Millennium Bulk Terminals–Longview SEPA Environmental Impact Statement

SEPA Air Quality Technical Report

Prepared for:

Cowlitz County
207 4th Avenue North
Kelso, WA 98626
Contact: Elaine Placido, Director of Building and Planning

In cooperation with:
Washington State Department of Ecology, Southwest Region

Prepared by:

ICF
710 Second Street, Suite 550
Seattle, WA 98104

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ICF

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Acronyms and Abbreviations

°F	degrees Fahrenheit
Applicant	Millennium Bulk Terminals–Longview, LLC
BNSF	BNSF Railway Company
CFR	Code of Federal Regulations
CO	carbon monoxide
DPM	diesel particulate matter
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
HAP	hazardous air pollutant
L/kg/day	liter per kilogram per day
lb/day	pounds per day
LVSW	Longview Switching Company
mg/kg/day	milligrams per kilogram per day
NAAQS	National Ambient Air Quality Standards
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NEPA	National Environmental Policy Act
NO_2	nitrogen dioxide
NO_x	nitrogen oxide
NSPS	New Source Performance Standards
NW AIRQUEST	Northwest International Air Quality Environmental Science and Technology Consortium
O_3	ozone
OLM	Ozone Limiting Method
PM	particulate matter
PM2.5	particulate matter less than or equal to 2.5 micrometers in diameter
PM10	particulate matter less than or equal to 10 micrometers in diameter
ppb	parts per billion
ppm	parts per millions
RCW	Revised Code of Washington
SEPA	Washington State Environmental Policy Act
SO_2	sulfur dioxide
SWCAA	Southwest Clean Air Agency
TAP	toxic air pollutant
tpy	tons per year
TSP	total suspended particules
$\mu g/m^3$	micrograms per cubic meter

UP	Union Pacific Railroad
USC	United States Code
VOC	volatile organic compound
WAC	Washington Administrative Code

Chapter 1
Introduction

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

1.1 Project Description

Millennium Bulk Terminals—Longview, LLC (Applicant) is proposing to construct and operate a coal export terminal (Proposed Action) in Cowlitz County, Washington along the Columbia River (Figure 1). The coal export terminal would receive coal from the Powder River Basin in Montana and Wyoming, and the Uinta Basin in Utah and Colorado via rail shipment. The coal export terminal would receive, stockpile, and load coal onto vessels and transport the coal via the Columbia River and Pacific Ocean to overseas markets in Asia.

1.1.1 Proposed Action

Under the Proposed Action, the Applicant would develop the coal export terminal on 190 acres (project area) primarily within an existing 540-acre site that is currently leased by the Applicant (Applicant's leased area). The project area is adjacent to the Columbia River in unincorporated Cowlitz County, Washington near Longview, Washington (Figure 2). The Applicant currently operates and would continue to operate a bulk product terminal within the Applicant's leased area.

BNSF Railway Company (BNSF) or Union Pacific Railroad (UP) trains would transport coal on BNSF main line routes in Washington State, and the BNSF Spur and Reynolds Lead in Cowlitz County to the project area. Coal would be unloaded from rail cars, stockpiled, and loaded by conveyor onto ocean-going vessels for export at two new docks (Docks 2 and 3) located in the Columbia River.

Once construction is complete, the Proposed Action could have a maximum annual throughput capacity of up to 44 million metric tons of coal per year. The coal export terminal would consist of one operating rail track, eight rail tracks for storing up to eight unit trains, rail car unloading facilities, a stockpile area for coal storage, conveyor and reclaiming facilities, two new docks in the Columbia River (Docks 2 and 3), and shiploading facilities on the two docks. Dredging of the Columbia River would be required to provide access to and from the Columbia River navigation channel and for berthing at the two new docks.

Vehicles would access the project area from Industrial Way (State Route 432), and vessels would access the project area via the Columbia River. The Reynolds Lead and BNSF Spur track—both jointly owned by BNSF and UP and operated by Longview Switching Company (LVSW)—provide rail access to the project area from a point on the BNSF main line (Longview Junction) located to the east in Kelso, Washington. Coal export terminal operations would occur 24 hours per day, 7 days per week. The coal export terminal would be designed for a minimum 30-year period of operation.

At full terminal operations, approximately 8 loaded unit trains each day would carry coal to the export terminal, 8 empty unit trains each day would leave the export terminal, and an average of 70 vessels per month or 840 vessels per year would be loaded, which would equate to 1,680 vessel transits in the Columbia River annually.

Figure 1. Project Vicinity

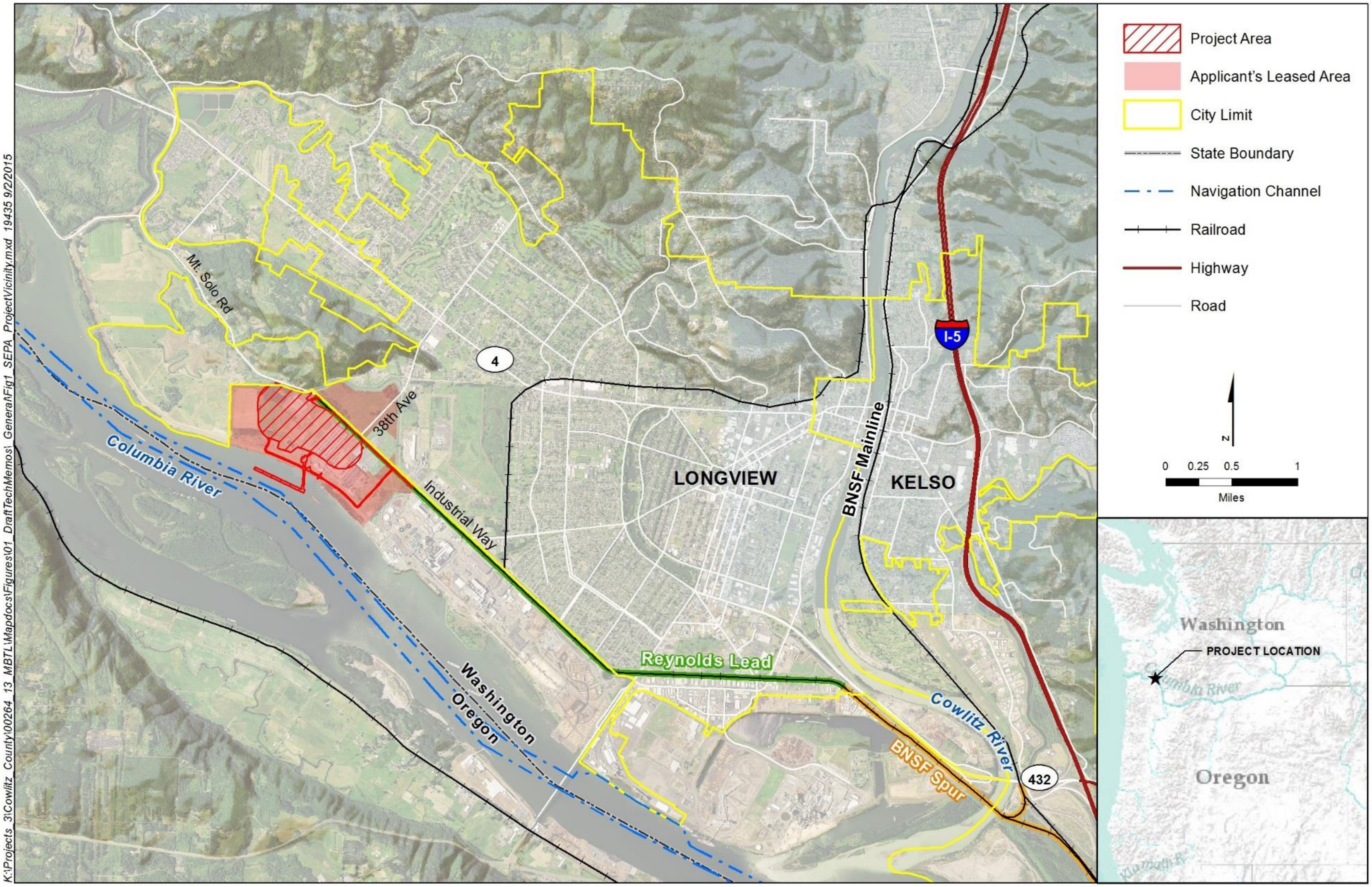
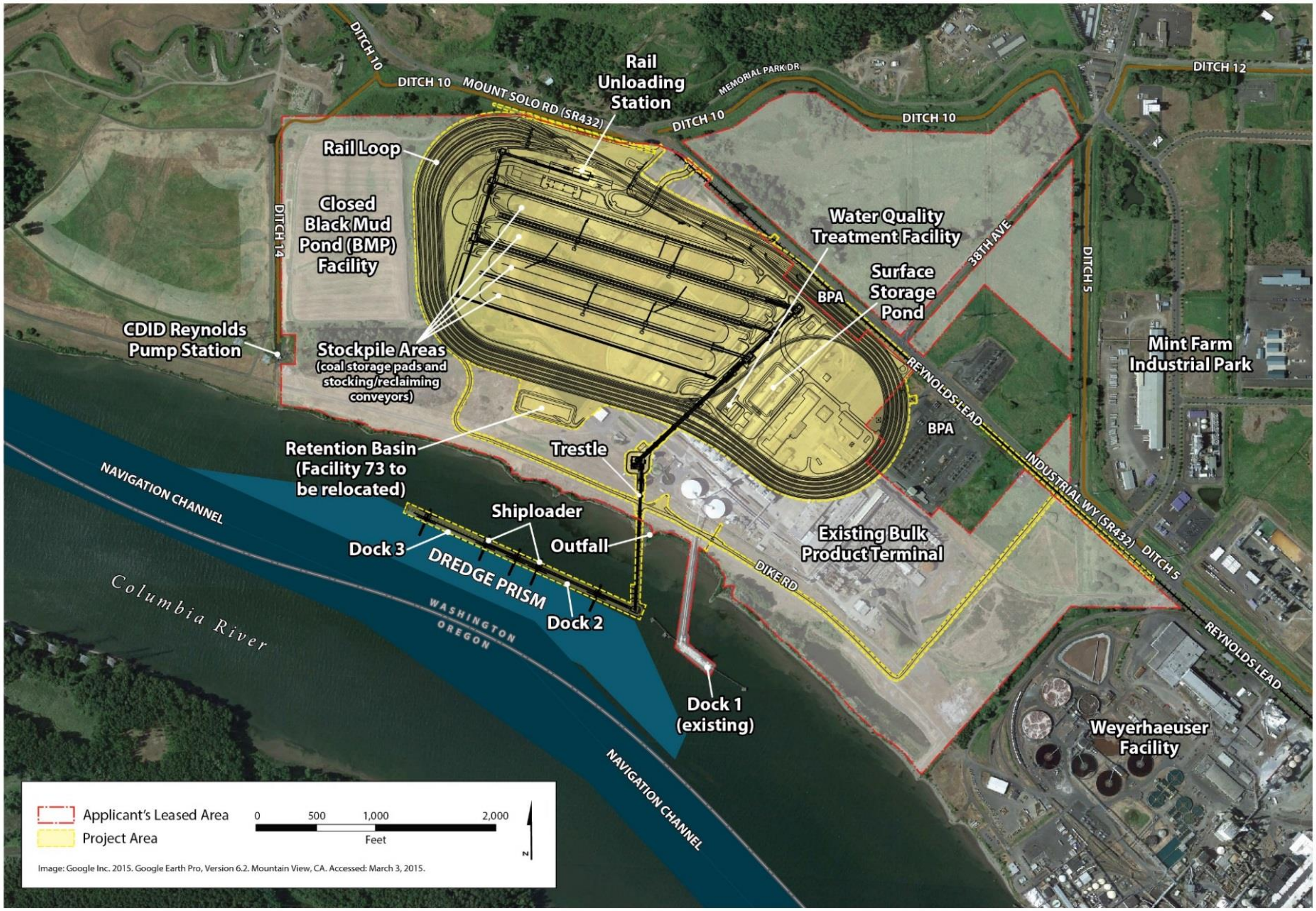


