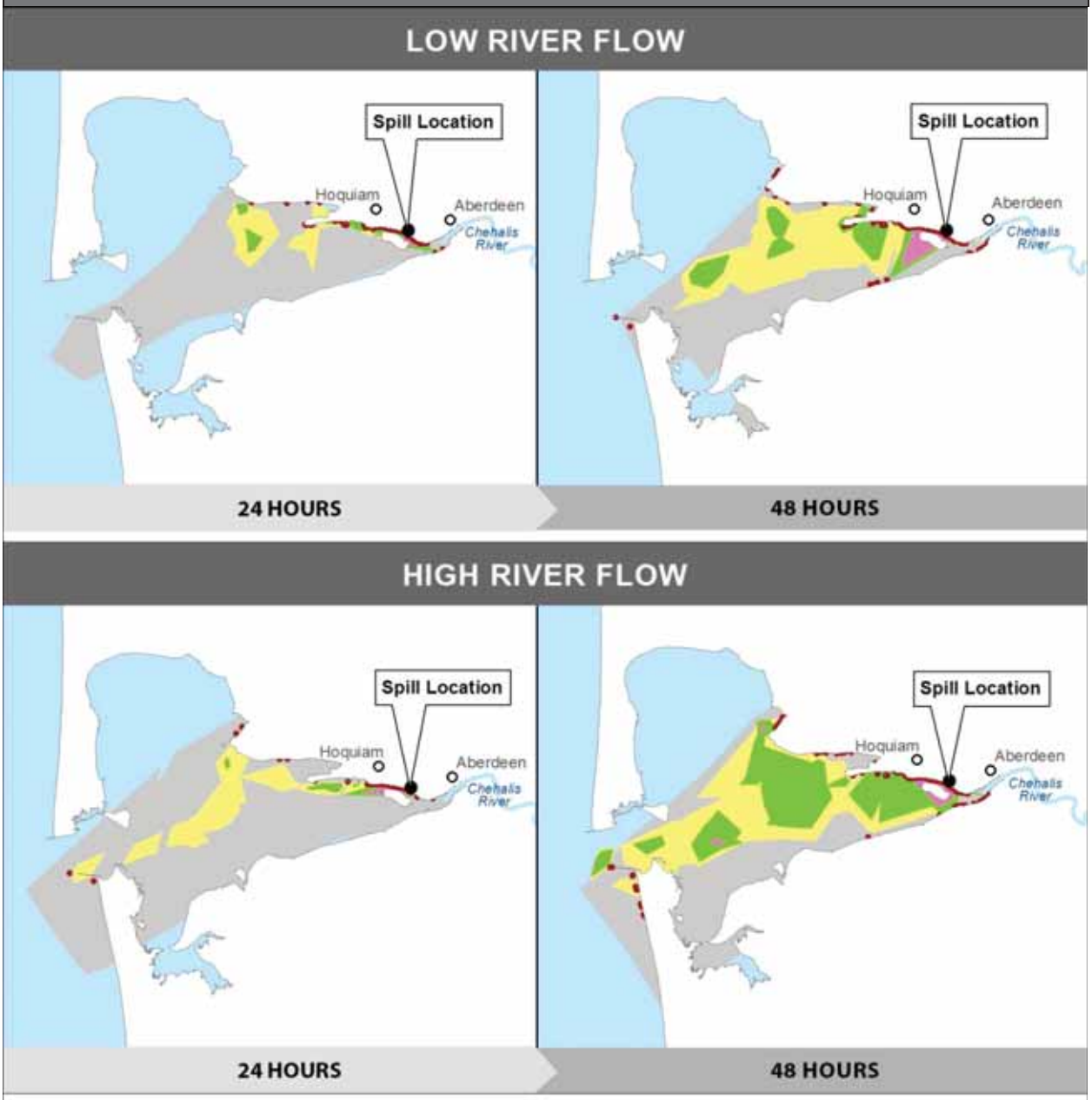
- Light
- Medium
- Heavy
- Confidence Limit

Model reflects trajectory (direction and extent) of oil spill during low (top) and high (bottom) river flows at 24 hours (left) and 48 hours (right) if no response actions were taken.

Release Location:	Grays Harbor at Terminal 1 Dock
Release Volume:	238 Barrels of Crude Oil
Winds:	Variable, Predominantly from the East North East (10 mph average)
Currents:	to the North

Distribution contours are modeled results obtained from the NOAA GNOME Analyst software

Figure 3. Trajectory of an Instantaneous Release of a Storage Tank—Summer Winds/Currents to the South



Legend

- Beached Oil

Relative Distribution

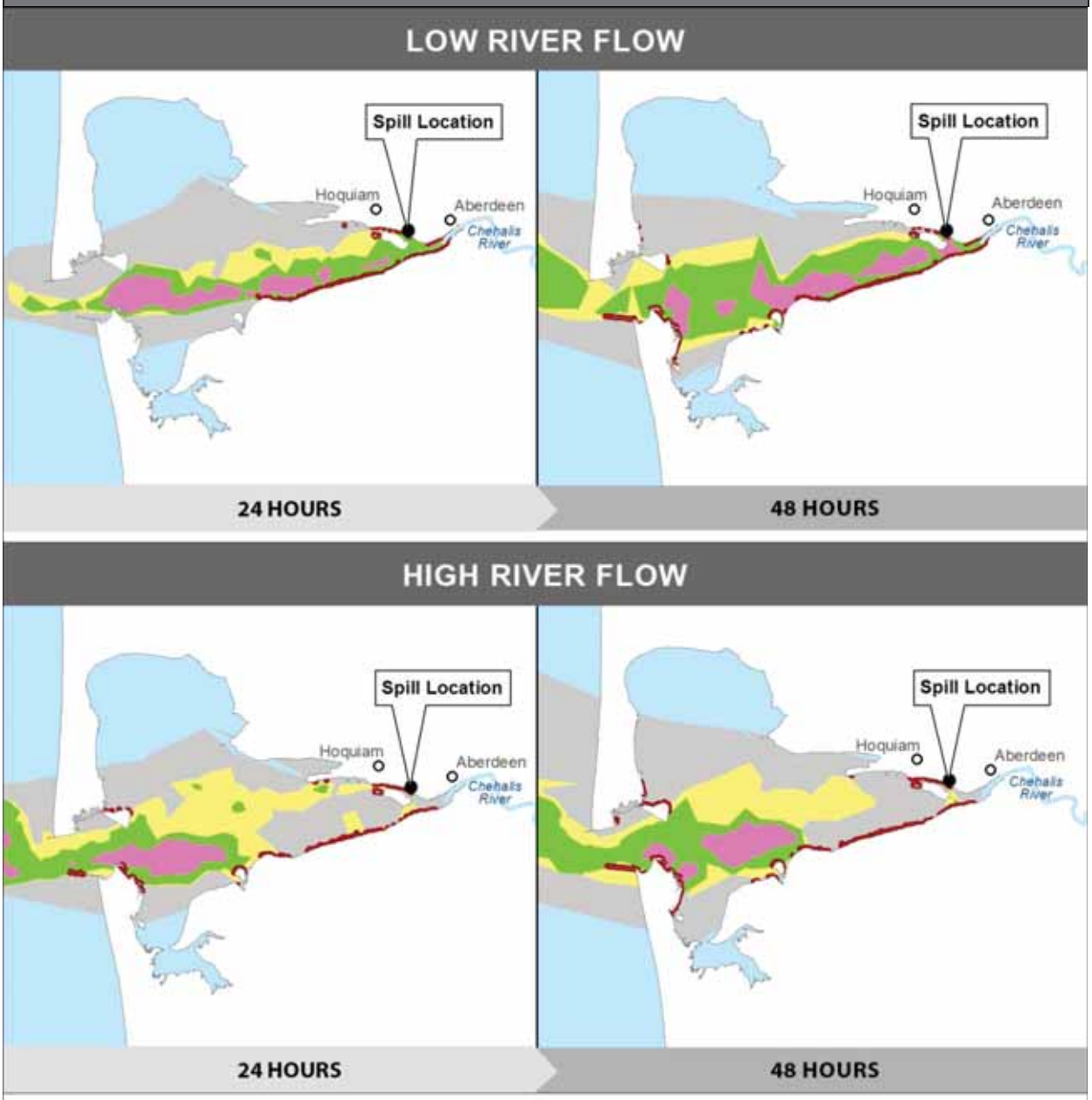
- Light
- Medium
- Heavy
- Confidence Limit

Model reflects trajectory (direction and extent) of oil spill during low (top) and high (bottom) river flows at 24 hours (left) and 48 hours (right) if no response actions were taken.

Release Location:	Project Site Tank Storage Area
Release Volume:	200,000 Barrels of Crude Oil
Winds:	Variable, Predominantly from the West South West (8 mph average)
Currents:	to the South

Distribution contours are modeled results obtained from the NOAA GNOME Analyst software

Figure 4. Trajectory of an Instantaneous Release of a Storage Tank—Winter Winds/Currents to the North



Legend

- Beached Oil

Relative Distribution

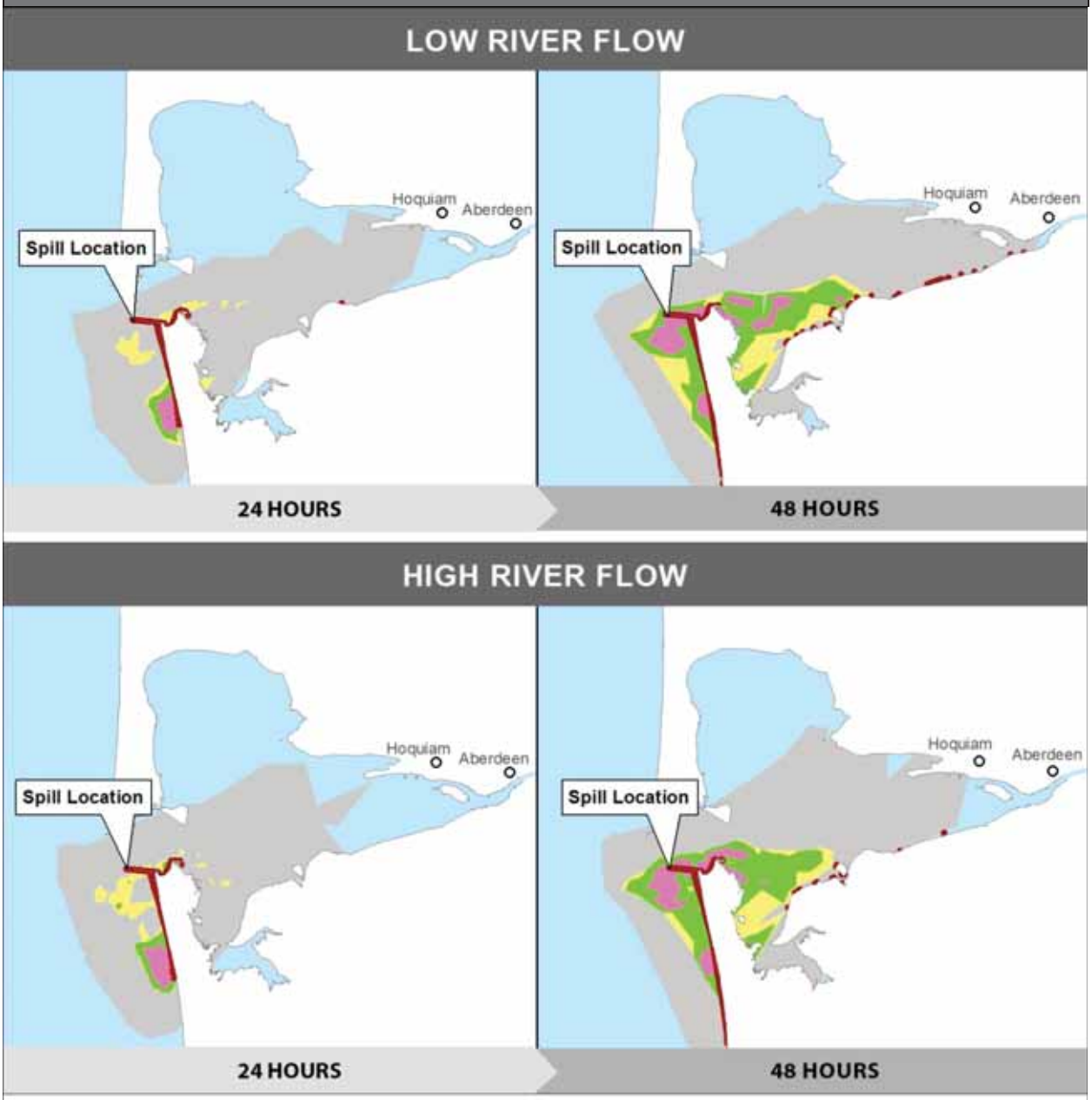
- Light
- Medium
- Heavy
- Confidence Limit

Model reflects trajectory (direction and extent) of oil spill during low (top) and high (bottom) river flows at 24 hours (left) and 48 hours (right) if no response actions were taken.

Release Location:	Project Site Tank Storage Area
Release Volume:	200,000 Barrels of Crude Oil
Winds:	Variable, Predominantly from the East North East (10 mph average)
Currents:	to the North

Distribution contours are modeled results obtained from the NOAA GNOME Analyst software

Figure 5. Trajectory of an Instantaneous Release from Tank Vessel during Transit—Summer Winds/Currents to the South



Legend

- Beached Oil

Relative Distribution

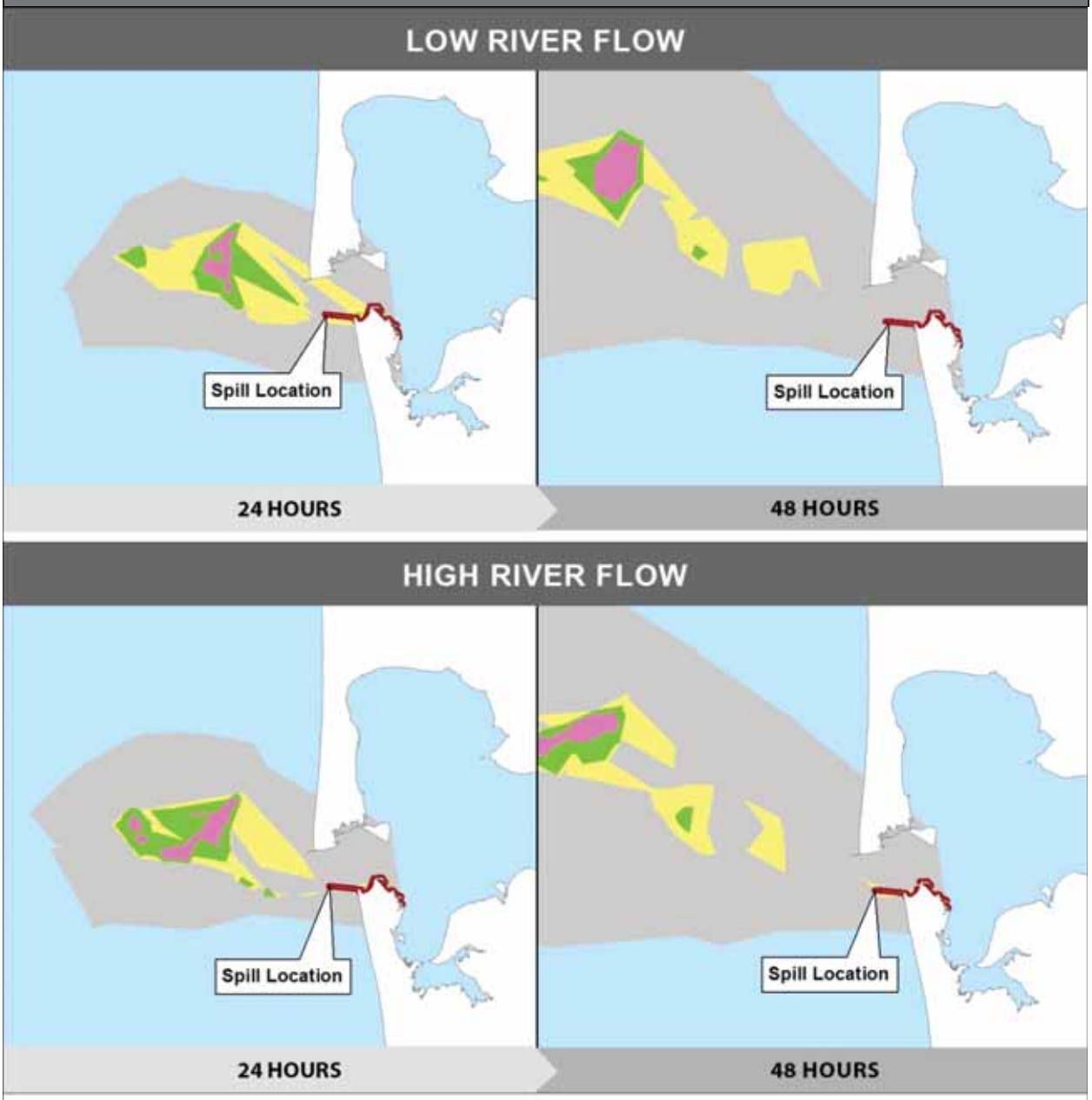
- Light
- Medium
- Heavy
- Confidence Limit

Model reflects trajectory (direction and extent) of oil spill during low (top) and high (bottom) river flows at 24 hours (left) and 48 hours (right) if no response actions were taken.