Figure 2. Proposed Action



1.1.2 No-Action Alternative

The Applicant plans to continue operating its existing bulk product terminal located adjacent to the project area. Ongoing operations would include storing and transporting alumina and small quantities of coal, and continued use of Dock 1. Maintenance of the existing bulk product terminal would continue, including maintenance dredging at the existing dock every 2 to 3 years. The Applicant plans to expand operations at the existing bulk product terminal, which could include increased storage and upland transfer of bulk products utilizing new and existing buildings. The Applicant would likely need to undertake demolition, construction, and other related activities to develop expanded bulk product terminal facilities.

If the coal export terminal is not constructed, the Applicant would likely propose expansion of the bulk product terminal onto areas that would have been subject to construction and operation of the proposed coal export terminal. Additional bulk product transfer activities could involve products such as a calcined pet coke, coal tar pitch, cement, fly ash, and sand or gravel. Any new operations would be evaluated under applicable regulations. Upland areas of the project area are zoned Heavy Industrial and it is assumed future proposed industrial uses in these upland areas could be permitted. Any new construction would be limited to uses allowed under existing Cowlitz County development regulations.

1.2 Regulatory Setting

Different jurisdictions are responsible for the regulation of air quality. These jurisdictions and their regulations, statutes, and guidance that apply to air quality are summarized in Table 1.

Table 1. Regulations, Statutes, and Guidance for Air Quality

Regulation, Statute, Guideline	Description
Federal	
National Environmental Policy Act (42 USC 4321 *et seq*.)	Requires the consideration of potential environmental effects. NEPA implementation procedures are set forth in the President's Council on Environmental Quality's Regulations for Implementing NEPA (49 CFR 1105).
Clean Air Act and Amendments	As amended in 1970, 1977, and 1990, requires EPA develop and enforce regulations to protect the public from air pollutants and their health impacts.
National Ambient Air Quality Standards (EPA)	Specifies the maximum acceptable ambient concentrations for seven criteria air pollutants: CO, lead, NO_2, O_3, PM10 and PM2.5, and SO_2. Primary NAAQS set limits to protect public health, and secondary NAAQS set limits to protect public welfare. Geographic areas where concentrations of a given criteria pollutant exceed NAAQS are classified as nonattainment areas for that pollutant.

Regulation, Statute, Guideline	Description
State	
Washington State Environmental Policy Act (WAC 197-11, RCW 43.21C)	Requires state and local agencies in Washington to identify potential environmental impacts that could result from governmental decisions.
Washington State General Regulations For Air Pollution Sources (WAC 173-400) and Washington State Clean Air Act (RCW 70.94)	Establishes the rules and procedures to control or prevent the emissions of air pollutants. Provides the regulatory authority to control emissions from stationary sources, reporting requirements, emissions standards, permitting programs, and the control of air toxic emissions.
Washington State Operating Permit Regulation (WAC 173-401)	Establishes the elements for the state air operating permit program.
Washington State Controls for New Sources of Toxic Air Pollutants (WAC 173-460)	Establishes the systematic control of new or modified sources emitting toxic air pollution to prevent air pollution, reduce emissions, and maintain air quality that will protect human health and safety.
Washington State Ambient Air Quality Standards (WAC 173-476)	Establishes maximum acceptable levels in the ambient air for particulate matter, lead, SO_2, NO_2, O_3, and CO. Washington State adopts current federal NAAQS in state regulations.
Local	
Cowlitz County SEPA Regulations (CCC 19.11)	Provide for the implementation of SEPA in Cowlitz County.
Southwest Clean Air Agency (SWCAA 400)	General regulations for regulating stationary sources of air pollution within Clark, Cowlitz, Lewis, Skamania, and Wahkiakum counties of Washington.

Notes:
USC = United States Code; NEPA = National Environmental Policy Act; CFR = Code of Federal Regulations; EPA = U.S. Environmental Protection Agency; CO = carbon monoxide; NO_2 = nitrogen oxides; O_3 = ozone; PM2.5 = particulate matter less than or equal to 2.5 micrometers in size; PM10 = particulate matter less than or equal to micrometers in size; SO_2 = sulfur dioxide; NAAQS = National Ambient Air Quality Standards; HAPs = hazardous air pollutants; WAC = Washington Administrative Code; RCW = Revised Code of Washington; SEPA = Washington State Environmental Policy Act; SWCAA = Southwest Clean Air Agency; CCC = Cowlitz County Code

The federal Clean Air Act and the Clean Air Act Amendments form the basis for a broad range of regulations that control allowable emissions and ambient concentrations of air pollutants in the environment. The National Ambient Air Quality Standards (NAAQS) were established by the U.S. Environmental Protection Agency (EPA) under authority of the Clean Air Act to protect the public from air pollution. Air pollutants for which there are NAAQS are called *criteria pollutants*. Geographic areas where concentrations of a given criteria pollutant exceed an ambient air quality standard are classified as *nonattainment areas* for that pollutant.

Under the federal Clean Air Act, the states are authorized to administer these programs and monitor air quality in different areas to determine if those areas are meeting the NAAQS. Under RCW 70.94, local counties can choose to form a county authority or join a multi-county authority. Cowlitz County is part of the multi-county air pollution control authority. The Southwest Clean Air Agency (SWCAA) maintains compliance with the NAAQS for most stationary source types of air pollutants via an air permitting programs (Revised Code of Washington [RCW] 70.94.053 and 70.94.057 and SWCAA 400-020). This authority includes the regulation of fugitive dust sources (SWCAA-400-040) as well as vented emissions.

Other federal air quality regulatory programs for major stationary sources include Prevention of Significant Deterioration, National Emission Standards for Hazardous Air Pollutants (NESHAPS), Title V Air Permitting Program, and New Source Performance Standards (NSPS). None of these programs is expected to apply to the Proposed Action because stationary source emissions are well below major source thresholds, and because current NESHAPS and NSPS standards do not apply to the proposed facility type. The state also has rules for toxic air pollutants (TAPs) that are applicable to stationary sources. These rules were established to provide systematic control of TAP emissions (which include both carcinogens and noncarcinogens) in order to maintain the protection of human health and safety.

EPA first began regulating on-road mobile sources in 1970 as part of the Clean Air Act. EPA was given the added regulatory authority under Section 213 in the 1990 Clean Air Act Amendments to control emissions from nonroad engines (e.g., construction equipment, locomotives, and vessels). An extensive number of exhaust emissions standards and regulations have been issued by EPA since 1990 on all classes of nonroad engines including construction equipment, locomotives, vessels, off-road vehicles, and lawn and garden equipment. Regulations that are relevant to the Proposed Action include locomotive emission standards for new and re-built locomotive engines and the North America Emission Control Area for marine vessels limiting the sulfur content in fuel oil. No provisions have been made to allow states (other than California) or local authorities to impose additional regulations on these source categories.

1.2.1 Current NAAQS and Washington State Ambient Air Quality Standards

Table 2 lists both the federal and state ambient air quality standards for six criteria air pollutants and total suspended particulates. Annual standards are never to be exceeded. Short-term standards are not to be exceeded more than once per year, unless noted. The NAAQS consist of primary standards and secondary standards. Primary standards are designed to protect public health, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards are designed to protect public welfare from effects such as visibility reduction, soiling, and nuisance (e.g., preventing air pollution damage to vegetation).

Table 2. Federal and Washington State Ambient Air Quality Standards

	State and Federal	
Pollutant	**Primary**	**Secondary**
Carbon monoxide		
8-hour average[a]	9 ppm	No standard
1-hour average[a]	35 ppm	No standard
Ozone		
8-hour average[b,c]	0.070 ppm	0.070 ppm
Nitrogen dioxide		
1-hour average[d]	100 ppb	No standard
Annual average	53 ppb	53 ppb
Sulfur dioxide		
3-hour average[e]	No standard	0.50 ppm
1-hour average[f]	75 ppb	No standard
Lead		
Rolling 3-month average	0.15 μg/m^3	0.15 μg/m^3
PM10		
24-hour average[g]	150 μg/m^3	150 μg/m^3
PM2.5		
Annual average[h]	12 μg/m^3	15 μg/m^3
24-hour average[i]	35 μg/m^3	35 μg/m^3

Notes:

[a] Not to be exceeded on more than 1 day per calendar year as determined under the conditions indicated in 173 WAC 476.

[b] In December 2015, EPA lowered the federal standard for 8-hour ozone from 0.075 ppm to 0.070 ppm.

[c] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.070 ppm.

[d] 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years.

[e] Not to be exceeded more than once per calendar year.

[f] 99th percentile of 1-hour daily maximum concentrations averaged over 3 years.

[g] Not to be exceeded more than once per year average over 3 years.

[h] Annual mean averaged over 3 years.

[i] 98th percentile averaged over 3 years.

Source: 173 WAC 476; U.S. Environmental Protection Agency 2012.

ppm = parts per million; ppb= parts per billion; PM10 = particulate matter with a diameter of less than or equal to 10 micrometers; PM2.5 = particulate matter with a diameter of less than or equal to 2.5 micrometers; μg/m^3 = micrograms per cubic meter

1.2.2 Federal and State Air Toxics

Under the federal Clean Air Act, EPA controls air toxics, which are pollutants known or suspected to cause cancer or other serious health effects, such as birth defects or reproductive effects. Examples of air toxics include benzene, formaldehyde, and toluene. EPA has identified 188 air toxics, which it refers to as hazardous air pollutants (HAPS). No ambient air quality standards have been established for HAPS, and instead EPA has identified all major industrial stationary sources that emit these pollutants and developed national technology-based performance standards to reduce their emissions. The performance standards are designed to ensure that major sources of HAPS are controlled, regardless of geographic location.

An action that requires a Notice of Construction application under WAC 173-400-110 is subject to the review requirements of controls for new sources of toxic air pollutants, except if emissions before control equipment of each toxic air pollutant from a new source are less than the applicable *de minimis* emission threshold for the toxic air pollutant listed in WAC 173-460-150 or if the increase in emissions from each modification is less than the applicable *de minimis* emission threshold for the toxic air pollutant listed in WAC 173-460-150. Southwest Clean Air Agency has a separate list of pollutants that may apply to emissions from this stationary source. The purpose is to establish the systematic control of new or modified sources emitting toxic air pollutants to prevent air pollution to the extent reasonably possible and maintain levels of air quality to protect human health.

1.2.3 Attainment Status

Based on monitoring information collected over a period of years, EPA and the Washington State Department of Ecology (Ecology) designate regions as being attainment or nonattainment areas for regulated air pollutants. Attainment status indicates that air quality in an area meets the federal, health-based ambient air quality standards. Nonattainment status indicates that air quality in an area does not meet those standards. If the measured concentrations in a nonattainment area improve to levels consistently below the federal standards, Ecology and EPA can reclassify the nonattainment area to a maintenance area. In this situation, Ecology and the local clean air agency are required to implement maintenance plans to ensure ongoing emissions reductions, and continuous compliance with the federal standards.

Cowlitz County is currently designated unclassifiable-attainment for all NAAQS. This designation means that EPA and Ecology expect the area to meet air quality standards despite a lack of monitoring data. Currently, Ecology and SWCAA only operate a particulate matter less than or equal to 2.5 micrometers in diameter (PM2.5) air quality monitor.

1.3 Study Area

The study area for direct impacts on air quality is the area in and near the project area that could be affected by construction and operation activities in the project area. The study area for indirect impacts includes Cowlitz County and accounts for rail operations in Cowlitz County and vessel activity on the Columbia River. An assessment of air quality impacts from Proposed Action-related trains and vessels for the routes in Washington State is also provided.

For inhalation health risks related to diesel particulate matter (DPM), the study area for direct impacts is the area that could be affected by operations in the project area and the study area for indirect impacts is the area that could be affected by terminal and rail operations in Cowlitz County.

Chapter 2
Existing Conditions

This chapter explains the methods for assessing the existing conditions and determining impacts, and describes the existing conditions in the study area as they pertain to air quality.

2.1 Methods

The air quality analysis evaluated emissions from construction and terminal operations.

Air emissions for the Proposed Action were estimated for carbon monoxide (CO), volatile organic compounds (VOCs), nitrogen oxide (NO_x), particulate matter less than or equal to 10 micrometers in diameter (PM10), PM2.5, and sulfur dioxide (SO_2) to evaluate the impact on air quality. Because construction emissions are temporary and have a short period of activity, these emissions are only evaluated in comparison with emissions thresholds. Operations emissions, however, are evaluated in comparison to their impacts on air quality.

The method used to assess construction-related air quality impacts was designed to estimate the strength of emissions during the peak construction period and to identify the maximum daily emissions. Sources of construction emissions included emissions from construction equipment, river barges, fugitive dust from earthwork activity, vehicle crossing delays, and construction worker commute vehicles.

The air quality assessment for terminal operations considered on-site activities that would generate potential fugitive emissions of particulate matter from the handling and transfer of coal, including unloading coal from rail cars, transferring coal on conveyors, piling coal onto storage piles, and loading coal onto ships. The coal transfers would occur in enclosed areas (i.e., rotary coal car dump and conveyors), as well as areas that are not enclosed (i.e., coal piles and the unloading of rail cars). In addition, the air quality assessment considered locomotive exhaust emissions that occur during the unloading and movement of coal cars, hoteling emissions during vessel loading, emissions from tugs used to maneuver vessels into the terminal, and emissions from operations (e.g., loader) and maintenance equipment.

The operations emissions were assessed for their potential local air quality impacts using EPA's standard regulatory air dispersion model, AERMOD (Version 15181). AERMOD is the appropriate tool for this application as the air quality impacts are localized and AERMOD is designed to assess emissions for multiple point, area, and volume sources in simple and complex terrain, and uses hourly meteorological on-site data. AERMOD output results are compared to the federal and state ambient air quality standards presented in Table 2. Appendix A, *Air Quality Data,* provides details on emissions calculations.

An inhalation-only[1] health risk assessment was performed using the AERMOD dispersion model to assess the increased cancer risk associated with the Proposed Action-related increase in DPM emissions. The assessment was performed per California Environmental Protection Agency guidance using Ecology's evaluation and selection of available guidelines (Washington State Department of Ecology 2008).

2.1.1 Data Sources

The following sources of information were used to determine the potential impacts from the Proposed Action and the No-Action Alternative on air quality in the study area.

- Data and information on coal export terminal construction and operation (URS Corporation 2015).
- Northwest International Air Quality Environmental Science and Technology Consortium for existing conditions data (2015).
- California's Air Resource Board vessel transit emissions study (California Air Resources Board 2011).
- California Environmental Protection Agency's guidance manual for preparation of health risk assessments (California Environmental Protection Agency 2003).
- National Climatic Data Center Longview, Washington climate data (National Climatic Data Center 2011).
- U.S. Environmental Protection Agency air pollutant emissions factors (U.S. Environmental Protection Agency 1995a, 1995b, 1995c, 1996).
- U.S. Environmental Protection Agency's air modeling guidance (U.S. Environmental Protection Agency 2004, 2014).
- U.S. Environmental Protection Agency's vessel fuel consumption data (U.S. Environmental Protection Agency 2000).
- U.S. Environmental Protection Agency's NONROAD Model (U.S. Environmental Protection Agency 2009).
- U.S. Environmental Protection Agency's vessel exhaust emission standards (U.S. Environmental Protection Agency 2012).
- U.S. Environmental Protection Agency's national-scale air toxic assessment (U.S. Environmental Protection Agency 2011).
- Washington State Department of Ecology statewide emissions inventory levels (Washington State Department of Ecology 2014).

2.1.2 Impact Analysis Approach

The following sections describe the approach that was taken to evaluate the potential impacts of the Proposed Action and No-Action Alternative on air quality.

[1] The risk assessment only considered the cancer risk by the inhalation pathway because the risk contributions by other pathways of exposure are difficult to quantify and are known to be negligible relative to the inhalation pathway.

2.1.2.1 Construction Impact Analysis Approach

The Applicant has identified three construction scenarios:

- **Truck.** If material is delivered by truck, it is assumed that approximately 88,000 truck trips would be required over the construction period. Approximately 56,000 loaded truck trips would be needed during the peak construction year.
- **Rail.** If material is delivered by rail, it is assumed that approximately 35,000 loaded rail cars (350 loaded train trips or 700 total train trips) would be required over the construction period. Approximately two-thirds of the rail trips would occur during the peak construction year.
- **Barge.** If material is delivered by barge, it is assumed that approximately 1,130 barge trips would be required over the construction period. Approximately two-thirds of the barge trips would occur during the peak construction year. Because the project area does not have an existing barge dock, the material would be unloaded at an existing dock elsewhere on the Columbia River and transported to the project area by truck.

Emissions included in the construction analysis include those from barge and truck emissions associated with the delivery of construction supplies and materials, in addition to direct emissions from construction equipment exhaust and fugitive dust emissions. Earthwork activity would take place during the first 18 months of construction. Based on the frequency and duration of use and fuel types, emissions were estimated based on either the EPA AP-42 compilation of emissions factors or EPA's NONROAD2008a model for non-road construction equipment activity. A brief description and key assumptions are presented in the following sections for each source type.

Construction Equipment

Construction equipment exhaust emissions are the result of fuel combustion. This includes activity associated with rail infrastructure, construction of the conveyor and transfer stations, and surge bins, dock, and trestles. Combustion emissions estimates were obtained by applying the EPA NONROAD2008a emissions model (U.S. Environmental Protection Agency 2009) for nonroad equipment activity. Construction activity was assumed to occur 8 hours per day, 5 days per week, 52 weeks per year, with the exception of track laying machines, which were assumed to occur only 4 hours per day. Emissions factors were then combined with maximum numbers of equipment operated, duration of use, and horsepower to obtain annual emissions. Diesel particulate emissions were derived from PM10 emissions estimates for diesel-powered equipment, which included most on-site combustion sources as well as barges. Additional details on the approach are identified in Appendix A, *Air Quality Data,* for annual emissions and maximum daily emissions.

River Barges

Emissions estimates for barge engines were based on EPA's approach for large diesel engines (U.S. Environmental Protection Agency 1996). The river barge was assumed to use ultra-low sulfur diesel, with less than 15 parts per million (ppm) sulfur content. The barge positioning time was assumed to take 1 hour (0.5 hour in and 0.5 hour out), with 753 round trips during the peak construction period (average of 2.9 daily). Additional details on this approach are identified in Appendix A, *Air Quality Data,* for annual emissions and maximum daily emissions.

Fugitive Dust from Earthwork Activity

Fugitive dust emissions were estimated using a conservative approach for construction equipment (U.S. Environmental Protection Agency 1995a). This method uses a generic, all-inclusive, emissions factor of 1.2 tons particulate matter (PM)/acre-month for land preparation activities. Land clearing, excavation, earth moving (cut and fill), and other miscellaneous dust-generating activities that typically occur during construction are included as part of this emissions factor. All earthwork for the project area was assumed to occur evenly over a 1-year period, and the standard best management practice of watering to minimize fugitive dust emissions was assumed to be used as well. Additional details on this approach are identified in Appendix A, *Air Quality Data,* for annual emissions and maximum daily emissions.