Release Location:	Near Grays Harbor Entrance Jetties
Release Volume:	360,000 Barrels of Crude Oil and Vessel Fuel
Winds:	Variable, Predominantly from the West South West (8 mph average)
Currents:	to the South

Distribution contours are modeled results obtained from the NOAA GNOME Analyst software

Figure 6. Trajectory of an Instantaneous Release from Tank Vessel during Transit—Winter Winds/Currents to the North



Legend

- Beached Oil

Relative Distribution

- Light
- Medium
- Heavy
- Confidence Limit

Model reflects trajectory (direction and extent) of oil spill during low (top) and high (bottom) river flows at 24 hours (left) and 48 hours (right) if no response actions were taken.

Release Location:	Near Grays Harbor Entrance Jetties
Release Volume:	360,000 Barrels of Crude Oil and Vessel Fuel
Winds:	Variable, Predominantly from the East North East (10 mph average)
Currents:	to the North

Distribution contours are modeled results obtained from the NOAA GNOME Analyst software

GNOME Mass Balance Results

As mentioned previously, GNOME also calculates a mass balance of the "best guess," or forecast, solution for each spill. In the case of this analysis, the mass balance is the fate (i.e., proportion of the spilled oil that is floating, gets beached, or evaporates or is dispersed) of different portions of the oil spill due to the trajectory, the pollutant type, and the weathering that the pollutant has undergone (National Oceanic and Atmospheric Administration 2002:81). GNOME shows the mass balance in percentages over time as the proportion of the spill that is floating, beached, evaporated and dispersed, and off the map (National Oceanic and Atmospheric Administration 2002:52).[10]

Because GNOME does not currently offer the ability to model spilled Bakken crude or diluted bitumen, all mass balance estimates herein are based on modeling medium crude oil as the spilled pollutant. Medium crude oil was selected to present an over-estimation of persistence in the environment, comparable to an actual spill of Bakken crude oil or of diluted bitumen. However, both Bakken and diluted bitumen will not behave identically to medium crude under spill conditions due to their different compositions.

The numbers in Table 2, representative of a spill of medium crude, depict the model's best estimates for the most quantity of oil that would remain in the environment as time progresses (from a 24- to 48-hour period) post-spill, presented as a percentage range across the four sets of hydrodynamic conditions for each scenario.

Table 2. Range of Mass Balance Estimates for "Best Guess" GNOME Analysis of Selected Scenarios

Scenario		Percentage Range of Oil Floating	Percentage Range of Oil Beached	Percentage Range of Oil Evaporated and/or Dispersed
Release During Vessel Loading (10,000 gallons or 238 barrels)	At 24 hours	2.9–20.0%	57.2–74.3%	22.8%
	At 48 hours	3.2–15.7%	51.6–64.1%	32.7%
Facility Release (8.4 million gallons or 200,000 barrels)	At 24 hours	1.9–18.6%	58.6–75.3%	22.8%
	At 48 hours	1.9–15.0%	52.3–65.4%	32.7%
Vessel Release (15.1 million gallons or 360,000 barrels)	At 24 hours	2.7–31.4%	45.8–74.5%	22.80%
	At 48 hours	2.4–5.7%	61.4–64.9%	32.7–32.8%

ADIOS Output Comparison Results

The mass balance outputs in GNOME for spills of medium crude provide a baseline for comparison when estimating the persistence of a spill of Bakken crude oil or diluted bitumen in the environment. Some understanding of the differences in the behavior of Bakken crude oil or diluted bitumen in the environment may be obtained by comparing the weathering properties of the two

[10] The "off map" numbers for all of the trajectories were zero and are omitted for the sake of brevity.

products against the weathering properties of medium crude oil using NOAA's ADIOS (National Oceanic and Atmospheric Administration 2015). A general discussion of oil properties is presented in Attachment B.

This section provides an ADIOS modeling comparison to further illustrate the difference in oil properties and behaviors. A spill of each type of oil (medium crude, Bakken crude, and diluted bitumen) was modeled in ADIOS (at a wind speed of 10 miles per hour) to allow for a comparison of oil characteristics and weathering.

The oil properties depicted in the ADIOS model are from samples of oil that were analyzed by a laboratory or, if no sample were available of a particular blend, the best-known information available about the crude oil. During an actual spill event, the oil spilled may exhibit slightly different properties even if it is referred to by the same name (i.e., Bakken or diluted bitumen) because of where it was mined or how it was treated for transportation.

A comparison of select chemical property values (viscosity and density) and weathering effects (rate of evaporation, dispersion, and oil remaining) of medium, Bakken, and diluted bitumen crude oils after 48 hours in the environment is shown in Table 3. The spill amount modeled was the same in all cases.

Chemical property and weathering terms are provided in *Definitions*, below to help understand the ADIOS results.

Table 3. Comparison of Oil Properties after 48 Hours in the Environment with 10 mph Winds

Property	Medium Crude Oil[a]	Bakken Crude Oil[b]	Diluted Bitumen Crude Oil[c]
Viscosity (cSt)	>100,000	500–600	>100,000
Density (kg/cu m)	1,000	896	995
Evaporated	23%	49%	25%
Dispersed	<1%	15%	<1%
Oil Remaining	77%	36%	75%

[a] An Alaska North Slope (ANS) crude blend was modeled in ADIOS as the medium crude oil. ANS crude blends are considered medium grade oils and can have an *American Petroleum Institute (API)* gravity generally in the range of 27.5 to 31.4. [11]

[b] NOAA used data from a Bakken spill in February 2014 to characterize Bakken crude oil behavior. API gravity for this sample was 40.8.

[c] The diluted bitumen selected in ADIOS was the Cold Lake Blend (from Alberta, Canada). The API gravity for this particular crude oil is 22.6.

cSt = centistokes

kg/cu m = kilograms per cubic meter

[11] API gravity will vary depending on the source of the crude oil. The NOAA Office of Response and Restoration website *Alaska North Slope Crude Blends* (http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/alaska-north-slope-crude-blends.html) introduces a BP ANS crude from Pump Station #9 with an API gravity of 29.6. The ANS crude used in GNOME has an API of 27.5. ExxonMobile mines and distributes an ANS crude with an API of 31.4 (http://www.exxonmobil.com/crudeoil/about_crudes_api.aspx#c101).

Definitions

- Viscosity: the amount of resistance to flow by a liquid. Low viscosity oils spread more quickly than those with a high viscosity. In addition to the chemical properties inherent to the oil, ambient temperature will influence oil viscosity. At low temperatures, an oil will tend to be more viscous (and spread less rapidly) than at higher temperatures. The medium crude modeled in ADIOS is slightly less viscous than the diluted bitumen.
- Density: the property of oil that reflects the mass or weight of the oil. The specific gravity of oil relates the density of oil to fresh water. If the specific gravity of an oil is greater than 1, then the oil is likely to sink in fresh water. None of the oils evaluated for this analysis have a specific gravity greater than 1.
- Evaporation: the physical change by which any substance is converted from a liquid to a vapor or gas. The rate of evaporation and the speed at which it occurs depend upon the volatility of the oil.
- Dispersion: waves and turbulence at the water's surface can cause some or all of the oil slick to break up into fragments and droplets. Some of the oil will become mixed into the upper levels of the water column and may remain suspended or even sink if they meet silt or sand. Other droplets may rise back to the surface and create a new slick or spread out in to a very thin film. The comparison in Table 3 shows that Bakken crude is the most likely of the three oils to disperse after a period in a turbulent marine environment.
- Oil remaining: represents the balance of spilled oil that is not evaporated or dispersed and that remains in the environment, either on the water's surface or on the shoreline.

Also relevant to a discussion about weathering is *emulsification*, which occurs when oil and water combine over time, resulting in the suspension of seawater droplets in oil creating a water-in-oil emulsion. This occurs by physical mixing promoted by turbulence at the sea surface. The emulsion formed is usually very viscous and more persistent than the original oil and is sometimes referred to as chocolate mousse because of its appearance. (International Tanker Owners Pollution Federation Limited 2015)

The ADIOS analysis demonstrated that, in most cases, medium crude oil would persist longer in the environment than Bakken. An exception is that Bakken is shown to be more likely to disperse than medium crude. This tendency may result in a mixing of the oil droplets or fragments with sediment in the water column and a resultant suspension of oil beneath the water's surface. As discussed in Attachment B, at the Marshall spill into Talmadge Creek and the Kalamazoo River, under certain conditions, diluted bitumen was observed as suspended in the water column or even sank.

Movement of Oil in Chehalis River

Methods

Based on the modeled oil spill locations, the existing Hydrologic Engineering Centers River Analysis System (HEC-RAS) one-dimensional hydraulic model for the Chehalis River and its tributaries was pared down to focus on the area of interest in the lower Chehalis River. The hydraulic model was used to assess the river channel characteristics for three flow events: low flow (731 cubic feet per

second), 2-year flood (31,000 cubic feet per second), and 100-year flood (83,000 cubic feet per second). The low-flow rate was developed based on the period of record (1952–2013) for U.S. Geological Survey stream gage #12031000 – Chehalis River at Porter, Washington.

The modeling results of interest included channel velocity, depth, and flow area at each representative river channel cross section. The model also included existing bridges and adjacent floodplains. The volume of spilled oil for three scenarios—one car, three cars, and five cars—was compared to the predicted volume of flowing water in the river for three flow rates. In most cases the total volume of the spill was less than 5% of the water volume in the river. However, at certain bridge locations the flow area is constricted, and oil volumes could greatly increase the combined depth of oil and water at the bridge, creating a localized flood stage scenario.

To determine the travel time from the location of the oil spill to the mouth of the lower Chehalis River in the Grays Harbor estuary, the measured distance between modeled cross sections was divided by the calculated velocity between two adjacent cross sections. This was repeated for all of the modeled cross sections and added to determine the cumulative travel time from the spill location to the estuary.

$$T = L/V, \text{ converted from seconds to minutes}$$

where

T = time (minutes)

L = length (in feet between cross sections)

V = velocity (hydraulic velocity in feet per second)/60 second per minute

Modeled Scenarios

Two locations were evaluated for the discharge of oil into the Chehalis River from rail tank cars involved in an accident. Each location was evaluated for three different flow events: low, 2-year, and 100-year. The first location was along the Chehalis River near Porter Creek Road West, in Elma and the second location was at the Wynochee Bridge (Figures 7 and 8).

Figure 7. Chehalis River near Porter Creek Road West

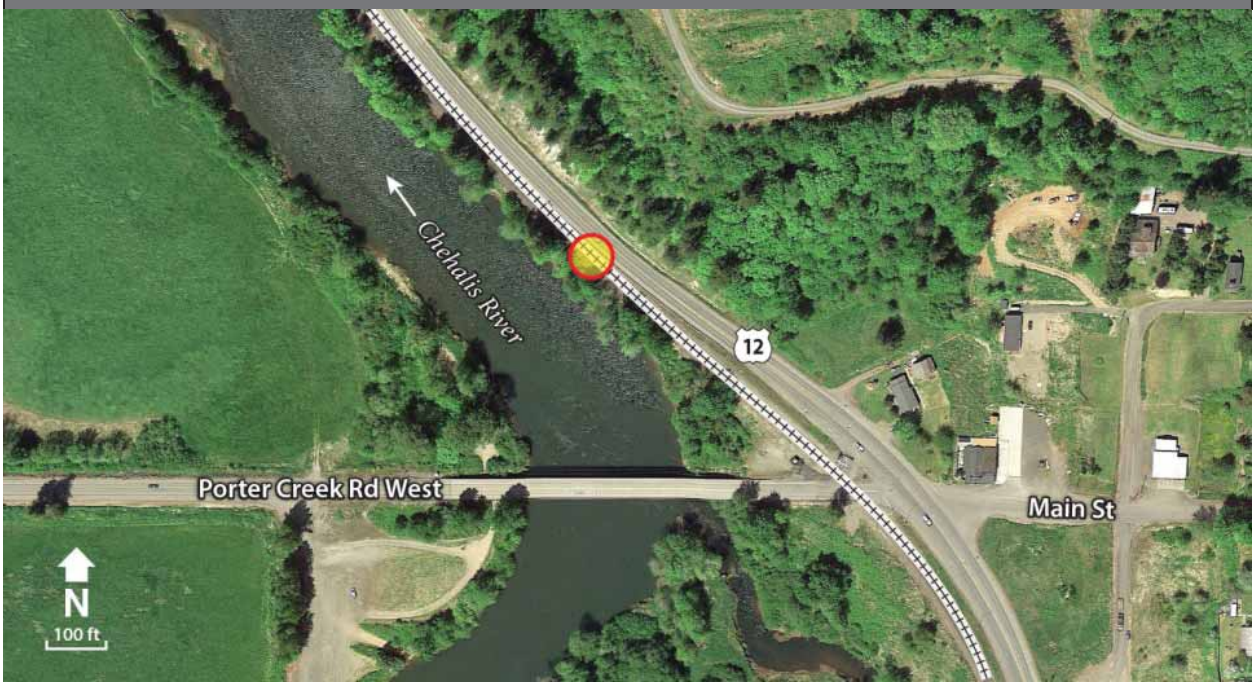


Figure 8. Wynochee Bridge

The low flow event was an average minimum flow based on the U.S. Geological Survey stream gage record that dates from the 1950s to the present.

ICF developed a 1-dimensional hydraulic model (HEC-RAS) to review the potential travel time of oil if a spill were to occur along the shoreline of the Chehalis River during various flood stages. The model relied on the geometry and hydrology that was previously developed by the Washington Office of Financial Management as part of the ongoing Chehalis River Flood Reduction Analysis (Elliot and Karpack 2014).

Amounts spilled at each location and evaluated within the model are shown in Table 4.

Table 4. Spill Amounts Modeled in the Chehalis River

One Rail Car	Three Rail Cars	Five Rail Cars
714 barrels	2,143 barrels	3,571 barrels
30,000 gallons	90,000 gallons	150,000 gallons

Model Results

Travel times consider that all of the oil spilled is transported to the estuary and do not account for the fate of the oil (due to weathering or transport of the oil onto shorelines or debris, for example) while it is in the river. Table 5 summarizes the results in travel times downstream from the spill point.

Table 5. Travel Times (in hours) of the Oil in the River for Three Different River Flows

Spill Location	Low Flow	2-Year	100-Year
Elma	108.5	18.1	7.6
Wynochee	75.3	11.5	8.2

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Attachment A
Factors Influencing Movement along the Washington Coast

Factors

Oil pushed outside of Grays Harbor by the local currents and the winds will migrate due to the influences of ocean winds and currents. Along the coastline and just off entrances to inland waterways (such as Grays Harbor and the Columbia River) currents are influenced by tidal and drainage effects. Farther offshore and at specific times of the year, currents depend largely upon prevailing winds[12]. Furthermore, as with the currents and winds within Grays Harbor, there are seasonal influences on ocean currents. Two oil spills that occurred off the Washington coastline illustrate the directions oil can migrate offshore depending upon seasonal conditions: The *Tenyo Maru* oil spill off Neah Bay, Washington, in July 1991 and the barge *Nestucca* oil spill that occurred in December 1988 just outside of Grays Harbor.

The *Tenyo Maru*, a fish processor vessel, and the Chinese freighter *Tuo Hai* collided on July 22, 1991, approximately 20 miles west of Cape Flattery, Washington, and 20 miles south of Vancouver Island, British Columbia, Canada. The location of the accident was approximately 110 miles north of the entrance to Grays Harbor. The collision resulted in the sinking of the *Tenyo Maru* in an estimated 350 feet of water. At the time, the *Tenyo Maru* was carrying 273,000 gallons (6,500 barrels) of intermediate fuel oil; 90,972 gallons (2,166 barrels) of diesel oil; and some quantity of lube, bilge, and fish oils. The oil leaked from the *Tenyo Maru* and migrated southeast for the most part, although a reversal of winds for a few days resulted in a northward movement (Watabayshi pers. comm.). Although oil shoreline impacts were north of Grays Harbor (oil was observed at Shi Shi beach, Cape Flattery, and the area between Tatoosh Island and Rialto Beach, with the heaviest impacts at Shi Shi; some impacts were also observed at Hobach Beach, Sooes Beach and Cape Alava), the case study illustrates how oil from a spill occurring offshore of Washington could migrate south (National Oceanic and Atmospheric Administration 1992:188).

The tug *Ocean Service* collided with its tow, the barge *Nestucca*, while trying to replace a broken towline. The collision occurred approximately 3 kilometers off the coast of Washington, near Grays Harbor on December 23, 1988, while the tug and tow were en route from Ferndale, Washington, to Portland, Oregon. The tug punctured a cargo tank on the *Nestucca*, spilling an estimated 231,000 gallons (5,500 barrels) of the heavy marine fuel oil that the barge was carrying (the barge was carrying over 2.9 million gallons (69,000 barrels) of Number 6 fuel oil; one tank was punctured). Some spilled oil entered Grays Harbor, affecting the mudflats. Oil also moved north and some came ashore on Vancouver Island on December 31, 1988 (8 days after the collision). Over the next 15 days, the oil reached to Cape Scott at the northwest tip of Vancouver Island, and, on January 27, 1989, oiled material, determined to be from the *Nestucca*, was found in the Moore Islands area on

[12] National Oceanic and Atmospheric Administration. 1992. Oil Spill Case Histories 1967–1991. September. Report No. HMRAD 92-11. Page 260.

the mainland of British Columbia. Along the coastline (north of Grays Harbor), the Canadian Coast Guard estimated that a total of about 95 miles of shoreline were oiled, with 1.5 miles heavily oiled.[13]

Neither of these oil spills originated within Grays Harbor, and it is impossible to compare the movement of oil from a spill origin point outside the harbor to one inside the harbor because of the heavier tidal influences within the harbor. Nevertheless, these case studies illustrate the many variables involved with an oil spill: the type of oil, the location spilled, and the climatological and hydrodynamic conditions in effect at the time of the spill all influence the movement, physical behavior, and ultimate disposition of the oil.

[13] *Ibid: page 128.*

Bakken

Bakken crude oil, like other crude oils, consists of a range of primarily hydrocarbon gases and liquids. Bakken crude oil is regarded as a light crude oil based upon its chemical properties (light crude oils are generally regarded as those crude oils with an American Petroleum Institute [API] gravity of 37 degrees or more). Light crudes tend to have higher concentrations of light ends (such as methane, ethane, propane, butanes, and pentanes) than heavier crude oils (like the medium crude modeled in GNOME). [14] The presence of these increasing amounts of dissolved gases and other light ends means that, spilled onto water, unweathered Bakken crude oil will primarily float on the surface.[15]

> From an analysis of spilled Bakken Crude Oil taken from the Mississippi River
>
> *The unweathered oil is highly aliphatic and contains a moderate amount of aromatics. The oil is highly volatile and caution should be taken when dealing with oil in confined areas.*
>
> NOAA Office of Response and Restoration. Incident News for Barge E2MS 303. 22 Feb. 2014.

Other general, but related, distinctions between a spill of medium crude oil and Bakken crude oil are as follows.

- Bakken crude oil has an API gravity generally in the range of 40 to 44.[16] This means that the Bakken crude oil is less viscous than a medium grade crude oil and will spread out more thinly on the surface of the water.
- Bakken crude oil's volatility suggests additional care if the material is corralled into a confined area.

In other words, compared to a spill of medium crude oil, as was modeled for the environmental impact statement using GNOME, the Bakken crude oil would more easily spread on the water's surface, and more of the oil would evaporate into the air over the same period.[17]

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[14] American Fuel & Petrochemical Manufacturers. 2014. *Survey of Bakken Crude Oil Characteristics for the U.S. DOT*. May 14. Page 12.

[15] As spilled oil remains in the environment, its physical and chemical characteristics interact with the physical and biochemical features of the habitat where the spill occurred. The sum of these processes is called "weathering" of the oil. See NOAA Office of Response and Restoration, "What is Weathering?" at http://response.restoration.noaa.gov/oil-and-chemical-spills/significant-incidents/exxon-valdez-oil-spill/what-weathering.html.

[16] *Survey of Bakken Crude Oil Characteristics for the U.S. DOT* and Louisiana State University Department of Environmental Sciences analysis of Bakken crude from E2MS303 barge spill.

[17] On February 22, 2014, a tank barge (E2MS 303) carrying Bakken crude oil as cargo collided with a towing vessel in the Mississippi River near Vacherie, Louisiana. Samples of the spilled oil were taken from the waterway and analyzed by the Louisiana State University Department of Environmental Sciences (taking samples for analysis is standard procedure for the investigation of oil spills). The results of that analysis informed the ADIOS model.

Diluted Bitumen

Diluted bitumen crude oil represents a range of oils produced from bitumen extracted from oil sands in Western Canada. In its original form, bitumen does not flow through a pipeline efficiently, so it is mixed with diluents to be readied for transportation.[18] Although diluted bitumen is a crude oil blend with an initial "heavy" constitution, its behavior in the environment when spilled and subsequently weathered is not fully understood because of the limited spill history associated with the oil. Taylor (2013:13) reported the following based on tests and two actual spills.

> The most significant observations are that the behavior of diluted bitumens tested or spilled are consistent with Group 3 and 4 crude oils: they float on water until oil densities change through weathering and/or sediment uptake. As with most crude oils, diluted bitumens may gradually overwash, become suspended in the water column, or sink depending upon the degree of weathering and formation of oil-mineral aggregates. The Marshall spill into Talmadge Creek and the Kalamazoo River resulted in oil transport down river with most oil remaining on the water surface. A portion of oil, mixed with riverbank and/or suspended settlement, and submerged or in places sank.

The API of diluted bitumen ranges from 18 to 39 (Taylor 2013:5). The values provided include weathered diluted bitumen from tests.

[18] American Petroleum Institute (API) and Association of Oil Pipelines. 2013. *Diluted Bitumen*. April. Available: http://www.api.org/policy-and-issues/policy-items/oil%20sands/diluted-bitumen. Accessed: January 2015.

Appendix O

Economic Impact Analysis

Economic Impact Analysis of Bulk Liquid Storage Facilities at the Port of Grays Harbor

October 2014 Update

October 28, 2014

Prepared for:

Westway Terminal Company LLC
and Imperium Renewables Inc.

ECONorthwest
ECONOMICS • FINANCE • PLANNING

Contact Information

This report was prepared by Matthew Kitchen, Tessa Krebs, and Robert Whelan of ECONorthwest, which is solely responsible for its content.

ECONorthwest specializes in economics, planning, and finance. Founded in 1974, we're one of the oldest independent economic consulting firms in the Pacific Northwest. ECONorthwest has extensive experience applying rigorous analytical methods to examine the benefits, costs, and other economic effects of environmental and natural resource topics for a diverse array of public and private clients throughout the United States and across the globe.

For more information about ECONorthwest, visit our website at www.econw.com.

For more information about this report, please contact:

ECONorthwest
222 SW Columbia Street
Portland, OR 97201
503-222-6060

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Appendix A: Overview of Economic Multiplier Models

1 Summary and Background

This report updates an analysis completed on September 5, 2013, which measured the combined economic impacts of two bulk liquid storage facilities planned for the Port of Grays Harbor. ECONorthwest updated the earlier analysis and calculated the impacts of each of the two facilities separately. In addition, ECONorthwest estimated the construction and operational impacts if the facilities were completed in two phases – a full build-out and half build-out.

Executive Summary

Westway Terminal Company, LLC (Westway) and Imperium Renewables Inc. are planning for expansion of their bulk liquid storage facilities at the Port of Grays Harbor. The expanded facilities will take bulk liquids from trains, store it, and then load it onto ships for distribution. Westway and Imperium Renewables engaged ECONorthwest to determine the economic impacts of expanding their storage services at the Port. This report summarizes that analysis.

ECONorthwest first calculated the overall impacts of the facilities' construction at full build-out on the economy of Washington. ECONorthwest found that:

- Westway will invest $61.3 million in Washington to expand their facilities and $39.7 million of that would be spent on Washington state labor and suppliers (Page 15).
    - At the Port of Grays Harbor, construction will last 9-16 months and, on average, have 128 Washington residents on the job with total labor income of $18.6 million (Page 16). The $39.7 million of direct construction expenditures in Washington will engender an additional $27.3 million in indirect and $23 million in induced economic output for a combined effect of $90.1 million (Page 16).
- Imperium Renewables will invest $66.1 million on the project and $32.3 million of that would be spent in Washington (Page 15).
    - The project will have, on average, 106 Washington residents on the job with total labor income of $12.9 million (Page 17). Imperium's construction spending in the state will have a combined effect of $74.1 million in economic output (Page 17).

ECONorthwest then calculated the impacts of the construction at Half Build-out for both Westway and Imperium Renewables. The results are:

- Westway will spend $38.3 million in Washington to build the first phase of the facility expansion and $23.6 million of that would be spent in state (Page19). This amount of spending will require an estimated 82 jobs on site with $10.4 million in income. The total economic output generated from Westway's expenditures is $54.1 million in economic output.

Economic Impacts: Full Build-out

ECONorthwest estimates that the plant will create the following economic impacts:

Westway Construction

Output: $90.1 million

Labor Income: $37.3 million

Jobs: 480

Annual Operations

Output: $24.9 million

Labor Income: $5.1 million

Jobs: 73

Imperium Construction

Output: $74.1 million

Labor Income: $28.6 million

Jobs: 390

Annual Operations

Output: $90.8 million

Labor Income: $13.1 million

Jobs: 207

- Imperium Renewables will invest $45.8 million to construct the half Build-out, of which $21.9 million will be purchased within the state. Approximately 73 local jobs will be required during construction. The impact, in terms of economic output, will total $51 million.

ECONorthwest also conducted an economic impact analysis of the first full year of operations at the Westway and Imperium Renewables facilities. In the first full year of operations, ECONorthwest estimates that the facilities will have the following impacts on the local economy:

- Operations at the Westway facilities, including supporting rail and marine services, will spend $6.6 million on goods, services, and labor. This spending will result in $24.9 million in economic output in Grays Harbor County (Pages 23 and 24).

- Imperium Renewables will spend $18.4 million a year on operations, which will result in $90.8 million in economic output in the county. (Pages 23 and 25).

- These operations (15 new terminal jobs at Westway and 20 at Imperium), supported entirely by the transshipment of bulk liquid, will directly employ 21 people in marine and rail services from Westway's operations and 83 from Imperium's. (Page 23).

- The terminal expansions represent a long-term commitment to the local economy ("permanent" jobs); which can result in further economic growth and stability. These terminal, rail and marine jobs will pay substantially higher compensation rates than the average in Grays Harbor County. Average annual wages, salaries, and benefits for these jobs will be over $84,000.

Finally, ECONorthwest looked at the operations impacts if both companies were to only construct the first phase of the facilities:

- Westway operating costs will be $3.9 million. The money spent in Grays Harbor County will stimulate production at many additional businesses through business purchases and consumer spending and generate $13.6 million in total economic output (Page 28).

- Imperium Renewables will spend $11.7 million, which will result in $48 million in total economic output in the county. (Page 29)

- Westway will employ 11 people and Imperium 14 directly, and additional jobs supported entirely by the transshipment of bulk liquid, will directly support 12 marine and rail jobs from Westway's operations and 49 from Imperium's. (Page 27).

Economic Impacts: Half Build-out

ECONorthwest estimates that the plant will create the following economic impacts:

Westway

Construction

Output: $54.1 million

Labor Income: $21.7 million

Jobs: 293

Annual Operations

Output: $13.6 million

Labor Income: $2.8 million

Jobs: 46

Imperium

Construction

Output: $51 million

Labor Income: $19.9 million

Jobs: 270

Annual Operations

Output: $48 million

Labor Income: $8.1 million

Jobs: 131

The impacts from operations, estimated in the first year, will reoccur in future years. Terminals are long-term investments. They operate steadily for decades. The jobs they provide and the jobs they support are generally high paying and secure. As such, workers and area business that rely on these initial investments will make investments of their own. Although beyond the scope of this report, these expected dynamic impacts can be nonetheless significant as the benefits from stable, long-term employment and business activity become rooted in the local economy.

In addition, Westway and Imperium Renewables will produce revenues for state and local governments in Washington. Such fiscal impacts are dependent on Westway and Imperium Renewables expanding in Grays Harbor, Washington. Market conditions are such that if not built in Grays Harbor, bulk liquid storage facilities may be constructed in another area. However, if built at the Port of Gray Harbor, the full Build-out scenario will result in state and local taxes and other revenues increasing by $11.1 million during construction and $1.8 million during the first year of full operations.

Project Background

Westway and Imperium Renewables have developed plans for expanded bulk liquids storage facilities at the Port of Grays Harbor. The Port is in Grays Harbor County along the central coast of Washington State. Timing for the construction and the start of operations is similar for each project and Westway and Imperium Renewables is interested in understanding the combined economic impacts from these expanded facilities.

The proposed projects will construct expanded bulk liquid storage facilities on two separate properties at the Port of Grays Harbor. Westway and Imperium Renewables will unload bulk liquid from trains, store the liquid at the terminals, and then load it onto oceangoing ships and barges. Somewhere between 1-2 trains a day will deliver the liquid to the combined facilities. And about 260 vessels a year will deliver bulk liquid from the Port to refineries and other customers along the west coast of the U.S.