Vehicle Delays at At-Grade Rail Crossings

Off-site emissions associated with vehicle delays at train crossings from construction-related locomotives transporting construction materials along the Reynolds Lead and BNSF Spur are included in the analysis.

Construction Worker Commute Vehicles

During peak construction, up to 200 construction workers may commute to the project area (ICF and DKS Associates 2017). Off-site emissions associated with commute vehicles for construction workers are included in the analysis. Additional details on this approach are identified in Appendix A, *Air Quality Data*.

2.1.2.2 Operations Impact Analysis Approach

The on-site transfer and storage of coal would create fugitive emissions of coal dust due to product movement and wind erosion. In addition, combustion emissions from rail and vessel movement, as well as some nonroad equipment emissions associated with the operation and maintenance of the terminal, are included in the analysis. The project area also includes emissions at Docks 2 and 3, as well as maneuvering to dock vessels at the terminal; these on-site emissions were considered in the analysis as well. The sections that follow describe the approach taken to address emissions associated with coal storage and handling, locomotive, vessel, vehicle delays at rail crossings, and employee commute vehicles as well as how emissions were characterized for air quality modeling. The following sections also describe the approach to evaluate the operations sources of DPM emissions for their potential contribution to the increase in inhalation cancer risk.

Coal Storage and Handling

Most on-site coal movement would occur in enclosed areas, including the rotary coal car dump and conveyors. Some transfer activities at the coal storage piles would not be enclosed; however, the conveyors, transfer towers, and the coal storage piles themselves would have systems in place for dust control (watering or dry fogging). Watering of the coal storage piles would help to reduce wind erosion. In general, the combination of these passive (enclosures) and active (watering, fogging) control systems would provide a high level of dust control (up to 99%); however, because these control systems would not operate with negative pressure and not all systems are enclosed, a more conservative 95% effectiveness assumption was used. This approach is consistent with a similar type facility that was issued a permit from Oregon Department of Environmental Quality for the Coyote Island Terminal at the Port of Morrow. To account for the reduction in emissions from watering of the coal within the project area (URS Corporation 2014), a 95% effectiveness in reducing coal dust emissions was assumed in this analysis. Appendix A, *Air Quality Data,* presents this approach in detail (Table 3).

Locomotives

The impact analysis approach for rail operations used EPA projected emissions factors (grams per gallon [g/gal]) for line-haul locomotives, which are based on projected changes in locomotive fleet over the next 30 years (U.S. Environmental Protection Agency 2009). These emissions were based on locomotive engine load and associated fuel consumption during transport to and from the coal export terminal, the unloading of coal from train cars, and the total annual coal throughput. Key assumptions for rail included an estimated duration of 111 minutes (1.85 hours) to unload a 125-car unit train (ICF and Hellerworx 2017). It was assumed that all locomotives would use ultra-low-sulfur diesel (15 ppb sulfur). Appendix A, *Air Quality Data,* presents this approach in detail (Table 3).

Vessel

The impact analysis approach for vessel operations assumed that each vessel receiving coal would need three tugs to maneuver the ship, and would require 3 hours total time to assist with docking and departing operations. Further, it was estimated that an average of 13 hours would be needed to load each vessel with coal, and during this period, the vessel would be hoteling using auxiliary engines. The typical main and auxiliary engine size was based on Lloyd's Register of Ships Sea-web (Sea-Web 2015).[2] To comply with International Maritime Organization 2016 Emission Control Areas for North America, all vessels were assumed to use the maximum allowed sulfur content marine distillate fuel of 0.1% (1,000 ppm). It was also assumed that all tugboats would use ultra-low-sulfur diesel (15 ppb sulfur). To estimate the vessel emissions outside Cowlitz County but within Washington State, a one-way travel distance of 51.5 miles (Cowlitz County line to 3 nautical miles beyond the mouth of the Columbia River) was used in the analysis along with a round-trip travel time of 8.2 hours. Appendix A, *Air Quality Data,* presents this approach in detail (Table 3).

Vehicle Delays at At-Grade Rail Crossings

Off-site emissions associated with vehicle delays at at-grade rail crossings from Proposed Action-related trains on the Reynolds Lead and BNSF Spur are included in this analysis. Appendix A, *Air Quality Data,* presents this approach in detail (Table 3).

Employee Commute Vehicles

The impact analysis approach for employee vehicle emissions assumed approximately 135 vehicles commuting to and from the project area each day, and an average travel time of 24.1 minutes. Appendix A, *Air Quality Data,* presents this approach in detail (Table 3).

[2] The Sea-Web data is produced by IHS Global Limited. The data is based on Lloyd's Register of Ships Sea-web provided ship characteristics data for ships over 100 gross tons.

Table 3. Operations Emissions, Source Type, and Location of Detailed Methods

Source Type	Characterization for the Air Dispersion Modeling	Appendix A Section Detailing Calculation Methods
Handling and transfer of coal, including unloading coal from rail cars, transferring coal on conveyors, piling coal onto storage piles, and loading coal onto ships[a]	Volume	A6
Locomotive exhaust emissions that occur during moving, unloading, idling, and switching of rail cars	Line	A8a, A8b, and A8c
Maneuvering and hotel emissions during vessel loading and tug assist maneuvering	Point	A9a and A9b
Emissions from operations (e.g., loader) and maintenance equipment	Point	A10a and A10b
Coal dust from coal storage piles	Area	A4 and A5
Coal dust from moving rail cars	Line	A7

Characterizing Emissions for Air Quality Modeling

An air quality modeling impact assessment was conducted to assess the localized air quality impacts from operation of the terminal on air quality and assess the contribution from just terminal emissions, from all on-site activities, and from all activities, including off-site activities.

The air quality modeling methodology follows general EPA protocols used in air quality permitting. The methodology used is similar to the approach used in the *Air Quality Analysis Environmental Report* prepared by URS (URS Corporation 2015). One notable exception was the use of the Tier 3 level Ozone Limiting Method (OLM) to estimate NO_2 concentration. The OLM approach accounts for the NO_x to NO_2 conversion,[3] using EPA's default NO_2/NO_x equilibrium ratio of 0.9, an in-stack NO_2 to NO_x of 0.05 for locomotives,[4] an in-stack of NO_2 to NO_x of 0.20 for vessels (Alföldy et al. 2013), and an NO_2 to NO_x of 0.30 for on-site equipment (Wang et al. 2011). The OLM approach also requires the O_3 data. The nearest representative O_3 data available was from the Oregon Department of Environmental Quality's Sauvie Island monitor located on the Columbia River approximately 25 miles south-southeast of the project area. However, this site is not a year-round monitor, and other more distant and less representative sites would be needed to complete the analysis using monitored data. Instead, representative background concentrations for the study area were obtained from the Northwest International Air Quality Environmental Science and Technology Consortium (NW AIRQUEST), Washington State University, for 2009 through 2011.[5] The background ozone concentration for this location was 79 $\mu g/m^3$.

[3] Atmospheric chemistry changes NO to NO_2; the rate at which this conversion takes place is limited by the available ozone and sunlight.

[4] About 5% of NO_x freshly emitted from locomotives is in the form of NO_2 (Fritz pers. comm.).

[5] The consortium developed background design value estimates for 2009 through 2011, based on model-monitor interpolated products that provide realistic background design value estimates where nearby ambient monitoring data are unavailable. The work is sponsored by EPA Region 10, Ecology, and others. More information about the NW AIRQUEST tool can be found at http://www.lar.wsu.edu/nw-airquest/lookup.html.

The air quality model requires that emissions be characterized for use in AERMOD as four types of sources: point, volume, area, and line sources.[6] Each emissions source type characteristic is summarized below.

- **Point sources.** Vessels and tugboat emissions from vented stacks were characterized as point sources. The operating and maintenance equipment were also modeled as point sources spread across the terminal. Exhaust emissions from on-site operations and maintenance equipment were also based on the NONROAD model. Vessel emissions factors came from several sources, including California's Air Resource Board (CARB) *Emission Estimation Methodology for Ocean Going Vessels* (California Air Resource Board 2011), and EPA's *Federal Marine Compression-Ignition Engines, Exhaust Emission Standards* for highest tier engines—auxiliary and Tugs C2; main engine C3 (U.S. Environmental Protection Agency 2012). This analysis assumes that EPA's engine emissions standards are fully implemented by 2016, and that all vessels would be using these types of engines by the time the terminal would become fully operational.
- **Volume sources.** Coal transfer operations were characterized as volume sources, which included eight transfer towers, a rotary rail dump, surge bins work points, and two conveyors to load coal onto the vessels with emissions rates estimated based on the EPA AP-42, Chapter 13.2.4 approach (U.S. Environmental Protection Agency 1995b).
- **Area sources.** Area sources were used to model low-level ground releases. The four coal storage piles were modeled as area sources with emissions estimated following the EPA AP-42, Chapter 13.2.5 approach (U.S. Environmental Protection Agency 1995c).
- **Line sources.** Exhaust emissions from locomotives unloading operations and coal dust from moving rail cars were modeled as line sources. Coal dust particulate emissions were estimated following EPA's AP-42, Chapter 13.2.5 approach (U.S. Environmental Protection Agency 1995c), and locomotive exhaust emissions were estimated following EPA's NONROAD2008a model[7] (U.S. Environmental Protection Agency 2009).

Table 3 presents a list of emissions source types associated with operations and identifies how the source type is characterized in AERMOD. Appendix A, *Air Quality Data,* provides further details on emissions calculations.

Health Risk Assessment Impacts Approach

The operations sources of DPM emissions were also assessed for their potential increase in inhalation cancer risk using AERMOD. The model outputs DPM concentrations, which are then expressed in terms of cancer risk using the 80th percentile value breathing rate ((302 liters per kilogram per day [L/kg/day]) for residential receptors with a cancer potency value for diesel PM of 1.1 milligrams per kilogram per day (mg/kg/day)-1 and conservatively assuming that the receptors are exposed 24 hours per day for 70 years. This approach follows California's 2003 Office of Environmental Health Hazard Assessment Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments for a Tier 1 standard point estimate risk assessment approach. The results are presented in terms of increased inhalation cancer risk per million population. Two risk assessments were performed: one using DPM emissions fixed at when the facility reaches maximum operations (2028) and a second using integrated lifetime DPM emissions over 70 years.