Westway and Imperium Renewables will function as terminals, and will function on behalf of buyers and sellers of bulk liquids in return for revenue and/or transshipment fees. The combined facilities will be able to store up to 1,520,000 barrels of liquid, and are expected to transship over 36 million barrels of liquid per year.

This study measures the impacts of the full and half build-out (Phase 1 and 2) construction period for the terminal expansions, and for an operating year at their full and half production. ECONorthwest used an economic impact model for Washington State and Grays Harbor County based on the local spending patterns of businesses and workers. The model mathematically traces such spending as it flows through the local economy affected other businesses, households, and employment.

Construction of the projects will affect the economy through purchases from suppliers of construction goods and services, and by employing construction workers throughout Washington State.

Once operating, Westway and Imperium Renewables will employ people, and buy goods and services from the Grays Harbor County economy. So too will the supporting rail and marine businesses. Collectively, they will affect the economy and generate revenues for local government.

Westway and Imperium Renewables asked ECONorthwest to estimate the economic and fiscal impacts of the combined expansion projects. The analysis examined the impacts of each firm separately. This report summarizes the findings of that work.

This rest of this section of the report provides a general overview of Westway and Imperium Renewables bulk liquid storage expansion projects. Section 2 describes the method of analysis used by ECONorthwest, limitations and some key analysis assumptions. Section 3 summarizes the economic impact of the construction of the combined bulk liquid storage facilities on the economy of Washington. Section 4 discusses the results of ECONorthwest's analysis of impacts from operating the facilities on Grays Harbor County in an average future year of operations. The last section discusses the potential fiscal impacts of the combined facilities' construction and operations.

Westway

Westway Terminal Company LLC is a premier provider of bulk liquid storage and related services throughout the world. Westway has concentrated on the chemical and commodity markets.

Westway has 15 listed facilities in North America, 4 in Europe.

Westway's commitment to compliance on Health, Safety, Environment, Security and Quality (HSEQ) is demonstrated by their status as an OSHA Star participant, ISO and GMP accreditation in Europe, and Responsible Care in the U.S.

Westway is seeking to expand their current facilities at the Port of Grays Harbor. Westway has been a part of Grays Harbor County since 2009, operating a liquid bulk storage and transport facility. Westway is seeking to expand their current facility to include an area to receive, store and ship bulk liquids. This will enable the facility to receive approximately 9.6 million barrels of bulk liquids per year and store 800,000 barrels at any point in time.

The proposed action would be completed in two phases: Phase 1 would include constructing two storage tanks, expanding the existing onsite rail facilities, constructing related pipelines, upgrading dock capabilities, and installing a marine vapor combustion unit. The construction of this phase is also referred to as *half build-out* in this report. Phase 2 would include constructing three additional storage tanks.

The first phase of construction is expected to begin in late 2015 or early 2016 and is anticipated to last 10 to 12 months. The start date for Phase 2 construction is unknown, but construction is anticipated to last 10 months.

The project expands the existing Westway terminal to permit the transshipment of 9,600,000 barrels of bulk liquids on up to 60 Articulated Tug Barges (ATB) and vessels per year. The addition of rail spurs will provide a total of 80 rail loading/unloading spots to service the four 200,000 barrel capacity, internal floating roof tanks. The facilities will also include a new marine vapor combustion unit. The project will also upgrade dock capabilities in order to accommodate the loading of vessels with bulk liquids.

Imperium Renewables, Inc. (IRI) was founded in 2004 to commercialize novel and innovative design for biodiesel refining, with a focus on fuel quality and environmental sustainability.

Today, Imperium Renewables is a national leader in next generation biofuel production, driven by a single yet ambitious goal – to fundamentally change the way we fuel our cars, trucks, ships, trains and planes by developing and producing clean, renewable and sustainable alternative fuels, now and into the future.

Imperium Renewables

Imperium Renewables is a leader in the renewable energy industry. Headquartered in Seattle, Washington, Imperium Renewables currently operates a 100 million gallon per year capacity production facility in Grays Harbor, Washington and is the largest pure-play producer of biodiesel on the West Coast. Imperium Renewables is planning to expand their bulk liquid storage operations on a 10.9-acre site located at the Port of Grays Harbor. This project will involve construction of a tank farm that includes storage tanks, pipelines to Terminal 1 from the tank farm, rail spurs in connection with the existing Schneider's loop rail line, and construction of new buildings to support office, laboratory, maintenance and warehousing functions of the operations.

The proposed action would be constructed in two phases: Phase 1, or the *half build-out*, would include constructing five storage tanks; expanding the on-site rail facilities; and constructing a system of pipelines, a marine vapor combustion unit, and additional buildings. Phase 2 would include constructing the remaining four storage tanks.

Phase 1 construction of the proposed action is tentatively scheduled to start in late 2015 or early 2016 and is anticipated to last up to 18 months. Construction of the additional storage tanks could be completed within this timeframe or, if done at a later date, would require 3 to 4 months.

The expansion design and permits will require all tanks and infrastructure to be designed and constructed to store both renewable and conventional fuels and liquids. It is anticipated that the products stored onsite will vary over the life of the facility, and may include biodiesel, ethanol, US crude oil, jet fuel, gasoline, diesel, vegetable oils and other biofuel feed stocks.

They expect that all bulk liquids will arrive by train. The existing rail system will be expanded. Approximately 6,100 feet of track in multiple new rail spurs will be constructed on site in connection with the existing rail line, and the existing rail yard will be expanded. Rail delivery is projected to be up to one unit train per day consisting on average of 105 tank cars.

Pipelines will be installed connecting Terminal 1 with the tank farm, and a Marine Vapor Combustion Unit (MVCU) will be installed to incinerate displaced vapors during vessel loading. Based on the projections for inbound rail shipments, the need for transshipment includes up to 200 outbound vessels and barges per year.

2 Analysis Methods and Scope

Economic Impact Methodology

Researchers, policy makers, industry officials, and others are often interested in measuring the change in regional economic activity as result of an initial stimulus such as a business expansion project, changes in government policies, or the entry of an industry. Economic impact analysis provides a framework for analyzing these changes. ECONorthwest uses an expenditure approach within an input-output modeling framework to measure the economic impacts or "contributions" from an economic stimulus, in this case the combined expansion of Westway and Imperium Renewables bulk liquid storage facilities at the Port of Grays Harbor.

Input-Output Modeling

Input-output models are mathematical representations of the economy that show how different parts (or sectors) are linked to one another. The strengths of the input-output modeling framework include:

- A double-entry accounting framework that results in a model structure that is well ordered, symmetric, and where, by definition, inputs must be equal to outputs;
- A reasonably comprehensive picture of the economic activities within a region, with mathematical equations that describe the flow of commodities between producing and consuming sectors, the flow of income between businesses and institutions, and the trade in commodities between regions;
- Model construction using secondary source data that are gathered and vetted by government agencies; and
- The ability to cost-effectively create input-output or economic impact models for any region.

Input-output models that rely on survey or primary source data are expensive to construct. As a result, special modeling techniques have been developed to estimate the necessary empirical relationships. These techniques use a combination of national technological relationships and state- and county-level measures of economic activity, and have been packaged into the IMPLAN (for IMpact Analysis for PLANning) modeling software. This is the modeling system ECONorthwest used in this analysis.

IMPLAN Economic Impact Model

IMPLAN has been developed and distributed by the Minnesota IMPLAN Group, Inc., since 1993. The IMPLAN modeling system is widely used and well respected—there are currently more than 1,500 public and private users of the IMPLAN modeling software. The selection of IMPLAN by the United States Department of Agriculture (USDA) as its analysis framework for monitoring job creation associated with the American Recovery and Reinvestment Act (ARRA) of 2009 is a testament to its credibility.

In general terms, the IMPLAN model works by tracing how spending associated with an industry circulates through an economy or study area. That is, changes in one sector or multiple sectors trigger changes in demand and supply throughout the economy. Initial changes in the model propagate through the economy via supply- and demand-chain linkages, altering the equilibrium quantities of inputs and outputs and associated jobs, income, and value-added. These *multiplier effects* continue until the initial change in final demand leaks out of the economy in the form of savings, taxes, and imports.

Economic Impact Terms and Definitions

Economic impacts are classified by their relationship to the activity in question. For this analysis, the three types of impacts are defined, with regard to the terminal expansions, as follows:

- ***Direct impacts*** are those occurring at the terminals and include the jobs, output, and incomes earned at the terminals.

- ***Indirect impacts*** are production changes in backward-linked industries caused by the changing input needs of directly affected industries. Suppliers to the directly involved industry will also purchase additional goods and services; this spending leads to additional rounds of indirect impacts. Because they represent interactions among businesses, these indirect effects are often referred to as *supply-chain impacts*.

- ***Induced impacts*** are the changes in regional household spending patterns caused by changes in household income. The direct and indirect increases in employment and income enhance the overall purchasing power in the economy, thereby inducing further consumption- and investment-driven stimulus. Employees at the terminal, for example, will use their income to purchase groceries or take their children to the doctor. These induced effects are often referred to as *consumption-driven impacts*.

These three types of economic impacts are measured in terms of output, labor income, and employment resulting from spending in the study area:

- ***Output*** represents the value of goods and services produced, and is the broadest measure of economic activity.

- ***Labor income*** consists of employee compensation and proprietary income, and is a subset of output.

- Employee compensation includes workers' wages and salaries, as well as other benefits such as health, disability, and life insurance; retirement payments; and employer paid payroll taxes.

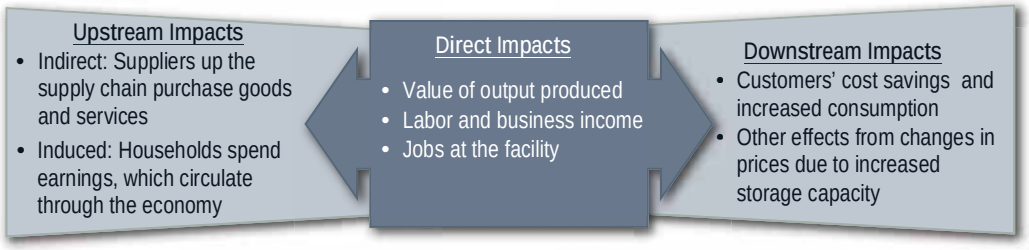
- Proprietary income (owner-operated business income) represents the payments received by small-business owners or self-employed workers. Business income would include, for example, income received by private business owners, doctors, accountants, and lawyers.

- ***Jobs,*** according to IMPLAN's methodology, are measured in terms of full-year–equivalents (FYE). One FYE job equals work over twelve months in a given industry (this is the same definition used by the federal government's Bureau of Labor Statistics). For example, two jobs that last six months would together count as one FYE job. A job can be full-time or part-time, seasonal or permanent; IMPLAN counts jobs based on the duration of employment, not the number of hours a week worked. Job impacts from operations are for one year of normal operations.

Scope of the IMPLAN Analysis

Economic impact analysis distinguishes between direct, upstream, and downstream impacts. Figure 1 summarizes the types of upstream and downstream impacts. In this case, the terms refer to the economic relationships between the services associated with storing and transshipping bulk liquids and the regional economy. Activities at the storage facilities themselves, including their construction and operations, count as direct impacts.

Figure 1: Types of Economic Impacts for Bulk Liquid Storage



Most commonly, economists follow the upstream impacts, which result from the projects' spending on all the goods and services it buys locally and on the payroll for its workers. Impacts continue moving upstream as suppliers and employee households spend money, triggering more spending and employment in the local economy. Using an input-output model, we can then follow the subsequent impacts going upstream to suppliers and induced household spending in the economy.

Downstream impacts are largely associated with changes in prices to goods and services as a result of the project. In the case of expanding liquid fuel storage capacity at the Port of Grays Harbor, for example, the effects on the price of fuels is assumed to be negligible (due to the global nature of the liquid fuels markets) and outside of the scope of this analysis, and therefore not estimated.

Geography

A vital element of Economic impact studies is the geography of the economy. Ideally, its boundaries should be defined such that most of the project's suppliers and workers come from within the defined region.

The construction associated with expanding Westway and Imperium Renewables storage facilities will draw mostly from construction labor within the State of Washington. This is typical of large industrial projects requiring specialized labor. Washington has a deep pool of skilled construction workers. Many of the business that would supply the development of the Westway and Imperium Renewables facilities are based inside the state. Thus, Washington was chosen for the construction impact analysis.

The economic geography of operations is different. Operating supplies, such as utilities and maintenance services, are most likely going to be locally sourced. The same is true for labor because a terminal offers long-term employment. Workers overwhelmingly will reside close by. This is normal, as evidence in Census data. U.S. Census data (2006-2010) shows that over 95% of employees working at businesses in Grays Harbor County also live in Grays Harbor County. Therefore, the economic impact analysis of Westway and Imperium Renewables facilities operations are measured for the economy of Grays Harbor County, not the entire state.

Project Elements

Construction Related Activities of the Terminal Expansions

Most impact studies of construction projects include the entire value of construction put-in-place. That is all construction and management jobs, all equipment installed, and all the building materials and services used. However, for large infrastructure developments, like Westway and Imperium Renewables, doing so overstates the true direct impacts on the economy. That is because some workers, equipment, and materials used in construction come from out of state. Their impact on the local economy is limited to whatever spending they cause in the state.

ECONorthwest chose to avoid overstating impacts. The scope of direct construction impacts is limited here to only the portion of jobs and construction spending paid to workers and businesses based in Washington State. In cases where equipment is purchased from outside Washington and installed at the terminal, the analysis here only counts the cost of installing that equipment as having a direct impact on the State of Washington.

Terminal Operations

The scope of the analysis of operations includes three elements or industries that will directly handle the bulk liquid at the Port. The first is the operations at the Westway and Imperium Renewables facilities themselves. The second is marine services. Those are the businesses associated with carrying bulk liquid on vessels. Although not directly working for Westway and Imperium Renewables, ships coming into the Port of Grays Harbor for bulk liquid would be doing so solely because of the Westway and Imperium Renewables facilities. Therefore, the work based in Grays Harbor County of tugs, pilots and others engaged in bringing ships in, loading them and providing provisions are included as contributing to the direct economic impacts of the terminal. The Port of Grays Harbor is one of the businesses that would provide services to the two facilities. The third element includes the direct impacts of the Puget Sound and Pacific Railroad at the facilities.

Time Coverage

The scope of an impact analysis is also defined by time. For construction impacts, this report condenses all the spending and employment for the entire period of development into one year. In reality, Phase 1 construction of the proposed action is tentatively scheduled to start in late 2015 or early 2016 and Westway anticipates their project to last 10 to 12 months; Imperium estimates this phase to last up to 18 months. The start date for Phase 2 construction is unknown, but Westway's construction is anticipated to last 10 months. Conversely, Imperium anticipates Phase 2 can be completed within the 18-month timeframe or, if done at a later date, would require 3 to 4 months.

The first full year of operations at the Westway and Imperium Renewables facilities is unknown. Currently, the economic impact analysis is for 2016, although it is likely the first year of operations will be later.

In both analyses, monetary values are expressed in 2013 dollars (*i.e.* real or inflation adjusted terms). Doing so removes changes in value that occur over time caused merely by inflation.

Outside the Scope of Analysis

IMPLAN measures the economic impacts of a project's spending on goods, services, and labor as money flows throughout the local economy over the course of a year. Money used to produce goods and provide services within the scope of analysis (time and location) are counted towards having economic impacts. But not all uses of money cause measureable impacts. The following are not considered:

- Downstream economic activity.
- Labor, goods and services from outside the local economy, such as new business activity and employment in locations where bulk liquids originate.
- Asset transfers are not a source of economic impacts because they do not cause anything new to be produced. For example, the sale of land.
- Interest and other finance charges.

- Savings that occur when businesses and workers retain rather than spend earnings.

- Savings are often invested, but IMPLAN does not account for them since the value of investments occur in future years. Undoubtedly some employees at the terminal will buy houses, but the impacts of this investment spending are not counted by IMPLAN.

Limitations

The goal of this research is to assess how the construction and operation of expanded liquid bulk storage facilities at the Port of Grays Harbor by Imperium Renewables and Westway will contribute to the local economy. To do this, the analysis relies heavily on construction and operating cost estimates provided by Imperium and Westway, and uses economic impact modeling techniques to measure the linkages between this spending and other industry sectors in the local economy.

This analysis does not measure potential counterfactual scenarios that consider how scarce resources would have been allocated, should the storage expansion projects never occur. For example, if there were no expansion of the facilities, and Westway and Imperium were to spend the money they otherwise would have on extensive renovations of their existing facilities, that spending would generate economic impacts to the state and county. However, this analysis does not take into account what would occur if Westway and Imperium were not to expand. It does not consider how funding and operating new bulk liquid storage tanks could divert spending from other potential uses (in economics, this is termed the "substitution effect"). This analysis assumes that as the investments are undertaken willingly by private entities the investment is a first-best use of those resources. The analysis assumes that access to national and international capital markets is unrestricted and that this investment does not drive out other worthwhile investments.

Furthermore, this analysis does not measure the potential economic development impacts of construction and expanded operations at the Port of Grays Harbor. Large investments in infrastructure can start a cycle of economic expansion, which economists refer to as an expansion of the "production possibilities frontier" of the economy. Such an effect is difficult at best to quantify, though local infrastructure improvements could lead to other businesses such as manufacturers, locating in and around Grays Harbor, Washington. The analysis also does not measure non-economic and environmental costs and benefits.

Westway and Imperium Renewables are in the advanced planning stages for their expanded tank farm terminal projects. ECONorthwest has used available estimates of construction costs, operations, throughput and timing to conduct this analysis. As a result, the economic impacts reported here may be subject to later revision. The results of the projects may reveal higher or lower impacts than those predicted in this analysis. For other information about Input-Output models, including their limitations, please consult Appendix A: An Overview of Economic Multiplier Models

Key Assumptions

ECONorthwest made the following assumptions regarding the Westway and Imperium Renewables facilities for the purposes of measuring the economic impacts of their construction and operations:

1. Construction will last 9-16 months. This report represents construction spending as a one year equivalent and shows the aggregate impact construction would have on Washington's economy.

2. All dollar values are expressed in 2013 dollars. Future price and wage increases are not reflected in any of the figures shown in this report.

3. ECONorthwest used the most current U.S. Census data on the heavy and civil engineering construction industry of Washington (2007), adjusted it to 2013 dollars, and calculated the number of construction managers per million dollars of terminal assets put in place.

4. The railroad delivering liquids to the Westway and Imperium Renewables facilities may invest in infrastructure. However, specifics are not known at this time and, therefore, not included in the economic impact analysis.

5. Operating output and employment for the railroad was limited to that which would occur in Grays Harbor County. Based on conversations with Puget Sound and Pacific, Westway and Imperium Renewables believe that there would be 30 added FYE railroad jobs in the full build-out scenario.

6. In the full build-out scenario, it is assumed that in 2016 the terminals will transship nearly 37 million barrels of bulk liquids per year. There will be nearly 260 oceangoing vessels loaded at the Port of Grays Harbor annually that would otherwise not come to the port but for the terminal storage facilities.

7. The terminals will handle and temporarily store bulk liquids. This analysis assumes that Westway and Imperium Renewables will not own the product. They will transship liquid for a fee to be paid to Westway and Imperium Renewables by the owner(s) of the liquids.

8. Each vessel call would cause $75,945 in direct economic output (in 2013 $) and employ the FYE of 0.45 workers, which is estimated to total 74 jobs annually. .[1]

[1] Data is based on the "2013 Local and Regional Economic Impact of the Port of Longview"

3 Economic Impacts from Construction

The following tables present the information related to the full build-out of the facility with detailed explanation of the construction plans and impacts associated. After this explanation, the costs and impacts associated with just the half build-out of the facility are reported. The full explanation is not provided along with the half build-out impacts, but it can be assumed, unless otherwise noted, that the description and explanations are the same as the following sections.

Construction Plans at Full Build-out

Westway and Imperium Renewables provided estimates of the capital costs for building the facilities. Construction costs include installation of tank farms that include storage tanks, pipelines to terminals from the tank farms, rail spurs and bermed rail car loading facilities, and construction of new structures for office, laboratory, maintenance, and warehouse functions. These estimates formed the basis of the construction impacts analysis.

For the purpose of simplifying the presentation, the economic impacts of the project were condensed into one year. Thus, employment is shown in full year equivalents. Values are inflation adjusted and expressed in 2013 dollars.

Westway and Imperium Renewables facilities expansions are large, heavy industrial projects. As such, much of the cost goes into buying equipment, concrete, steel, and engineering.

At full build-out, Westway and Imperium Renewables estimate that the entire cost of the facilities, from pre-development through opening, will cost $127.3 million to construct at the Port of Grays Harbor. The construction of the projects begins in 2014 and will be complete in 2015. The impacts of these construction projects on the economy of Washington State were measured and are reported in this section. Westway and Imperium Renewables provided ECONorthwest the following construction cost schedule.

Table 1: Full Build-out Cost to Construct Westway and Imperium Renewables by Asset Type, in Millions of 2013 Dollars

Category	Westway	Imperium
Total Labor		
$ wages, salaries, and benefits	$16.9	$13.5
FYEs	135	110
Construction spending		
Architectural, engineering, and related services	$3.6	$4.2
Various other services	1.9	3.7
Equipment purchases	7.5	27.2
Construction of other new nonresidential structures	44.5	26.5
Sales & use taxes	3.8	4.5
Total construction cost	**$61.3**	**$66.1**

Source: Westway and Imperium Renewables, September 2014

Put-in-Place Versus Washington Sourced Construction Spending

Although under the broadest definition the direct output of construction for the combined Westway and Imperium Renewables facilities is $127.3 million, not all of that affects the state's economy. For example, expensive pumping equipment made in another state is installed at the facility, that cost is included in the $127.3 million construction cost. But realistically, only the costs expended installing the pumping equipment at the facility is truly construction occurring in Washington. ECONorthwest has estimated that portion of the total construction which would use Washington sourced labor, materials, equipment, and services.

Westway and Imperium Renewables identified several key construction components with regard to their sources. Since the project in the planning stage, the sources of only some components are known with certainty. Westway and Imperium Renewables also provided information about direct construction labor. ECONorthwest then used Census data on commutation and the Washington construction industry to estimate the portion of labor that would come from within the state.

For equipment and materials costs in which the source has not yet been identified, IMPLAN's regional purchase coefficients were used to estimate how much would be purchased locally. These coefficients are based on Economic Census and other data collected by the government. The coefficients estimate the percentages of various components in detail that a heavy industrial construction project in Grays Harbor County would likely obtain from Washington.

Based on construction cost data provided by Westway and Imperium, the analysis estimates that $72 million out of the entire $127.3 million construction projects would come from Washington sources. $40.5 million of the $94.4 million in materials, equipment, other purchased goods, and services would be from Washington businesses and governments. Wages, salaries, and benefits earned by all those on the construction projects will total $32.9 million and, of that, $31.5 million would go to workers residing in Washington. The results of this analysis are shown in Table 2.

Table 2: Total Cost to Construct Westway and Imperium Renewables Facilities by Component, in Millions of 2013 Dollars

Components	Total cost of construction put-in-place	Sourced in Washington state
Labor: salaries, benefits*		
Westway	$16.9	$16.1
Imperium	13.5	12.9
Total Labor	30.4	29.0
Materials, equipment, services and other		
Westway	$41.8	$21.1
Imperium	52.6	19.4
Total Materials	94.4	40.5
Total All	**$127.3**	**$72.0**

Sources: Westway and Imperium Renewables, September 2014, IMPLAN, and ECONorthwest analysis of Census data.
** All labor involved in the project including management, engineering and administration.*

Westway will invest $61.3 million in Washington to expand their facilities and $39.7 million ($16.1 million in labor and $21.1 million in materials) of that would be spent on Washington state labor and suppliers. Imperium Renewables will spend $66.1 million on the project and $32.3 million ($12.9 million in labor and $19.4 million in materials) is estimated to be spent within the state.

Jobs

ECONorthwest estimated the number of full year equivalent jobs needed to build a $127.3 million heavy industrial project in Washington. The estimate involved information about construction labor from Westway and Imperium Renewables (these projects will directly employ 135 FYE construction jobs for Westway and 110 for Imperium) and an estimate of construction management and administration jobs using the 2007 Economic Census of Washington for the heavy and civil engineering construction sector.[2] Adjustments were necessary before the Census data could be applied to these projects.

The first adjustment was done to account for subcontractors. The Census reports that companies in the specialty subcontractor sector did about 19 percent of the work of the heavy construction industry. ECONorthwest added management and administrations jobs of specialty contractors in accordance to their share of the gross value of heavy construction. Other adjustments were made for inflation and productivity.

The construction projects themselves would last between 9 and 16 months. The jobs would not all be at the jobsite in Grays Harbor County. There will be jobs elsewhere in Washington at the offices of contractors, jobs on trucks delivering materials and equipment to the jobsite, and administrative jobs at subcontractor offices.

Results of the Construction Impact Analysis at Full Build-out

ECONorthwest ran an IMPLAN analysis using the Washington State sourced portion of construction that would be put-in-place while building the Westway and Imperium Renewables facilities. Thus, the direct output of construction, while $127.3 million in gross terms, is shown on Table 3 as $72 million as being sourced in Washington. Likewise, of the $30.4 million in labor costs for the project, $29 million is shown as being sourced from Washington IMPLAN measures indirect and induced impacts to Washington State that flow from the direct construction expenditures and jobs. IMPLAN accounts for out-of-state "imported" goods and services, and commuter flows, thus revealing the total impacts to Washington State alone. By taking this approach, the analysis gives a realistic perspective of what such a project means for the state's economy.

Table 3: Economic Impacts on Washington Arising from the Full Build-out Construction of Westway at the Port of Grays Harbor

		Put-in-Place	Sourced in Washington
Output	Direct	$61,172,000	$38,917,000
	Indirect		$29,535,000

[2] Available at the U.S. Census website http://www.census.gov/econ/census07/

	Induced		$21,656,000
	Total		$90,108,000
Labor Income			
	Direct	$16,878,000	$16,084,000
	Indirect		$11,407,000
	Induced		$7,583,000
	Total		$35,074,000
Jobs			
	Direct	135	128
	Indirect		193
	Induced		162
	Total		483

Sources: ECONorthwest IMPLAN analysis using data from Westway and the US Census, September 2014.

Direct construction output from Washington sources will require or cause $27.3 million in output from other industries within the state. Spending in Washington by jobholders of the Westway facilities construction projects, as well as workers of other industries needed to produce the indirect output, will add $23 million to the total. In aggregate, a total of $90.1 million in output in Washington, during the construction project, would be linked to the expansion.

In terms of labor income statewide, $35.1 million would be associated with Westway's construction project and its upstream effects. That income would be earned by the FYE of 480 workers. For every construction job, about another 2.5 jobs would be supported by the facilities' development. The average income of onsite construction jobs is noticeably higher than the compensation per worker for jobs supported by indirect and induced spending. The compensation for construction workers is estimated to average over $125,000 in total compensation; this is over two times the average of all secondary jobs ($53,500).

Table 4: Economic Impacts on Washington Arising from the Full Build-out Construction of Imperium Renewables facilities at the Port of Grays Harbor

		Put-in-Place	Sourced in Washington
Output	Direct	$66,083,000	$32,297,000
	Indirect		$24,171,000
	Induced		$17,671,000
	Total		$74,139,000
Labor Income			
	Direct	$13,483,000	$12,931,000
	Indirect		$9,498,000
	Induced		$6,188,000
	Total		$28,617,000

Jobs			
	Direct	110	106
	Indirect		151
	Induced		132
	Total		390

Sources: ECONorthwest IMPLAN analysis using data from Imperium Renewables and the US Census, September 2014.

Direct construction output from Washington sources will cause $24.2 million in output from other industries within the state due to Imperium's expenditures. Spending in Washington by jobholders of the Imperium facilities construction projects, as well as workers of other industries needed to produce the indirect output, will add $17.7 million. In aggregate, a total of $74.2 million in output in Washington would be associated with the expansion.

In terms of labor income statewide, $28.6 million would be associated Imperium's projects. That income would be earned by the FYE of 390 workers. For every construction job, about another 2.5 jobs would be supported by Imperium Renewables spending. Similar to Westway, the direct labor income is significantly higher than the compensation received by workers that are indirectly affected; the direct onsite workers receive over two times as much in income as do those being impacted secondarily.

The dimensions of these economic impacts are substantial, although typical of major heavy infrastructure developments. Importantly, for the state's economy, funding for the Westway and Imperium Renewables facilities would in part come from outside of Washington and would expand operations on existing Port property that might otherwise not significantly contribute to economic activity. Therefore, the projects would provide substantial economic stimulus without state and local government outlays, and in fact, would contribute to public funding through sales and business and occupation taxes.

Construction Plans at Half Build-out

The half build-out scenario (Phase 1) will cost $83.9 million. The impacts of these construction projects on the economy of Washington State were measured and are reported in this section.

Table 5: Half Build-out Cost to Construct Westway and Imperium Renewables by Asset Type, in Millions of 2013 Dollars

Category	Westway	Imperium
Total Labor		
$ wages, salaries, and benefits	$10.9	$9.4
FYEs	86	76
Construction spending		
Architectural, engineering, and related services	$2.2	$2.9
Various other services	1.2	2.5

Equipment purchases	6.8	18.8
Construction of other new nonresidential structures	25.6	18.3
Sales & use taxes	2.5	3.1
Total cost	**$38.3**	**$45.8**

Source: Westway and Imperium Renewables, September 2014
Note: Values may not add up due to rounding

The analysis estimates that $45.4 million out of the entire $83.9 million construction projects would come from Washington sources. $26.1 million of the $63.9 million in materials, equipment, other purchased goods, and services would be from Washington businesses and governments. Wages, salaries, and benefits earned by all those on the construction projects will total $20.3 million and, of that, $19.4 million would go to workers residing in Washington. The results of this analysis are shown in Table 6

Table 6: Total Cost to Construct Westway and Imperium Renewables Facilities by Component, in Millions of 2013 Dollars

Components	Total cost of construction put-in-place	Sourced in Washington state
Labor: salaries, benefits*		
Westway	$10.9	$10.4
Imperium	9.4	9.0
Total Labor	20.3	19.4
Materials, equipment, services and other		
Westway	$27.3	$13.2
Imperium	36.3	12.9
Total Materials	63.6	26.1
Total All	**$83.9**	**$45.4**

Sources: Westway and Imperium Renewables, September 2014, IMPLAN, and ECONorthwest analysis of Census data.
** All labor involved in the project including management, engineering and administration.*

Westway will invest $38.3 million in Washington to expand the first phase of construction and $23.6 million ($10.4 million in labor and $13.2 million in materials) of that would be spent on Washington state labor and suppliers. Imperium Renewables will spend $45.8 million on the project and $21.9 million ($9 million in labor and $12.9 million in materials) is estimated to be spent within the state.