[6] AERMOD User Guide (2004) provides additional information on the definition of these source types.
[7] Rail emissions were based on the national fleet Class-1 line-haul locomotive fleet.

The results from the modeling are discussed in terms of increased inhalation cancer risk per million people. To provide perspective on the increased cancer risk from the Proposed Action, results were compared with the countywide average inhalation cancer risk of 30 per million, as reported by EPA (2015) based on their most recent (2011) nationwide air toxic assessment. However, EPA does not include DPM in its cancer risk assessment, because it does not consider the data sufficient to quantitatively determine the diesel cancer potency factor. Because no baseline inhalation cancer risk for Cowlitz County that accounts for DPM is available,[8] the California Office of Environmental Health Hazard Assessment cancer potency value was applied to the EPA (2011) average Cowlitz County DPM concentration (1.14 $\mu g/m^3$) to establish a baseline for comparison in this analysis. The resulting countywide average inhalation cancer risk from DPM emissions is approximately 300 cancers per million. Thus, an increased risk of 10 cancers per million would represent an approximately 3% increase existing risk. Similarly, an increased risk of 30 cancers per million, would represent a 10% increase over existing levels.

2.2 Existing Conditions

The existing environmental conditions related to air quality in the study area are described below.

2.2.1 Project Area Air Quality Conditions

The following sections describe the meteorological conditions and background air quality conditions.

2.2.1.1 Prevailing Meteorology and Climate

The project area is located along the Columbia River in southwestern Washington, approximately 50 miles east of the Pacific Ocean. The region is characterized as a mid-latitude, west coast marine-type climate. The Cascade Range to the east has a large influence on the climate in Cowlitz County. The Cascade Range forms a barrier from continental air masses originating over the Columbia River Basin. The Cascades also induce heavy amounts of rainfall; as moist air from the west rises, it is forced to rise up the mountain slopes, which produces heavier rainfall on the western slopes of the Cascades and moderate rainfall amounts in the lower lying areas, such as Longview.

Summers in the region are mild and dry. Winters are cool, but typically wet and cloudy with a small range in daily temperature. The average annual precipitation in Longview is approximately 48 inches, with most precipitation falling during the months of November through March (National Climate Data Center 2011). Average annual rain events, taken as days with measured rain greater than 0.01-inch, are approximately 175 days per year, based on National Climatic Data Center summaries.

Due mostly to its geographical location, temperatures are usually mild. Days with maximum temperatures above 90 degrees Fahrenheit (°F) occur about 7 times per year on average. Days with a minimum temperature below 32°F occur about 57 times per year on average, and below 0°F temperatures occur only very rarely (none recorded between 1931 and 2006). Mean high

[8] Because the EPA 2002 health assessment document for diesel engine exhaust does not find data sufficient to quantitatively determine the diesel cancer potency factor.

temperatures range from the high 70s in the summer to mid-40s (°F) in winter, while average lows are generally in the low 50s in summer and mid-30s in winter.

Meteorological data collected by the Weyerhaeuser meteorological tower at the nearby Mint Farm Industrial Park between 2001 and 2003 indicates that the prevailing winds near the project area are from the west-northwest and southeast, following along the alignment of the Columbia River. In the fall and winter months (October through March), the winds are primarily from the southeast and east; the winds are typically from the west-northwest in the spring and summer months (April through September). Figure 3 shows the annual wind rose for the Mint Farm meteorological station for the three-year period from 2001 to 2003 with an average wind speed of 2.25 meters/second.

2.2.1.2 Project Area Background Air Quality

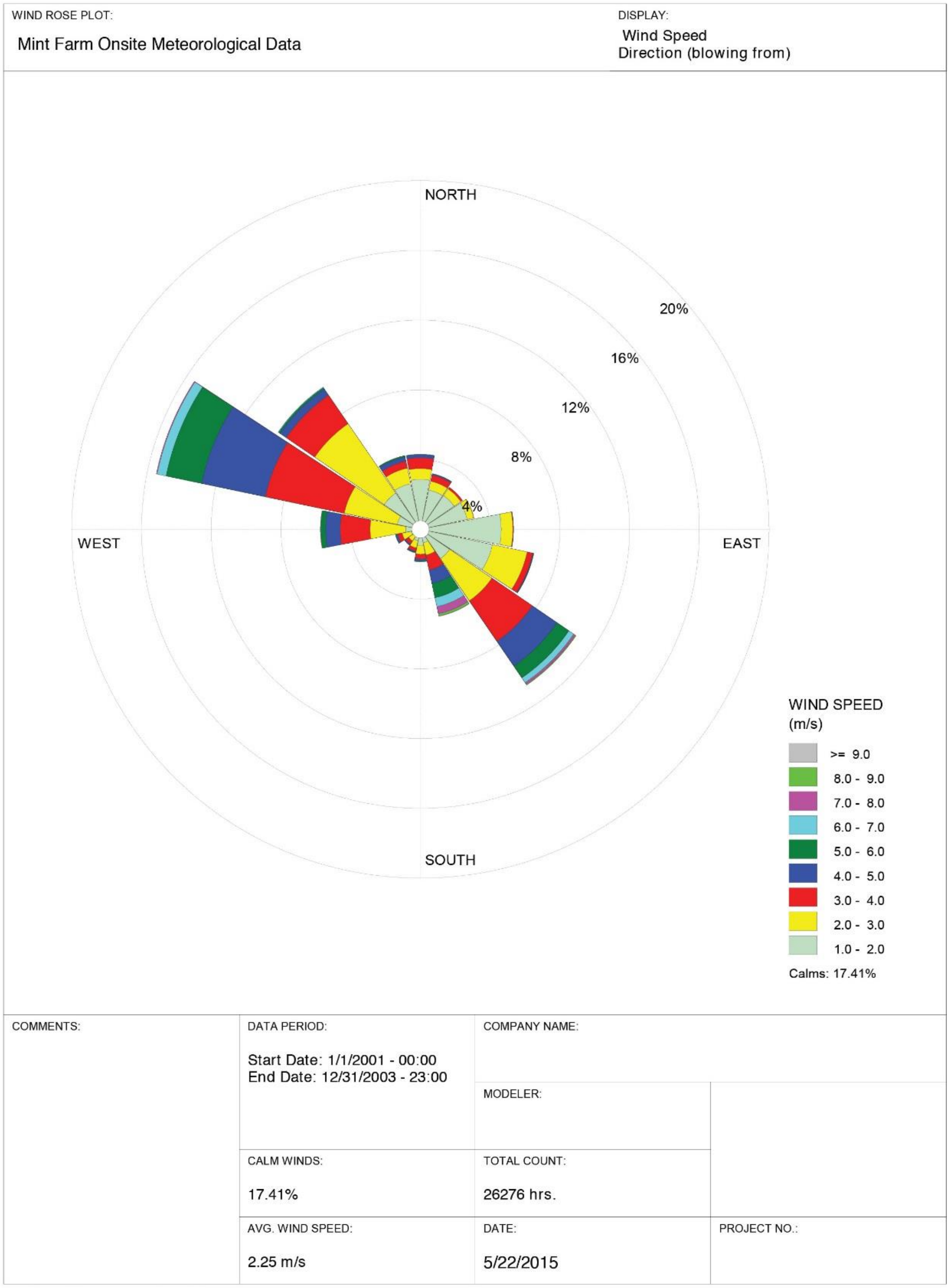
As discussed in Section 1.2.3, *Attainment Status*, Cowlitz County is attainment or unclassified for all criteria pollutants, indicating that air quality in the vicinity of the project area meets the federal and state ambient air quality standards shown in Table 2. The only available local air pollutant monitoring is for PM2.5. The monitor is operated by Ecology and is located at 1234 30th Avenue in Longview (Olympic School), approximately 1.5 miles east of the project area.

Beginning January 1, 2007, hourly data were made available for analysis and download at Ecology's monitoring data site (Washington State Department of Ecology 2015a). The four most recent years of complete data from this site (2013 through 2016) were reviewed and the 3-year average of 98th percentile is 19.3 $\mu g/m^3$. This 3-year average is well below the 24-hour 98th percentile PM2.5 standard of 35 $\mu g/m^3$. The maximum 3-year annual average PM2.5 concentration was 6.2 $\mu g/m^3$. The monitoring shows that PM2.5 levels in the Longview-Kelso area are well within the PM2.5 air quality standards. However this $PM_{2.5}$ monitor is not a Federal Reference Method or Federal Equivalence Method monitor, and thus, cannot be used to make formal designations of attainment status.

Concentrations of other criteria pollutants for the study area also are expected to be well within air quality standards, although no monitoring data are available. Estimated values based on air quality modeling are discussed in Section 3.1.2, *Operations*.

In addition, criteria pollutants results from the Longview air toxics study (Southwest Clean Air Agency 2007) showed that measured levels of toxic pollutants were below levels of concern for short-term and long-term exposures. The study found that, of the air toxics that could be directly monitored, the air toxics of most concern for potential health risk in Longview are acetaldehyde, arsenic, benzene, manganese, and formaldehyde, while DPM was identified as the most likely contributor to cancer risk in Washington State. No further studies on air toxic monitoring in the Longview-Kelso area has been conducted since that time. Regarding HAPs, the most recent national air toxic assessment (U.S. Environmental Protection Agency 2011) showed that Cowlitz County has an overall inhalation cancer risk of 30 cancers per million, which is slightly lower than the state and national averages of 40 cancers per million and below the national average of 40 cancers per million. However, the national air toxics assessment does not quantify cancer risk associated with exposure to DPM. A similar pattern emerges when DPM is included in the analysis, but with levels nearly ten times higher (Washington State Department of Ecology 2011).

Figure 3. Wind Data for Mint Farm 2001-2003, Supplemented with Portland International Airport for Missing Hours



WRPLOT View - Lakes Environmental Software

2.2.2 Cowlitz County Air Quality Conditions

Cowlitz County is classified as attainment or unclassified for all air pollutants. Of the criteria air pollutants, only PM2.5 is currently being monitored in the county. The PM2.5 monitoring station located at the Olympic Middle School is a neighborhood-scale site, affected primarily by smoke from home heating. It is considered representative of the Longview-Kelso area and is used for curtailment calls during the home heating season. As described previously, the 3-year average is well below the 24-hour 98th percentile PM2.5 standard of 35 $\mu g/m^3$. Although it is not a reference instrument, it is considered a strong indicator of the relative air quality for the Longview-Kelso area. Air quality in other locations of Cowlitz County is generally as good as or better than in the Longview-Kelso area. Refer to Section 2.2.1.2, *Project Area Background Air Quality*, for additional information on existing air quality conditions.