Results of the Construction Impact Analysis at Half Build-out

ECONorthwest ran an IMPLAN analysis using the Washington State sourced portion of construction that would be put-in-place while building the first phase of the Westway and Imperium Renewables facilities. The direct output of $23.6 million for Westway, and $21.9 million for Imperium, is that which is sourced in Washington. IMPLAN measures the total impacts to Washington State that flow from the direct construction expenditures and jobs. By taking this approach, the analysis gives a realistic perspective of what such a project means for the state's economy. The results for the impacts of a half build-out scenario construction for Westway and Imperium are reported below.

Table 7: Economic Impacts on Washington Arising from the Half Build-out Construction of Westway at the Port of Grays Harbor

		Put-in-Place	Sourced in Washington
Output			
	Direct	$38,313,000	$23,570,000
	Indirect		$17,157,000
	Induced		$13,407,000
	Total		$54,134,000
Labor Income			
	Direct	$10,911,000	$10,398,000
	Indirect		$6,619,000
	Induced		$4,695,000
	Total		$21,712,000
Jobs			
	Direct	86	82
	Indirect		111
	Induced		100
	Total		293

Sources: ECONorthwest IMPLAN analysis using data from Westway and the US Census, September 2014.

Table 8: Economic Impacts on Washington Arising from the Half Build-out Construction of Imperium Renewables facilities at the Port of Grays Harbor

		Put-in-Place	Sourced in Washington
Output			
	Direct	$45,750,000	$21,919,000
	Indirect		$16,795,000
	Induced		$12,312,000
	Total		$51,025,000
Labor Income			
	Direct	$9,417,000	$9,030,000
	Indirect		$6,597,000
	Induced		$4,311,000
	Total		$19,938,000
Jobs			
	Direct	76	73
	Indirect		105
	Induced		92
	Total		270

Sources: ECONorthwest IMPLAN analysis using data from Westway and the US Census, September 2014.

4 Economic Impacts from Operations

Operating Plans at Full Build-out

Westway

Westway is expanding its existing bulk liquid storage terminal to allow for the receipt of crude oil unit trains, storage of crude oil from these trains, and shipment of crude oil by vessel and/or barge from the Port of Grays Harbor Terminal #1. Four internal floating roof storage tanks will be added to the site on the south side of the existing tanks and will provide storage for crude oil. Each tank will have a capacity of 200,000 barrels (8,400,00 gallons). The new tanks will be surrounded by a concrete containment wall, which will have the capacity to contain the total volume of a single tank plus an allowance for rainfall.

The existing rail facility will be expanded from two short spurs with a total of 18 loading/uploading spots to 4 longer spurs with a total of 76 loading/uploading spots. It is estimated that the facility will receive 9,600,000 barrels of oil per year, equivalent to one unit train (120 cars) every three days.

Most of the oil shipments leaving the Westway terminal are expected to be aboard Articulated Tug Barges (ATB) with capacities of either 150,000 or 180,000 barrels. Westway estimates a total of 60 vessel calls per year during full operations.

Imperium

Imperium Renewables is planning to expand their bulk liquid storage operations on a 10.9-acre site located at the Port of Grays Harbor. This project will involve construction of a tank farm that includes storage tanks, pipelines to Terminal 1 from the tank farm, rail spurs in connection with the existing Schneider's loop rail line, and construction of new buildings to support office, laboratory, maintenance and warehousing functions of the operations.

The expansion design and permits will require all tanks and infrastructure to be designed and constructed to store both renewable and conventional fuel products. It is anticipated that the products stored onsite will vary over the life of the facility, and may include biodiesel, ethanol, US crude oil, jet fuel, gasoline, diesel, vegetable oils and other biofuel feedstocks.

Trains will deliver the bulk liquids. The existing rail system will be expanded. Approximately 6,100 feet of track in multiple new rail spurs will be constructed on site in connection with the existing rail line, and the existing rail yard will be expanded. Rail delivery is projected to be up to one unit train per day consisting on average of 105 tank cars.

Pipelines will be installed connecting Terminal 1 with the tank farm, and a Marine Vapor Combustion Unit (MVCU) will be installed to incinerate displaced vapors during vessel loading. Based on the projections for inbound rail shipments, the need for transshipment includes up to 200 outbound vessels and barges per year are projected.

Imperium's growth and expansion opportunities are made possible by the unique transportation infrastructure of the Port of Grays Harbor. Access to rail, road and marine vessel transportation options were key factors in Imperium's decision to build our existing operations here, and there are now have new growth opportunities that are focused on expanding Imperium's current capabilities. Expanding the terminal to store and transport additional products will allow Imperium to meet growing market demand for domestic energy supplies and transportation fuels on the West Coast of the United States.

Operational Dimensions of the Analysis at Full Build-out

Once constructed, the operations of the Westway and Imperium Renewables facilities will impact the economy of Grays Harbor County. The analysis determined the likely annual economic impacts. It is based on one year of operations.

The direct impacts are the spending and payrolls at the Westway and Imperium Renewables facilities plus the incremental payrolls and spending by the railroad and the marine vessel operations that will help ship liquids to and from the terminal.

The economic impact analysis is based on volumes anticipated in 2016. The first full year of operation is currently unknown. In that year, the two facilities terminals will transship 37 million barrels of liquid. Westway and Imperium Renewables provided ECONorthwest with expected new staffing levels and operating expenses at full operations.

IMPLAN uses government data for the industry that includes oil terminal operations. That industry is a very broad category including all types of wholesaling and warehousing businesses. ECONorthwest corrected the IMPLAN model by replacing the generic dimensions of the broader industry with actual operating data specific to Westway and Imperium Renewables and its related railroad and marine services. Doing so yields more accurate impact analysis results.

Driving the economic impact forecast are the direct labor, and purchases of goods and services at the Westway and Imperium Renewables facilities in the first year of operations That includes the ongoing capital expenditures common to industrial businesses and the incremental expenditures of the rail and marine businesses arising from the activities of Westway and Imperium Renewables. The value, in 2013 dollars, of the expenditures and the direct jobs, as full year equivalents, are listed on Table 9.

Table 9: Operations Spending and Employment at Full Build-out for Westway and Imperium Renewables, Values in 2013 Dollars and Jobs in FYEs

Sector/Direct Inputs		
Terminal Operations:	**Westway**	**Imperium**
Payroll	$1,625,000	$1,216,614
Electricity	127,000	240,000
Natural Gas	45,000	72,000
Water	3,000	5,000
Insurance	-	600,000
Tank Cleaning and Disposal	-	360,000
Environmental Services	25,000	180,000
Rail Services	-	120,000
Social Services& Education	20,000	40,000
Property Leases	220,000	145,876
Equipment Repair	40,000	480,000
Other	70,000	990,000
Marine and Rail Operations:		
Payroll	$1,994,908	$7,952,442
Other	2,453,199	6,014,767
Annual Operating Costs	**$6,623,108**	**$18,416,700**
FYE Jobs:		
Terminals	15	20
Marine & Rail Operations	21	83

Source: Westway and Imperium Renewables, and ECONorthwest, September 2014.

ECONorthwest, using data from the Port of Longview, estimated the direct impacts of vessels that would come to port for Westway and Imperium Renewables facilities. These were included in the economic impact analysis.

For rail operations, ECONorthwest obtained estimates directly from the projects sponsors based on their conversations with railroad officials. The analysis includes the direct output associated with 30 FYEs of railroad employment. Direct operating costs were estimated using industry averages as they compare with labor costs. Labor costs were calculated using the average pay of railroad engineers reported by the U.S. Department of Labor Occupational Employment Statistics[3] and compared against local estimates.

[3] http://www.bls.gov/oes/home.htm

Results of the Operations Impact Analysis at Full Build-out

Table 10 shows the results of the analysis. Economic impacts for operating the Westway facility, including supporting rail and marine services, are substantial. In a single year of operations, the Westway terminal will generate about $20 million in economic output directly. It will purchase goods and services from within Grays Harbor County that will trigger a string of subsequent purchases from those businesses resulting in a total additional spending of about $3 million, which is shown as an indirect output. Induced output, resulting from employee spending, could cause approximately $2 million in added output by local businesses.

Table 10: The Annual Economic Impacts on Grays Harbor County by Westway at Full Build-out, Values in Millions of 2013 Dollars and Jobs in FYEs

Operations		Terminals	Marine	Rail	Total
Output					
	Direct	$13,440,000	$2,724,000	$3,778,000	$19,942,000
	Indirect	$608,000	$813,000	$1,540,000	$2,961,000
	Induced	$799,000	$552,000	$600,000	$1,951,000
	Total	$14,847,000	$4,089,000	$5,918,000	$24,854,000
Labor Income					
	Direct	$1,625,000	$995,000	$1,000,000	$3,620,000
	Indirect	$211,000	$271,000	$374,000	$856,000
	Induced	$235,000	$162,000	$177,000	$574,000
	Total	$2,071,000	$1,429,000	$1,551,000	$5,051,000
Jobs					
	Direct	15	11	10	36
	Indirect	3	6	11	20
	Induced	7	5	5	17
	Total	25	21	26	73

Sources: ECONorthwest IMPLAN analysis using data from Westway and the US Census, September 2014.

Table 11 shows the economic impacts for Imperium operations, and supporting rail and marine services. In a single year of operations, the Imperium terminal will generate about $78 million in economic output directly. Their purchases will start a string of subsequent purchases from supply-chain businesses resulting in a total additional spending of about $7.9 million. Output supported by employee spending could be approximately $5.1 million in the county.

Table 11: The Annual Economic Impacts on Grays Harbor County by Imperium Renewables at Full Build-out, Values in Millions of 2013 Dollars and Jobs in FYEs

Operations		Terminals	Marine	Rail	Total
Output					
	Direct	$54,740,000	$12,250,000	$10,823,000	$77,813,000
	Indirect	$2,348,000	$2,497,000	$3,080,000	$7,925,000
	Induced	$896,000	$2,955,000	$1,200,000	$5,051,000
	Total	$57,984,000	$17,702,000	$15,103,000	$90,789,000
Labor Income					
	Direct	$1,217,000	$5,952,000	$2,000,000	$9,169,000
	Indirect	$834,000	$833,000	$749,000	$2,416,000
	Induced	$264,000	$870,000	$353,000	$1,487,000
	Total	$2,314,000	$7,655,000	$3,102,000	$13,071,000
Jobs					
	Direct	20	63	20	103
	Indirect	19	18	22	60
	Induced	8	26	11	45
	Total	47	107	53	207

Sources: ECONorthwest IMPLAN analysis using data from Imperium Renewables and the US Census, September 2014.

Countywide, the total impact on jobs will be six times the number (35) working directly for Westway and Imperium Renewables. Each year the terminals that are operated there will be over 100 FYE jobs in direct marine and rail services, and together these direct jobs will result in an additional 104 FYE jobs in other industries because of Imperium's operations, and 37 FYEs due to Westway's operations.

All three industries engaged directly in delivering, storing, and loading liquids onto ships rely on highly skilled labor. Compensation is commensurate with the skills and experience required. This is evident from the direct labor income estimates. Fully loaded compensation, including overtime, healthcare, vacation pay, retirement, employer-paid payroll taxes, and wages, will average over $84,000 per FYE in these three industries. Although combined wage and benefit data is unreported for counties, the U.S. Department of Labor does estimate that the average worker in Southwestern Washington nonmetropolitan area makes $40,010 a year.[4] Jobs at the Westway and Imperium Renewables facilities and the supporting rail and marine industries would be higher paying than the average in Grays Harbor County and its surrounding areas.

[4] May 2012 Occupational Employment and Wage Estimates from the U.S. Department of Labor accessed August 31, 2013 at http://www.bls.gov/oes/current/oes_5300002.htm

Westway and Imperium Renewables will bring high paying jobs to Grays Harbor County. The terminal expansions represent a long-term commitment to the local economy ("permanent" jobs); which can result in further economic growth and stability. The importance of these jobs is substantial, as evidenced when comparing recent economic conditions of county residents with those living throughout Washington. In August 2014, the unemployment rate in Grays Harbor County was 8.6 percent compared to 5.6 percent statewide. The lack of jobs affects the wellbeing of residents.

Table 12: Comparing the Economic Situation of Grays Harbor County to Washington State Residents

Statistic	Grays Harbor County	Washington State
Unemployment rates:		
August 2014, NSA	8.6%	5.6%
Annual average 2013	11.8%	7.0%
2012 per capita income $ per resident	$31,848	$47,055
Sources of personal income:		
Work	50%	67%
Investments	16%	17%
Transfer* and retirement payments	33%	16%

*including unemployment and welfare disbursements

Sources: ECONorthwest analysis of Washington State Employment Security Department and U.S. Bureau of Economic Analysis data collected on October 15, 2014.

The most recent personal income data released for Grays Harbor County by the federal government is further evidence of a need for more and higher paying jobs. In 2012, the average county resident made $31,848 and 50 percent of that came from work (jobs, family farm income, self employment). The average resident of Washington was better off. They made $47,055 in 2012 and earned 67 percent of that money working. They were less reliant on welfare, unemployment checks, retirement, and disability income sources than were the citizens of Grays Harbor County.

Operational Dimensions of the Analysis at Half Build-out

The following tables show operating spending and economic impacts if both Westway and Imperium were to generate half the amount of output as their full build-out levels.

Table 13: Operations Spending and Employment at Half Build-out for Westway and Imperium Renewables, Values in Millions of 2013 Dollars and Jobs in FYEs

Sector/Direct Inputs		
Terminal Operations:	**Westway**	**Imperium**
Payroll	$715,000	$851,630
Electricity	95,250	180,000
Natural Gas	22,500	36,000
Water	3,000	5,000
Insurance	-	450,000
Tank Cleaning and Disposal	-	270,000
Environmental Services	18,750	135,000
Rail Services	-	60,000
Social Services& Education	10,000	20,000
Property Leases	220,000	145,876
Equipment Repair	30,000	360,000
Other	52,500	742,500
Marine and Rail Operations:		
Payroll	$1,197,454	$4,706,912
Other	1,510,200	3,751,182
Annual Operating Costs	**$3,874,654**	**$11,714,101**
FYE Jobs:		
Terminals	11	14
Marine & Rail Operations	12	49

Source: Westway and Imperium Renewables, and ECONorthwest, September 2014.

Results of the Operations Impact Analysis at Half Build-out

Table 14: The Annual Economic Impacts on Grays Harbor County by Westway at Half Build-out, Values in Millions of 2013 Dollars and Jobs in FYEs

Operations		Terminals	Marine	Rail	Total
Output					
	Direct	$7,231,000	$1,362,000	$1,889,000	$10,482,000
	Indirect	$513,000	$407,000	$1,078,000	$1,998,000
	Induced	$389,000	$276,000	$420,000	$1,085,000
	Total	$8,133,000	$2,044,000	$3,387,000	$13,564,000
Labor Income					
	Direct	$715,000	$497,000	$700,000	$1,912,000
	Indirect	$180,000	$136,000	$262,000	$578,000
	Induced	$115,000	$81,000	$124,000	$320,000
	Total	$1,009,000	$714,000	$1,086,000	$2,809,000
Jobs					
	Direct	11	5	7	23
	Indirect	3	3	8	13
	Induced	3	2	4	10
	Total	17	11	18	46

Sources: ECONorthwest IMPLAN analysis using data from Westway and the US Census, September 2014.

Table 15: The Annual Economic Impacts on Grays Harbor County by Imperium Renewables at Half Build-out, Values in Millions of 2013 Dollars and Jobs in FYEs

Operations		Terminals	Marine	Rail	Total
Output					
	Direct	$27,370,000	$6,806,000	$5,412,000	$39,588,000
	Indirect	$1,741,000	$1,387,000	$2,156,000	$5,284,000
	Induced	$645,000	$1,642,000	$840,000	$3,127,000
	Total	$29,756,000	$9,834,000	$8,407,000	$47,997,000
Labor Income					
	Direct	$852,000	$3,307,000	$1,400,000	$5,559,000
	Indirect	$623,000	$463,000	$524,000	$1,610,000
	Induced	$190,000	$483,000	$247,000	$920,000
	Total	$1,665,000	$4,253,000	$2,171,000	$8,089,000
Jobs					
	Direct	14	35	14	63
	Indirect	14	10	15	40
	Induced	6	14	7	28
	Total	34	60	37	131

Sources: ECONorthwest IMPLAN analysis using data from Imperium Renewables and the US Census, September 2014.

5 Fiscal Impacts

Westway and Imperium Renewables provided initial estimates of sales tax for construction. ECONorthwest estimated property taxes for the terminal and rail operations using the Washington combined trended investment table and the 2013 tax rates at Grays Harbor County. Property is the investment made through construction and tax on that property and is included as an operating cost. ECONorthwest estimated the business and occupation taxes for construction as 1.50 percent of construction. This tax was included under indirect taxes in the following table. Additionally, Westway and Imperium provided the direct property taxes, and also estimated the amount of sales tax they would pay based on a rate of 8.5%. The indirect and induced fiscal revenues were estimated using IMPLAN's fiscal impact results, which calculates tax impacts based on actual taxes collected, not specific tax rates. Total taxes, fees, permits, and other revenues garnered by state and local governments during the construction period are estimated at $12.3 million of which an estimated $8.7 million would be directly paid by the construction project.

Table 16: Fiscal Impact Analysis for the Full Build-out Construction Phase and One Year of Operations, in Millions of 2013 Dollars

	Property Tax	Sales Tax	B&O and other taxes	Total
Construction				
Direct	$223,222	$8,123,814	303,177	$8,650,212
Indirect	124,803	177,791	1,450,681	1,753,276
Induced	559,032	956,534	418,082	1,933,649
Total	**$907,057**	**$9,258,140**	**$2,171,940**	**$12,337,137**
Operations				
Direct	$1,869,393	$449,757	$590,181	$2,909,330
Indirect	67,398	73,424	92,164	232,987
Induced	146,015	267,805	92,112	505,932
Total	**$2,082,807**	**$790,985**	**$774,457**	**$3,648,249**

Sources: ECONorthwest IMPLAN analysis and data from taxing jurisdictions.
** Note: ECONorthwest estimates a B&O tax on construction, which is a direct cost of construction, but appears on this table as an indirect tax.*

IMPLAN estimates all other taxes including those incurred indirectly and through induced spending and employment. IMPLAN has only limited fidelity for taxes rates by industrial classification, asset classes and geography for these secondary effects, and the results should be seem as illustrative and not construed to be the detailed analysis of a tax professional. Cumulatively, state and local taxes, permits, and fees would be approximately $3.6 million in the first year of full operations.

Appendix A: Overview of Economic Multiplier Models

Input-Output Modeling

One economic modeling framework that captures the direct, indirect, and induced effects of spending on a project is called input-output modeling. Input- output models provide an empirical representation of the economy and its inter- sectorial relationships.

Because input-output models generally are either not available or affordable for state and regional economies, special data techniques have been developed to estimate the necessary empirical relationships from a combination of national technological relationships and county-level measures of economic activity. This planning framework, called IMPLAN (for IMpact Analysis for PLANning), is the technique that ECONorthwest applied to the estimation of impacts.

The Origins of the IMPLAN Model

IMPLAN was developed by the Forest Service of the US Department of Agriculture in cooperation with the Federal Emergency Management Agency and the Bureau of Land Management of the US Department of the Interior to assist federal agencies in their land and resource management planning. U.S. government agencies, other public agencies, and private firms including ECONorthwest have applied the model to a wide variety of public and private sector projects.

The model is distinguished from typical input-output models in that it is not survey based; survey-based input-output models place significant demands on data, and are uneconomical to apply in most situations. Rather, IMPLAN employs secondary source data, available by state, county and zip code, to define a model for any region in the United States.

Two sources of data are particularly central to the IMPLAN models: the National Income and Product Accounts published annually by the Bureau of Economic Analysis (BEA) of the U.S. Commerce Department, and the BEA input-output model for the United States. The IMPLAN modeling process utilizes the national input-output model and county- and zip code-level economic activity data to derive input-output models for units as small as a zip code, but more common is the use of county level data as the smallest unit.

The process that develops the county-level input-output model generates coefficients that are internally consistent, in that county data sum to state totals and state data sum to national totals. This generally is not the case with survey- based input-output models, which limits their applicability to large-scale projects that affect a number of interrelated regions. (Arguably, however, an input-output model estimated from survey data has more accurate coefficients, because the survey can be customized to the problem at hand.

In contrast, IMPLAN derives its coefficients using a combination of the national input-output survey model and local activity data; conceivably, this will produce somewhat different results from a direct, local survey. Given the difficulty and expense of input-output surveys, however, the disadvantages of the IMPLAN approach are slight.)

Modeling

The process of modeling involves three steps:

- Creation of study area database;
- Customization of IMPLAN model and coefficients;
- Estimating the impact of an activity on the model of the study area economy.

The IMPLAN model allows substitution and incorporation of primary data at each stage of the model-building process, greatly increasing the model's accuracy and flexibility. In addition to being able to directly modify the IMPLAN database statistics, the user can alter import and export relationships, utilize modified input-output functions, and change industry groupings. IMPLAN allows the creation of aggregate models consisting of industries grouped together for a specific purpose.

Once a regional input-output model has been specified, impact analysis may be performed on that model. New industries or commodities can be introduced to "shock" the regional economy, industries or commodities may be removed or disaggregated, and reports can be generated to show the consequences (on output, employment, and value-added) of various impacts.

The key to input-output analysis is the construction of the input-output or transactions table, which shows the flow of commodities from each of a number of producing industries to all consuming industries and final demand (ultimate consumers). Given that many industries produce more than one commodity, production information is often tabulated on an industry-by-commodity basis into a "Make" matrix, containing the value of commodities produced by different industries, and a "Use" matrix, containing the value of commodities used by each industry in the production process. These matrices are combined to produce the input-output transactions table showing each industry buying and selling from other industries.

From these industry flows, two other structural tables are developed: (1) a table of technical coefficients or direct requirements and (2) a table of direct and indirect coefficients or total requirements. The entries in the former are interpreted as the dollar value of the minimal requirements from each of the contributing industries in order for each producing industry to produce one dollar's worth of output. The entries in the latter table are to be interpreted as the amount of output from the contributing industries required, both directly and indirectly, to deliver one dollar's worth of the producing industry's output to final demand.

Defining the Study Areas

The IMPLAN program uses an ordered series of steps to build the model. We describe them here to provide the interested reader with a view of the sequence of steps employed, and the types of data needed to model the impacts.

The first step is the definition of the study area or study areas. Study area Databases are created corresponding to these areas. These databases contain the representation of the behavior of the study area economies, but do not contain any information about the specific project under study.

Customizing the IMPLAN Coefficients

The process of customizing the IMPLAN model does not stop with the development of the Study Area Databases. Part of the expertise of input-output practitioners is in the customization of the model coefficients. In this section, we describe the various steps in the customization process.

Constructing the Social Accounting Matrix

From the Study Area Databases, a mathematical concept called the Social Accounting Matrix is constructed, using computer procedures incorporated in the IMPLAN modeling system. The initial study area data in this transformation can be viewed and edited in a spreadsheet-like program. The matrix is a complex table that contains an array of different transfers between market participants. The database elements are organized into five main groups: Final Demand, Sales, Value Added, Employment, and Total Industry Output. These elements can be further divided into those that are specific to commodities and those that relate to industries.

The user may edit the Regional Purchase Coefficient and the Directly Allocated Exports Coefficient for each commodity. Both of these coefficients are calculated from the Social Accounting Matrix so they may only be modified after that matrix has been constructed. The IMPLAN program contains internal checks, which enforce data integrity and will not allow values outside the specific, valid range for these coefficients to be accepted by the model.

Building the Input-Output Accounts

After creating the social accounting matrix, the input-output accounts for the model are constructed. Transforming parts of the social accounts from an “industry-by-commodity” format to an “industry-by-industry” format forms the input-output accounts; it combines sub-matrices into a single “transactions” sub-matrix, as described in general above. The input-output accounts may be constructed with either aggregated or disaggregated industry data. The disaggregated data is made up of 440 IMPLAN-defined industries that correspond to one or more NAICS industry codes, and comprise the entirety of each economy. The creation of aggregated industries from individual industries will reduce the size of the industry matrix (and processing time).

Estimating Multipliers

The last step in building the model is to estimate the multipliers. Five different sets of multipliers are estimated by IMPLAN corresponding to five measures of regional economic activity: Total Industry Output, Personal Income, Total Income, Value Added, and Employment. Multiplier analysis is used to estimate the regional economic impacts resulting from a change in final demand. Impacts can be in terms of direct and indirect effects (commonly known as Type I multipliers), or in terms of direct, indirect, and induced effects (Type II and Type III multipliers). More specifically, direct effects are production changes associated with the immediate effects of final demand changes. Indirect effects are production changes in backward-linked industries caused by the changing input needs of directly affected industries. Induced effects are the changes in regional household spending patterns caused by changes in household income-- generated from the direct and indirect effects.

IMPLAN calculates two types of multipliers for each of the five impact measures. The first output multiplier represents the value of production, from indirect and direct effects, required from all sectors by a particular sector in order to deliver one dollar's worth of output. The second output multiplier adds in the induced requirements. The size of the multiplier is not a measure of the amount of activity or the importance of a given industry for the economy. It is an estimation of what would happen if that industry's sales to final demand increased or decreased. In other words, output multipliers can be used to gauge the interdependence of sectors; the larger the output multiplier, the greater the interdependence of the sector on the rest of the regional economy.

Performing Impact Analysis

Once the model is complete, impact analysis can be performed on the model. Impact analysis involves posing a change in the demand for commodities and using the multiplier model to examine the effects that producing and delivering the commodities may have on a region's employment, income, and output. One can do several types of economic impact analyses by varying structural, technological, and/or trade factors within the model. For instance, the user may add or remove sectors from the model, or change the size of an industry, or the user may change production functions, or make changes in commodity imports and exports. To perform a full economic impact analysis with IMPLAN, all of the relevant structural, technological, and trade related adjustments must already be incorporated in the regional model.

In order to keep track of and organize all of the information needed to describe a change in the final demand for commodities, IMPLAN uses the general concept of a "scenario" to capture all of the information about the change(s) in commodity demand for which impacts are being estimated. Scenarios are made up of several building blocks.

At the lowest level is a transaction; this is the actual expenditure that represents the final demand for a commodity. Descriptive information about this transaction, such as what commodity is involved, when it occurred, and how it was measured, are collectively referred to as an event. A collection of events, which have descriptive information in common, occurring together, are referred to as an activity. For instance, the group of events that make up an activity may be related to each other by what caused them to take place or why they took place.

A scenario is a collection of one or more activities (which includes, in turn, events with transactions), specifying where the activity(s) occurred and at what amounts(s). A scenario may be viewed as equivalent to a management, planning, or policy alternative. Units of measure are assigned to each activity and can be in physical terms, monetary terms, household consumption, or any other terms appropriate for the problem under study. The unit price represents the transaction rate--the total amount of purchases necessary to participate in one unit of an activity.

In order to run an economic impact analysis, the user must build a data file of changes in final demand. All activities to be included in the analysis must be defined, providing information about who initiated the demand change, the base year of the activity, the transaction basis (commodity purchase or an industry's output), conversion rate (which gives a scale of the transactions occurring in the activity), and measurement units. There is a finite list of causal agents to choose from when describing the activity, comprised of the following choices: households, federal government, state/local government, enterprises (investment), and industry. Once the activity is defined, the next step is to define events that occur in the activity, in much the same way as for the activity itself.

Model Outputs

The IMPLAN model provides estimates of impacts of the expenditures on income, and employment that follow from direct, indirect, and induced expenditures. By writing special fiscal impact modules, the model also can be used to estimate impacts on the tax revenue collected through property taxes, sales taxes, corporate income taxes, and other fiscal devices.

Limitations of Input-Output Models

Like many quantitative tools, input-output models rely on a set of assumptions. The use of simplifying assumptions imposes certain limitations on the use of input-output modeling. These limitations should be fully understood and guide its use.

Input-output models are static models that measure the flow of inputs and outputs in an economy at a point in time. With this information and the balanced accounting structure of an input-output model, an analyst can: 1) describe an economy at one time period, 2) introduce a change to the economy, and then 3) evaluate the economy after it has accommodated that change.

This type of analysis is called "partial equilibrium" analysis. Partial equilibrium analysis permits comparison of the economy in two separate states, but does not describe how the economy moves from one equilibrium to the next. In partial equilibrium analysis, other than the initial economic stimulus, the researcher assumes that all other relationships in the economy remain the same.

Contrary to dynamic models, static models assume that there are no changes in wage rates, input prices, and property values. In addition, underlying economic relationships in input-output models are assumed constant, i.e., there are no changes in the productivity of labor and capital, and no changes in population migration or business location patterns.

Input-output models have fixed production relationships, including he following assumptions:

- *Constant Returns to Scale* means that an industry's production function is linear, and an increase in output requires all inputs to increase proportionately.
- *Fixed Commodity Input Structure* means that input-output models do not allow changing input prices to affect the production decisions of businesses.
- *No Supply Constraints* means input-output models show how local industries respond to some initial change in final demand, but assume that supplies of raw materials and intermediate goods are unlimited.
- *Sector Homogeneity* means in input-output modeling, industry sectors are assumed to be homogenous. That is, all businesses within an industry sector 1) produce commodities in fixed proportions and 2) produce identical commodities that are perfectly substitutable.

Appendix P

Census Block Group Data

Appendix P
Census Block Group Data

The following data were obtained from the *2009–2013 5-Year American Community Survey* (U.S. Census Bureau 2014).