2.2.3 Washington State Air Quality Conditions

As described in the SEPA Rail Transportation Technical Report (ICF and Hellerworx 2017), most loaded and empty trains would be expected to travel the same route between the Washington-Idaho State line and Pasco, Washington. West of Pasco, westbound loaded trains would travel to the project area along the Columbia River Gorge route, through Vancouver, to Longview Junction on the BNSF main line, and then along the BNSF Spur and Reynolds Lead to the project area. Empty trains would travel from the project area along the Reynolds Lead and BNSF Spur to Longview Junction, on the BNSF main line to Auburn, over Stampede Pass, then through Yakima and back to Pasco.

Air quality along the loaded portion of the rail route in eastern Washington from the Idaho border to Pasco is generally good. Spokane is a maintenance area for carbon monoxide, but has not had an exceedance of the carbon monoxide standard in over 10 years. Also in this region of the Columbia Plateau from spring through fall, high winds can combine with dry weather conditions to create dust storms, which can lead to extremely high levels of PM10. The state monitors for PM2.5 along this route, but in general the monitoring is below the state's goal to keep concentrations below 20 $\mu g/m^3$, which is well below the PM2.5 NAAQS of 35 $\mu g/m^3$. Air quality through the Columbia Gorge is generally good, with the primary concern focused on visibility impairment and regional haze issues; standards established to protect visibility are much lower than for health effects. The air quality from Vancouver up to Longview is generally good with PM2.5 being the pollutant of most concern; readings are generally below the state's goal to keep PM2.5 concentrations below 20 $\mu g/m^3$. The few days with higher levels mostly occur during the home heating season. Vancouver design values cannot be calculated because of data completeness issues.

Unloaded rail cars would pass from Longview through Tacoma, up to Auburn, and over the Cascades via Stampede Pass. The area east of Auburn experiences some of the highest ozone levels in western Washington, but these levels are below the NAAQS. The ozone monitoring site near Enumclaw has shown exceedances of the 8-hour ozone standard during the past 3 years (Washington State Department of Ecology 2015b).

Air quality from Stampede Pass through Yakima and back to Pasco is generally good but in the Yakima region recent monitoring data in the area has shown higher than usual levels of PM2.5 that contains nitrate. In Yakima, much of the PM2.5 comes from wood burning, with the highest levels occurring during the wintertime as a result of increased wood burning along with stagnant air conditions (Washington State Department of Ecology 2015b); nitrate accounts for up to one-quarter of the wintertime PM2.5 in the Yakima area. High levels of daily PM2.5 are found in Ellensburg for 2 to 3 weeks each year. Unloaded rail cars would then pass along the same route from Pasco back to Spokane with the same air quality as described above.

Vessel traffic would traverse along the Columbia River between the project area and the mouth of the Columbia River. Wahkiakum and Pacific Counties are designated as attainment areas for criteria air pollutants.

With respect to HAPs, the 2005 EPA National-Scale Air Toxics Assessment was adjusted by Ecology to estimate cancer risk (Washington State Department of Ecology 2011). Inhalation cancer risks were highest in the major population centers along the rail route (i.e., Vancouver and Spokane), with a cancer risk of up to 500 cancers per million. For the smaller communities (i.e., Kelso-Longview, Spokane, Yakima, and Pasco), cancer risks were up to 300 cancers per million, although locations along the rail line have cancer risks of less than 75 cancers per million.[9]

[9] EPA released the results from the 2011 National-Scale Air Toxics Assessment in December 2015. The 2011 Ecology study uses the 2005 National-Scale Air Toxics Assessment.

Chapter 3
Impacts

This chapter describes the impacts on air quality that would result from construction and operation of the Proposed Action or the ongoing activities of the No-Action Alternative.

3.1 Proposed Action

Potential impacts on air quality from the construction and operation of the Proposed Action are described below.

3.1.1 Construction

The construction material delivery scenario with the highest emissions would be the barge scenario, which would deliver construction materials via barge and truck. Haul truck emissions are included for the truck trips needed to make deliveries of construction material from the barge dock to the project area.

Table 4 illustrates the maximum daily construction emission estimates. The maximum daily construction emissions occur early in the construction schedule with earthwork activity and with the delivery of construction of materials via barge and truck (Table 4). Maximum annual construction emission estimates for the peak construction year are shown in Table 5. The estimated emissions shown in Tables 4 and 5 assume the implementation of best management practices, including reduced idling measures, dust control measures to minimize soil disturbance, and the application of water along access roads to minimize track-out of soil.

The maximum annual construction-related emissions would be below the prevention of significance deterioration thresholds[10] established by EPA, as shown in Table 4. This means that although emissions of criteria air pollutants would occur during construction, they would not be expected to cause a substantial change in air quality or adversely affect sensitive receptors[11] near the project area.[12]

[10] The prevention of significance deterioration thresholds are the lowest thresholds that would define the emissions as less than a major modification to a major stationary source. This applies to areas in attainment with NAAQS.

[11] Sensitive air quality receptors are a facility or land use that houses or attracts members of a population who are particularly sensitive to the effects of air pollutants, such as children, the elderly, and people with illnesses. Examples of sensitive receptors include schools, hospitals, day care centers, convalescent facilities, senior centers, and parks or recreational facilities.

[12] While the study area is not a major stationary source subject to federal prevention of significant deterioration rules (40 CFR 52.21), the emission threshold levels were used to provide a threshold against which to evaluate potential impact from construction.

Table 4. Maximum Annual Estimated Construction Emissions

Source	Construction Emissions (tpy)								
	NO_x	CO	VOCs	SO_2	TSP	PM10	PM2.5	HAPs	DPM
Combustion Sources									
Equipment (in project area)	24.60	9.04	2.23	0.95	2.34	1.93	1.93	0.05	2.34
Haul Trucks (in project area)	4.06	0.88	0.18	0.01	0.23	0.19	0.13	0.004	0.23
Haul Trucks (in study area)[a]	9.37	2.04	0.41	0.03	0.54	0.44	0.31	0.010	0.54
Barges[b]	59.0	15.68	1.51	0.028	1.29	1.06	1.06	0.03	1.29
Passenger Commute Vehicles/Crossing-Delay (in study area)[a]	0.05	7.5	0.13	0.010	0.22	0.22	0.04	0.001	<0.001
Total Combustion Sources (project area)	**28.66**	**9.92**	**2.41**	**0.96**	**2.57**	**2.12**	**2.06**	**0.05**	**2.57**
Total Combustion Sources (all study area)[c]	**38.1**	**19.5**	**2.95**	**1.0**	**3.3**	**2.8**	**2.4**	**0.07**	**3.1**
Fugitive Sources									
Controlled Fugitive Earthwork (in project area)	-	-	-	-	12.00	5.87	1.22	-	-
Total Fugitive Sources	**-**	**-**	**-**	**-**	**12.00**	**5.87**	**1.22**	**-**	**-**
Total									
On-site construction emissions sources (in project area)	**28.7**	**9.9**	**2.41**	**0.96**	**14.6**	**7.99**	**3.28**	**0.05**	**2.6**
All construction emissions sources[c]	**38.1**	**19.5**	**2.95**	**1.0**	**15.3**	**8.7**	**3.6**	**0.07**	**3.1**
PSD significance thresholds (40 CFR 52.21)	**40**	**100**	**40**	**40**	**—**	**15**	**10**	**—**	**—**

Source: Combustion and fugitive emissions sources were obtained from various references, as described above under Section 2.1.2.1, *Construction Impact Analysis Approach*.

Notes:

[a] Not in the project area but within Cowlitz County.

[b] Not in study area. Based on barge maneuvering time for docking of 0.5 hour in and 0.5 hour out; does not include transit on the Columbia River.

[c] Rounded. Does not include barge emissions, but does include haul truck emissions to the project area.

"-" = not applicable

tpy = tons per year; NO_x = nitrogen oxide; CO = carbon monoxide; VOCs = volatile organic compounds; SO_2 = sulfur dioxide; TSP = total suspended particles; PM10 = particulate matter less than or equal to 10 micrometers in diameter; PM2.5 = particulate matter less than or equal to 2.5 micrometers in diameter; HAPs = hazardous air pollutants; DPM = diesel particulate matter; PSD = prevention of significance deterioration; CFR = Code of Federal Regulations

Table 5. Maximum Daily Estimated Construction Emissions

Source	Construction Emissions (lb/day)								
	NO_x	CO	VOCs	SO_2	TSP	PM10	PM2.5	HAPs	DPM
Combustion Sources									
Equipment (in project area)	229.6	82.89	20.4	8.67	21.49	17.66	17.66	0.42	21.5
Haul Trucks (in project area)	54.7	14.4	3.1	0.2	6.1	5.0	2.6	0.1	6.12
Haul Trucks (in study area)[a]	110.48	24.0	4.81	0.33	6.34	5.21	3.66	0.12	6.34
Barges[b]	454.7	120.8	11.6	0.21	9.90	8.14	8.14	0.61	9.9
Passenger Commute and Crossing Delay (in study area)[a]	1.43	20.0	0.35	0.03	0.58	0.58	0.11	0.01	<0.001
Total Combustion Sources (in project area)	**284.3**	**97.29**	**23.5**	**8.87**	**27.59**	**22.66**	**20.26**	**0.52**	**27.62**
Total Combustion Sources (all study area)[c]	**396.2**	**141.29**	**28.7**	**9.23**	**34.5**	**28.5**	**24.0**	**0.65**	**34.0**
Fugitive Sources									
Controlled Fugitive Earthwork	-	-	-	-	66.7	32.6	6.80	-	-
Total Fugitive Sources	**-**	**-**	**-**	**-**	**66.7**	**32.6**	**6.80**	**-**	**-**
Total									
Onsite construction emissions sources (in project area)	**284.3**	**97.29**	**23.5**	**8.87**	**94.3**	**55.3**	**27.1**	**0.52**	**27.6**
All construction emissions sources[c]	**396.2**	**141.29**	**28.7**	**9.23**	**101.21**	**61.1**	**30.8**	**0.65**	**34.0**

Notes:

Source: Combustion and fugitive emissions sources were obtained from various references, as described above under Section 2.1.2.1, *Construction Impact Analysis Approach*.