Table 1. Minority Populations in the Study Area Census Block Groups

Census Block Group	Population	Estimated Minority Population	Percent Minority
Grays Harbor County			
Block Group 1, Census Tract 2	2,818	200	7.10
Block Group 2, Census Tract 2	1,547	213	13.77
Block Group 3, Census Tract 2	1,355	73	5.39
Block Group 4, Census Tract 2	661	166	25.11
Block Group 1, Census Tract 3	1,057	36	3.41
Block Group 1, Census Tract 4	1,409	57	4.05
Block Group 2, Census Tract 4	1,256	343	27.31
Block Group 4, Census Tract 4	868	102	11.75
Block Group 5, Census Tract 4	2,620	130	4.96
Block Group 1, Census Tract 5	1,273	310	24.35
Block Group 2, Census Tract 5	1,387	129	9.30
Block Group 3, Census Tract 5	612	276	45.10
Block Group 4, Census Tract 5	2,557	99	3.87
Block Group 5, Census Tract 5	930	46	4.95
Block Group 1, Census Tract 7	2,265	675	29.80
Block Group 3, Census Tract 7	1,491	123	8.25
Block Group 1, Census Tract 8	1,124	69	6.14
Block Group 2, Census Tract 8	1,293	174	13.46
Block Group 3, Census Tract 8	1,712	123	7.18
Block Group 1, Census Tract 9	1,240	245	19.76
Block Group 2, Census Tract 9	511	249	48.73
Block Group 3, Census Tract 9	1,081	330	30.53
Block Group 4, Census Tract 9	960	227	23.65
Block Group 1, Census Tract 10	741	129	17.41
Block Group 2, Census Tract 10	367	103	28.07
Block Group 3, Census Tract 10	1,320	603	45.68
Block Group 4, Census Tract 10	1,171	528	45.09
Block Group 2, Census Tract 12	806	458	56.82
Block Group 3, Census Tract 12	886	242	27.31
Block Group 5, Census Tract 12	1,067	476	44.61
Block Group 2, Census Tract 13	737	141	19.13
Block Group 4, Census Tract 13	539	198	36.73
Block Group 1, Census Tract 15	1,138	80	7.03
Block Group 2, Census Tract 15	2,736	456	16.67
Block Group 1, Census Tract 16	1,116	161	14.43

Census Block Group	Population	Estimated Minority Population	Percent Minority
Block Group 2, Census Tract 16	3,124	938	30.03
Block Group 3, Census Tract 16	1,094	73	6.67
Block Group 4, Census Tract 16	1,113	317	28.48
Lewis County			
Block Group 1, Census Tract 9703	1,161	32	2.76
Block Group 2, Census Tract 9703	949	156	16.44
Block Group 4, Census Tract 9703	1,539	267	17.35
Block Group 1, Census Tract 9704	2,360	573	24.28
Block Group 2, Census Tract 9704	791	291	36.79
Block Group 3, Census Tract 9704	926	266	28.73
Block Group 4, Census Tract 9704	1,447	293	20.25
Block Group 1, Census Tract 9705	1,170	181	15.47
Block Group 2, Census Tract 9705	934	180	19.27
Block Group 1, Census Tract 9706	997	411	41.22
Block Group 1, Census Tract 9707	747	99	13.25
Block Group 2, Census Tract 9707	1,187	433	36.48
Thurston County			
Block Group 1, Census Tract 127.10	2,168	301	13.88
Block Group 1, Census Tract 127.20	1,790	486	27.15
Block Group 2, Census Tract 127.20	1,506	216	14.34
Block Group 4, Census Tract 127.20	820	444	54.15
Block Group 5, Census Tract 127.20	1,627	704	43.27
Block Group 1, Census Tract 127.30	1,831	351	19.17
Block Group 3, Census Tract 127.30	2,150	244	11.35
Totals	**76,082**	**15,226**	**20.01**

Table 2. Minority Populations in Project Site Block Groups (all in Grays Harbor County)

Census Block Group	Population	Estimated Minority Population	Percent Minority
Block Group 3, Census Tract 12	886	242	27.31
Block Group 2, Census Tract 13	737	141	19.13
Block Group 4, Census Tract 13	539	198	36.73
Totals	**2,162**	**581**	**26.87**

Table 3. Minority Populations in PS&P Rail Line Block Groups

Census Block Group	Population	Estimated Minority Population	Percent Minority
Grays Harbor County			
Block Group 1, Census Tract 4	1,409	57	4.05
Block Group 2, Census Tract 4	1,256	343	27.31
Block Group 4, Census Tract 4	868	102	11.75
Block Group 5, Census Tract 4	2,620	130	4.96
Block Group 1, Census Tract 5	1,273	310	24.35
Block Group 2, Census Tract 5	1,387	129	9.30
Block Group 3, Census Tract 5	612	276	45.10
Block Group 4, Census Tract 5	2,557	99	3.87
Block Group 5, Census Tract 5	930	46	4.95
Block Group 1, Census Tract 7	2,265	675	29.80
Block Group 3, Census Tract 7	1,491	123	8.25
Block Group 1, Census Tract 8	1,124	69	6.14
Block Group 2, Census Tract 8	1,293	174	13.46
Block Group 3, Census Tract 8	1,712	123	7.18
Block Group 3, Census Tract 9	1,081	330	30.53
Block Group 4, Census Tract 9	960	227	23.65
Block Group 1, Census Tract 10	741	129	17.41
Block Group 2, Census Tract 10	367	103	28.07
Block Group 3, Census Tract 10	1,320	603	45.68
Block Group 4, Census Tract 10	1,171	528	45.09
Block Group 2, Census Tract 12	806	458	56.82
Block Group 3, Census Tract 12	886	242	27.31
Block Group 5, Census Tract 12	1,067	476	44.61
Block Group 2, Census Tract 13	737	141	19.13
Lewis County			
Block Group 1, Census Tract 9703	1,161	32	2.76
Block Group 2, Census Tract 9703	949	156	16.44
Block Group 4, Census Tract 9703	1,539	267	17.35
Block Group 1, Census Tract 9704	2,360	573	24.28
Block Group 2, Census Tract 9704	791	291	36.79
Block Group 3, Census Tract 9704	926	266	28.73
Block Group 4, Census Tract 9704	1,447	293	20.25
Block Group 1, Census Tract 9705	1,170	181	15.47
Block Group 2, Census Tract 9705	934	180	19.27
Block Group 1, Census Tract 9706	997	411	41.22
Block Group 1, Census Tract 9707	747	99	13.25
Block Group 2, Census Tract 9707	1,187	433	36.48

Census Block Group	Population	Estimated Minority Population	Percent Minority
Thurston County			
Block Group 1, Census Tract 127.10	2,168	301	13.88
Block Group 1, Census Tract 127.20	1,790	486	27.15
Block Group 2, Census Tract 127.20	1,506	216	14.34
Block Group 4, Census Tract 127.20	820	444	54.15
Block Group 5, Census Tract 127.20	1,627	704	43.27
Block Group 1, Census Tract 127.30	1,831	351	19.17
Block Group 3, Census Tract 127.30	2,150	244	11.35
Totals	**56,033**	**11,821**	**21.10**

Table 4. Minority Populations in Grays Harbor Shoreline Block Groups (all in Grays Harbor County)

Census Block Group	Population	Estimated Minority Population	Percent Minority
Block Group 1, Census Tract 2	2,818	200	7.10
Block Group 2, Census Tract 2	1,547	213	13.77
Block Group 3, Census Tract 2	1,355	73	5.39
Block Group 4, Census Tract 2	661	166	25.11
Block Group 1, Census Tract 3	1,057	36	3.41
Block Group 1, Census Tract 9	1,240	245	19.76
Block Group 2, Census Tract 9	511	249	48.73
Block Group 3, Census Tract 9	1,081	330	30.53
Block Group 1, Census Tract 10	741	129	17.41
Block Group 2, Census Tract 10	367	103	28.07
Block Group 4, Census Tract 10	1,171	528	45.09
Block Group 2, Census Tract 12	806	458	56.82
Block Group 3, Census Tract 12	886	242	27.31
Block Group 5, Census Tract 12	1,067	476	44.61
Block Group 2, Census Tract 13	737	141	19.13
Block Group 4, Census Tract 13	539	198	36.73
Block Group 1, Census Tract 15	1,138	80	7.03
Block Group 2, Census Tract 15	2,736	456	16.67
Block Group 1, Census Tract 16	1,116	161	14.43
Block Group 2, Census Tract 16	3,124	938	30.03
Block Group 3, Census Tract 16	1,094	73	6.67
Block Group 4, Census Tract 16	1,113	317	28.48
Totals	**26,905**	**5,812**	**21.60**

Table 5. Poverty Status in the Study Area Census Block Groups

Census Block Group	Population	Population Below Poverty	Percent Below Poverty
Grays Harbor County			
Block Group 1, Census Tract 2	2,818	258	9.16
Block Group 2, Census Tract 2	1,547	140	9.05
Block Group 3, Census Tract 2	1,355	100	7.38
Block Group 4, Census Tract 2	661	93	14.07
Block Group 1, Census Tract 3	1,039	69	6.64
Block Group 1, Census Tract 4	1,409	87	6.17
Block Group 2, Census Tract 4	843	251	29.77
Block Group 4, Census Tract 4	868	29	3.34
Block Group 5, Census Tract 4	2,569	124	4.83
Block Group 1, Census Tract 5	1,257	201	15.99
Block Group 2, Census Tract 5	1,387	282	20.33
Block Group 3, Census Tract 5	612	204	33.33
Block Group 4, Census Tract 5	2,535	318	12.54
Block Group 5, Census Tract 5	930	129	13.87
Block Group 1, Census Tract 7	2,265	279	12.32
Block Group 3, Census Tract 7	1,491	367	24.61
Block Group 1, Census Tract 8	1,124	58	5.16
Block Group 2, Census Tract 8	1,293	477	36.89
Block Group 3, Census Tract 8	1,691	194	11.47
Block Group 1, Census Tract 9	1,240	307	24.76
Block Group 2, Census Tract 9	511	74	14.48
Block Group 3, Census Tract 9	1,081	104	9.62
Block Group 4, Census Tract 9	960	72	7.50
Block Group 1, Census Tract 10	741	67	9.04
Block Group 2, Census Tract 10	340	144	42.35
Block Group 3, Census Tract 10	1,320	673	50.98
Block Group 4, Census Tract 10	1,089	627	57.58
Block Group 2, Census Tract 12	787	356	45.24
Block Group 3, Census Tract 12	859	337	39.23
Block Group 5, Census Tract 12	1,067	250	23.43
Block Group 2, Census Tract 13	737	241	32.70
Block Group 4, Census Tract 13	539	96	17.81
Block Group 1, Census Tract 15	1,116	519	46.51
Block Group 2, Census Tract 15	2,701	432	15.99
Block Group 1, Census Tract 16	1,086	174	16.02
Block Group 2, Census Tract 16	905	46	5.08
Block Group 3, Census Tract 16	1,094	297	27.15
Block Group 4, Census Tract 16	1,113	428	38.45

Census Block Group	Population	Population Below Poverty	Percent Below Poverty
Lewis County			
Block Group 1, Census Tract 9703	1,077	220	20.43
Block Group 2, Census Tract 9703	901	84	9.32
Block Group 4, Census Tract 9703	1,539	384	24.95
Block Group 1, Census Tract 9704	2,308	683	29.59
Block Group 2, Census Tract 9704	791	155	19.60
Block Group 3, Census Tract 9704	926	119	12.85
Block Group 4, Census Tract 9704	1,447	130	8.98
Block Group 1, Census Tract 9705	1,170	148	12.65
Block Group 2, Census Tract 9705	934	108	11.56
Block Group 1, Census Tract 9706	989	218	22.04
Block Group 1, Census Tract 9707	747	174	23.29
Block Group 2, Census Tract 9707	1,168	354	30.31
Thurston County			
Block Group 1, Census Tract 127.10	2,168	241	11.12
Block Group 1, Census Tract 127.20	1,790	207	11.56
Block Group 2, Census Tract 127.20	1,506	176	11.69
Block Group 4, Census Tract 127.20	820	193	23.54
Block Group 5, Census Tract 127.20	1,451	247	17.02
Block Group 1, Census Tract 127.30	1,569	16	1.02
Block Group 3, Census Tract 127.30	2,150	155	7.21
Totals	**72,431**	**12,916**	**17.83**

Table 6. Poverty Status in Project Site Block Groups (all in Grays Harbor County)

Census Block Group	Population	Population Below Poverty	Percent Below Poverty
Block Group 3, Census Tract 12	859	337	39.23
Block Group 2, Census Tract 13	737	241	32.70
Block Group 4, Census Tract 13	539	96	17.81
Totals	**2,135**	**674**	**31.57**

Table 7. Poverty Status in PS&P Rail Line Block Groups

Census Block Group	Population	Population Below Poverty	Percent Below Poverty
Grays Harbor County			
Block Group 1, Census Tract 4	1,409	87	6.17
Block Group 2, Census Tract 4	843	251	29.77
Block Group 4, Census Tract 4	868	29	3.34
Block Group 5, Census Tract 4	2,569	124	4.83
Block Group 1, Census Tract 5	1,257	201	15.99
Block Group 2, Census Tract 5	1,387	282	20.33
Block Group 3, Census Tract 5	612	204	33.33
Block Group 4, Census Tract 5	2,535	318	12.54
Block Group 5, Census Tract 5	930	129	13.87
Block Group 1, Census Tract 7	2,265	279	12.32
Block Group 3, Census Tract 7	1,491	367	24.61
Block Group 1, Census Tract 8	1,124	58	5.16
Block Group 2, Census Tract 8	1,293	477	36.89
Block Group 3, Census Tract 8	1,691	194	11.47
Block Group 3, Census Tract 9	1,081	104	9.62
Block Group 4, Census Tract 9	960	72	7.50
Block Group 1, Census Tract 10	741	67	9.04
Block Group 2, Census Tract 10	340	144	42.35
Block Group 3, Census Tract 10	1,320	673	50.98
Block Group 4, Census Tract 10	1,089	627	57.58
Block Group 2, Census Tract 12	787	356	45.24
Block Group 3, Census Tract 12	859	337	39.23
Block Group 5, Census Tract 12	1,067	250	23.43
Block Group 2, Census Tract 13	737	241	32.70
Lewis County			
Block Group 1, Census Tract 9703	1,077	220	20.43
Block Group 2, Census Tract 9703	901	84	9.32
Block Group 4, Census Tract 9703	1,539	384	24.95
Block Group 1, Census Tract 9704	2,308	683	29.59
Block Group 2, Census Tract 9704	791	155	19.60
Block Group 3, Census Tract 9704	926	119	12.85
Block Group 4, Census Tract 9704	1,447	130	8.98
Block Group 1, Census Tract 9705	1,170	148	12.65
Block Group 2, Census Tract 9705	934	108	11.56
Block Group 1, Census Tract 9706	989	218	22.04
Block Group 1, Census Tract 9707	747	174	23.29
Block Group 2, Census Tract 9707	1,168	354	30.31
Thurston County			
Block Group 1, Census Tract 127.10	2,168	241	11.12
Block Group 1, Census Tract 127.20	1,790	207	11.56
Block Group 2, Census Tract 127.20	1,506	176	11.69
Block Group 4, Census Tract 127.20	820	193	23.54
Block Group 5, Census Tract 127.20	1,451	247	17.02

Census Block Group	Population	Population Below Poverty	Percent Below Poverty
Block Group 1, Census Tract 127.30	1,569	16	1.02
Block Group 3, Census Tract 127.30	2,150	155	7.21
Totals	**54,706**	**9,883**	**18.07**

Table 8. Poverty Status in Grays Harbor Shoreline Block Groups (all in Grays Harbor County)

Census Block Group	Population	Population Below Poverty	Percent Below Poverty
Block Group 1, Census Tract 2	2,818	258	9.16
Block Group 2, Census Tract 2	1,547	140	9.05
Block Group 3, Census Tract 2	1,355	100	7.38
Block Group 4, Census Tract 2	661	93	14.07
Block Group 1, Census Tract 3	1,039	69	6.64
Block Group 1, Census Tract 9	1,240	307	24.76
Block Group 2, Census Tract 9	511	74	14.48
Block Group 3, Census Tract 9	1,081	104	9.62
Block Group 1, Census Tract 10	741	67	9.04
Block Group 2, Census Tract 10	340	144	42.35
Block Group 4, Census Tract 10	1,089	627	57.58
Block Group 2, Census Tract 12	787	356	45.24
Block Group 3, Census Tract 12	859	337	39.23
Block Group 5, Census Tract 12	1,067	250	23.43
Block Group 2, Census Tract 13	737	241	32.70
Block Group 4, Census Tract 13	539	96	17.81
Block Group 1, Census Tract 15	1,116	519	46.51
Block Group 2, Census Tract 15	2,701	432	15.99
Block Group 1, Census Tract 16	1,086	174	16.02
Block Group 2, Census Tract 16	905	46	5.08
Block Group 3, Census Tract 16	1,094	297	27.15
Block Group 4, Census Tract 16	1,113	428	38.45
Totals	**24,426**	**5,159**	**21.12**

References

U.S. Census Bureau. 2014c. *2009–2013 5-Year American Community Survey*. Query: census block group data for minority and low income populations in the study. December 4. Available: http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t. Accessed: June 10, 2015.