[a] Not in the project area, but within Cowlitz County.

[b] Not in project area. Based on barge maneuvering time for docking of 0.5 hour in and 0.5 hour out; does not include transit on the Columbia River

[c] Rounded. Does not include barge emissions, but does include haul truck emissions to the project area.

"-" = not applicable

lb/day = pounds per day; NO_x = nitrogen oxide; CO = carbon monoxide; VOCs = volatile organic compounds; SO_2 = sulfur dioxide; TSP = total suspended particles; PM10 = particulate matter less than or equal to 10 micrometers in diameter; PM2.5 = particulate matter less than or equal to 2.5 micrometers in diameter; HAPs = hazardous air pollutants; DPM = diesel particulate matter

3.1.2 Operations

Sources of air pollution from the Proposed Action would include fugitive emissions from coal handling, coal storage piles, emergency equipment, employee commute vehicles, and mobile source emissions from maintenance and operation of the coal export terminal, as well as emissions from trains and vessels used in transport. As presented in Table 6, rail and vessel transport would be the largest sources of emissions. The Proposed Action would produce small quantities of air pollutants from maintenance, operations, and emergency equipment. The table also shows fugitive emissions related to coal transfer and storage.

Table 6. Full Operations Maximum Annual Average Emissions[a]

	Maximum Annual Average Emissions (tpy)								
Source	**NO_x**	**CO**	**VOCs**	**SO_2**	**TSP**	**PM10**	**PM2.5**	**HAPs**	**DPM**
Fugitive Sources									
Coal Transfer (except piles):									
Material Handling	-	-	-	-	5.25	1.84	0.28	-	-
Coal Piles:									
Wind Erosion	-	-	-	-	3.05	2.59	0.40	-	-
Material Handling	-	-	-	-	2.62	0.92	0.14	-	-
Mobile Sources									
Maintenance/Operations/ Emergency Equipment:									
Combustion	4.36	1.45	0.37	0.20	0.38	0.31	0.31	0.01	0.38
Employee Commute\Crossing Delay	0.13	2.05	0.04	0.003	0.08	0.08	0.02	0.01	<0.01
Locomotive:									
Combustion (study area)[b]	23.3	10.18	0.80	0.036	0.60	0.50	0.48	0.11	0.60
Fugitive Dust (study area)[b]	-	-	-	-	1.03	0.88	0.13	-	-
Combustion (project area)	14.0	5.04	0.56	0.02	0.36	0.30	0.29	0.05	0.27
Fugitive Dust (project area)	-	-	-	-	3.68	3.13	0.48	-	-
Vessels:									
Combustion (study area)[b]	24.8	37.9	14.1	3.04	2.17	1.78	1.64	0.03	0.00
Combustion (project area)	23.3	65.9	15.3	4.52	1.27	1.05	1.02	0.08	0.56
Total: All Mobile Sources, Project Area and Study Area	89.89	122.5	31.17	7.82	9.57	8.03	4.37	0.29	1.82
Total – Project Area Sources	37.30	70.94	15.86	4.54	5.31	4.48	1.79	0.13	0.83
Fugitive Dust Only (project area)	-	-	-	-	15.63	9.36	1.43	-	-
Mobile Combustion Sources (project area)	41.66	72.4	16.23	4.74	5.69	4.79	2.10	0.14	1.21

Notes:
Source: Combustion and fugitive emissions sources were obtained from various references, as described in Section 2.1.2.2, *Operations Impact Analysis Approach*.
[a] Full operations = Maximum production (44 million metric tons per year).
[b] Study Area = Not included in the project area.

"-" = Not applicable.
tpy = tons per year; NO_x = nitrogen oxide; CO = carbon monoxide; VOCs = volatile organic compounds; SO_2 = sulfur dioxide; TSP = total suspended particles; PM10 = particulate matter less than or equal to 10 micrometers in diameter; PM2.5 = particulate matter less than or equal to 2.5 micrometers in diameter; HAPs = hazardous air pollutants; DPM = diesel particulate matter

3.1.2.1 Air Quality Impact Assessment

A modeling analysis was performed with the AERMOD dispersion model. The results from the modeling are compared with the NAAQS.

Two sets of emissions were developed. The first set was used to model the long-term (annual average concentrations), reflecting emissions over an entire year with train and vessel arrivals spread over the year to simulate the average activity at the terminal. The second set of emissions was used to determine the short-term (24-hour or less concentrations), reflecting peak emissions that could occur during the course of an hour. Peak activity included a coal train unloading at the terminal, a vessel loading with coal, and a second vessel docking at the terminal.

To assess impacts associated with the Proposed Action, the AERMOD model was used to predict the increase in criteria pollutant concentrations. The maximum modeled incremental increases for each pollutant and averaging time were added to applicable background concentrations. With the exception of PM2.5, the background concentrations were obtained from NW AIRQUEST, Washington State University, for 2009 through 2011.[13] These consortium values are typically recommended for use as background concentration by Ecology in air quality analyses when no representative monitoring data is available. The resulting total pollutant concentrations (background plus modeled concentration) were then compared with the appropriate NAAQS.

As described in Section 2.2, *Existing Conditions*, there is a monitoring program for PM2.5 in the Longview-Kelso area and the resulting data were used to estimate the background concentration for PM2.5. The method for comparing modeled impacts with added background concentrations to each NAAQS is dependent on the form of the standard, and thus varies by pollutant and averaging time. The differences are footnoted in the comparison tables (Tables 7, 8, and 9). For example, the 1-hour NO_2 NAAQS is based on the 98^{th} percentile of 1-hour daily maximum concentration (8th highest 1-hour daily maximum for a full year of hourly values) across the 3 meteorological modeling years (2009 through 2011) plus the background concentration.

Table 7 summarizes the maximum predicted criteria pollutant concentrations due to maintenance and operations of the terminal only. This includes the material handling and moving of the coal and coal piles as well as exhaust emissions from mobile source equipment (e.g., loader and employee vehicles). In no case are the terminal-only estimated emissions in combination with the background concentrations anticipated to cause a violation of any NAAQS. The highest increase in concentration due to export terminal-only operation is the 24-hour PM10 impact, which would increase 88 $\mu g/m^3$, or about 59% of the PM10 NAAQS. The next highest increase in concentration due to export terminal-only operation is the 24-hour PM2.5 impact, which would increase 11.2 $\mu g/m^3$, or about 32% of the PM-2.5 NAAQS. Similarly, the 1-hour NO_2 impact would increase 18.8 $\mu g/m^3$, or about 10% of the NO_2 NAAQS. All other pollutants would increase less than 2% of the relevant NAAQS.

[13] The consortium developed background design value estimates for 2009 through 2011, based on model-monitor interpolated products that provide realistic background design value estimates where nearby ambient monitoring data are unavailable. The work is sponsored by EPA Regiol 10, Ecology, and others. More information about the NW AIRQUEST tool can be found at http://www.lar.wsu.edu/nw-airquest/lookup.html.

Table 7. AERMOD Modeling Results (Terminal Sources: Maintenance and Operations Equipment)[a]

Pollutant	Averaging Period	Modeled Impact (µg/m^3)	Background[b,c] (µg/m^3)	Total Predicted Concentration (µg/m^3)	NAAQS (µg/m^3)
CO	1 hour[d]	12.8	827	840	40,000
	8 hour[d]	5	600	605	10,000
NO_2	1 hour[e,f]	18.8	56.6	75.4	188
	Annual[f,g]	0.4	5.3	5.7	100
PM10	24 hour[h]	88	23	111	150
PM2.5	24 hour[i]	11.2	19.3	30.5	35
	Annual[j]	0.23	6.2	6.44	12
SO_2	1 hour[k]	1.2	14.7	15.9	196
	3 hour[l]	0.75	11.5	12.3	1,300

Notes:

[a] Coal export terminal operation sources include coal storage piles; rotary rail unloaders; mobile operation, maintenance, and emergency equipment; and employee vehicles.

[b] Background design value estimates for 2009 through 2011, based on model-monitor interpolated products (except PM2.5) sponsored by EPA Regionl 10, Ecology, and others. From NW AIRQUEST tool Washington State University (http://www.lar.wsu.edu/nw-airquest/lookup.html.)

[c] PM2.5 background based on Ecology's Kelso Monitor (2013 through 2016). The reported 24-hour value is the maximum of the 3-year average of the yearly 98th percentile of the daily concentration.

[d] Modeled impact is the highest 2nd high for each calendar year over the 3 modeled years..

[e] The NO_2 1-hour modeled impact is the 3-year average of the 98th percentile of 1-hour daily maximum concentrations.

[f] Modeled NO_2 impacts applied the Tier III Ozone Limiting Method (OLM), using an ozone background of 42 ppb, as per the NW AIRQUEST tool. For additional information regarding the modeling methodology, see Section 2.1.2.2, *Operations Impact Analysis Approach*.

[g] The NO_2 annual modeled impact is the maximum annual mean over the 3 modeled years.

[h] The PM10 24-hour modeled impact is the 2[nd] highest concentration over a 3-year period this is more conservative than the NAAQS compliance methodology of the 3-year average of the highest 2nd high concentration for each year.

[i] The PM2.5 24-hour modeled impact is the 3-year average of the 98th percentile of 1-hour daily maximum concentrations.

[j] The PM2.5 annual modeled impact is the 3-year average of the annual mean.

[k] The SO_2 1-hour modeled impact is the 3-year average of the 99th percentile of the 1-hour daily maximum concentrations.

[l] The SO_2 3-hour modeled impact is not to be exceeded more than once per year.

µg/m^3 = micrograms per cubic meter; NAAQS = National Ambient Air Quality Standards; CO = carbon monoxide; NO_2 = nitrogen dioxide; PM10 = particulate matter less than or equal to 10 micrometers in diameter; PM2.5 = particulate matter less than or equal to 2.5 micrometers in diameter; SO_2 = sulfur dioxide

Table 8 shows the modeling results for on-site sources (terminal emissions sources, plus cargo vessel and train operations while on-site). Estimated emissions from all project area operations, in combination with the background concentrations, would not exceed any NAAQS.

The highest increase in emissions due to export terminal operation plus cargo vessel and train operations is the 24-hour PM10 impact, which would increase 92.6 µg/m^3, or about 62% of the PM10 NAAQS. The largest source of this increase is form the fugitive emissions from the coal piles, followed closely by material handling of the coal and, to a lesser extent, the unloading of the coal train. The next highest increase is the 1-hour NO_2 impact, which would increase 94.3 µg/m^3, or about 50% of the NO_2 NAAQS. This increase is almost exclusively due to the line-haul locomotive emissions but the switch locomotive engine also contributes. Similarly, the 24-hour PM2.5 impact would increase 11.9 μg/m³, or about 34% of the PM2.5 NAAQS. All other pollutants would increase less than or equal to a 15% of the relevant NAAQS.

Table 8. AERMOD Modeling Results (Project Area Sources)[a]

Pollutant	Averaging Period	Modeled Impact (μg/m³)	Background[b,c] (μg/m³)	Total Predicted Concentration (μg/m³)	NAAQS (μg/m³)
CO	1 hour[d]	223	827	1,050	40,000
	8 hour[d]	51	600	651	10,000
NO_2	1 hour[d,e]	94.3	56.6	151	188
	Annual[f,g]	13.7	5.3	19	100
PM10	24 hour[h]	92.6	23	116	150
PM2.5	24 hour[i]	11.9	19.3	31.2	35
	Annual[j]	0.81	6.2	7.0	12
SO_2	1 hour[k]	10.6	14.7	25.3	196
	3 hour[l]	10.2	11.5	21.7	1,300

Notes:

a On-site sources include emissions from handling coal, coal storage piles, and mobile source exhaust emissions from the operation and maintenance of the facility.

b Background design value estimates for 2009 through 2011, based on model-monitor interpolated products (except PM2.5) sponsored by EPA Region 10, Ecology, and others. From NW AIRQUEST tool Washington State University (http://www.lar.wsu.edu/nw-airquest/lookup.html.)

c PM2.5 background based on Ecology's Kelso Monitor (2013 through 2016). The reported 24-hour value is the maximum of the 3-year average of the yearly 98th percentile of the daily concentration.

d Modeled impact is the highest 2nd high for each calendar year over the 3 modeled years.

e The NO_2 1-hour modeled impact is the 3-year average of the 98th percentile of 1-hour daily maximum concentrations.

f Modeled NO_2 impacts applied the Tier III Ozone Limiting Method (OLM), using an ozone background of 42 ppb, as per the NW-AIRQUEST tool. For additional information regarding the modeling methodology, see Section 2.1.2.2, *Operations Impact Analysis Approach*.

g The NO_2 annual modeled impact is the maximum annual mean over the 3 modeled years.

h The PM10 24-hour modeled impact is the 2nd highest concentration over a 3-year period this is more conservative than the NAAQS compliance methodology of the 3-year average of the highest 2nd high concentration for each year.

i The PM2.5 24-hour modeled impact is the 3-year average of the 98th percentile of 1-hour daily maximum concentrations.

j The PM2.5 annual modeled impact is the 3-year average of the annual mean.

k The SO_2 1-hour modeled impact is the 3-year average of the 99th percentile of the 1-hour daily maximum concentrations.

l The SO_2 3-hour modeled impact is not to be exceeded more than once per year.

μg/m³ = micrograms per cubic meter; NAAQS = National Ambient Air Quality Standards; CO = carbon monoxide; NO_2 = nitrogen dioxide; PM10 = particulate matter less than or equal to 10 micrometers in diameter; PM2.5 = particulate matter less or equal to than 2.5 micrometers in diameter; SO_2 = sulfur dioxide

Table 9 shows the modeling results for all project area sources and study area sources (vessels arriving and departing from the terminal, assist tugs, trains arriving and departing from the terminal to approximately 5 miles out, and vehicle delay at at-grade crossings in the study area). These results are similar to the on-site sources. The highest increase in emissions due to export terminal operation plus cargo vessel and train operations is the 24-hour PM10 impact, which would increase 92.6 μg/m³, or about 62% of the PM10 NAAQS. The largest source of this increase is from the fugitive emissions from the coal piles, followed closely by material handling of the coal and, to a lesser extent, the unloading of the coal train. The next highest increase is the 1-hour NO_2 impact, which would increase 94.3 μg/m³, or about 50% of the NO_2 NAAQS. This increase is almost exclusively due to the line-haul locomotive emissions but the switch locomotive engine also contributes. The 24-hour PM2.5 impact would increase 11.9 μg/m³, or about 34% of the PM2.5 NAAQS. All other pollutants would increase no more than15% of the relevant NAAQS.

Table 9. AERMOD Modeling Results (Project Area and Study Area Sources)

Pollutant	Averaging Period	Modeled Impact (μg/m³)	Background[a,b] (μg/m³)	Total Predicted Concentration (μg/m³)	NAAQS (μg/m³)
CO	1 hour[c]	377	827	1,204	40,000
	8 hour[c]	99	600	699	10,000
NO_2	1 hour[c,d]	94.3	56.6	151	188
	Annual[e,f]	13.7	5.3	19.0	100
PM10	24 hour[g]	93.6	23	117	150
PM2.5	24 hour[h]	12.5	19.3	31.8	35
	Annual[i]	0.83	6.2	7.0	12
SO_2	1 hour[j]	10.6	14.7	25.3	196
	3 hour[k]	10.2	11.5	21.7	1,300

Notes:

[a] Background design value estimates for 2009 through 2011, based on model-monitor interpolated products (except PM2.5) sponsored by EPA Region 10, Ecology, and others. Source: NW AIRQUEST tool Washington State University (http://www.lar.wsu.edu/nw-airquest/lookup.html.)

[b] PM2.5 background based on Ecology's Kelso Monitor (2013 through 2016). The reported 24-hour value is the maximum of the 3-year average of the yearly 98th percentile of the daily concentration.

[c] Modeled impact is the highest 2nd high for each calendar year over the 3 modeled years.

[d] The NO_2 1-hour modeled impact is the 3-year average of the 98th percentile of 1-hour daily maximum concentrations.

[e] Modeled NO2 impacts applied the Tier III Ozone Limiting Method (OLM), using an ozone background of 42 ppb, as per the NW-AIRQUEST tool. For additional information regarding the modeling methodology, see Section 2.1.2.2, *Operations Impact Analysis Approach*.

[f] The NO_2 annual modeled impact is the maximum annual mean over the 3 modeled years.

[g] The PM10 24-hour modeled impact is the 2nd highest concentration over a 3-year period this is more conservative than the NAAQS compliance methodology of the 3-year average of the highest 2nd high concentration for each year.

[h] The PM2.5 24-hour modeled impact is the 3-year average of the 98th percentile of 1-hour daily maximum concentrations.

[i] The PM2.5 annual modeled impact is the 3-year average of the annual mean.

[k] The SO_2 1-hour modeled impact is the 3-year average of the 99th percentile of the 1-hour daily maximum concentrations.

[l] The SO_2 3-hour modeled impact is not to be exceeded more than once per year.

μg/m³ = micrograms per cubic meter; NAAQS = National Ambient Air Quality Standards; CO = carbon monoxide; NO_2 = nitrogen dioxide; PM10 = particulate matter less than or equal to 10 micrometers in diameter; PM2.5 = particulate matter less than or equal to 2.5 micrometers in diameter; SO_2 = sulfur dioxide

3.1.2.2 Health Risk Impact Assessment

An inhalation-only health risk assessment was performed with the AERMOD dispersion model to assess increased cancer risk associated with increased DPM emissions related to the Proposed Action. Increased DPM exposure related to operations would be primarily from Proposed Action-related train locomotive diesel emissions. The risk assessment only considers the cancer risk by the inhalation pathway because the risk contributions by other pathways of exposure are difficult to quantify and are known to be negligible relative to the inhalation pathway.

The assessment looked at two scenarios.

- **Fixed emissions scenario.** Assumes DPM emissions in 2028 when the coal export terminal reaches maximum capacity.
- **Average lifetime emissions scenario.** Averages DPM emissions starting in 2018, reaching full capacity in 2028, and continuing at full capacity to reflect the cleaner Tier 4 locomotive engines gradually entering the fleet each year as older locomotives are retired.

A risk level of 1 cancer per million implies a likelihood that one person, out of 1 million people exposed to the same concentration of the same pollutant, would contract cancer if exposed continuously (24 hours per day/7 days per week) to that specific concentration over 70 years (an assumed lifetime)[14] per EPA (2015) guidance. This cancer risk would be in addition to any existing risk.

The cancer risk analysis follows standard approaches including use of the conservative assumption of continuous lifetime exposure. This overstates cancer risk even for residential uses where people typically spend more time, because individuals are mobile, spending time in locations other than their residence on an average day, and even changing residences over a lifetime. Cancer risk is further overstated for land uses where people spend less time, such as commercial and industrial locations.

To provide context for the increased cancer risk related to DPM, results can be compared with the countywide baseline of 300 cancers per million, developed for purposes of the analysis, as described in Section 2.1.2, *Impact Analysis Approach*. For example, an increased risk of 10 cancers per million would represent an approximately 3% increase over existing levels. Similarly, an increased risk of 30 cancers per million would represent an approximately 10% increase over existing levels.

Fixed Emissions Scenario (2028)

This section presents cancer risk based on the fixed emissions scenario. Figure 4 depicts increased inhalation cancer risk related to DPM emissions from coal export terminal sources (i.e., diesel-powered operation, maintenance, and emergency equipment). The contour for increased risk of 1 cancer per million extends across the width of the Columbia River and approximately 4 miles west of the project area and approximately 2.5 miles east of the project area. The 10 cancers per million risk contour is not shown on the figure, because no locations would experience increased risk levels at or above 10 cancers per million.

Figure 5 depicts increased inhalation cancer risk related to DPM emissions from all operation sources (i.e., terminal, rail, and vessel) in the project area. The contour for increased risk of 10 cancer per million extends across the Columbia River, approximately 1.3 mile southwest of the project area and approximately 0.1 mile northeast of the project area, and crosses Industrial Way near the northwest boundary of the project area. Portions of residential areas are within this contour.

[14] Consistent with EPA (2016) assumption for purposes of NATA risk characterization.

Figure 4. Increased Diesel Particulate Matter Cancer Risk from Coal Export Terminal Sources—Fixed Emissions Scenario

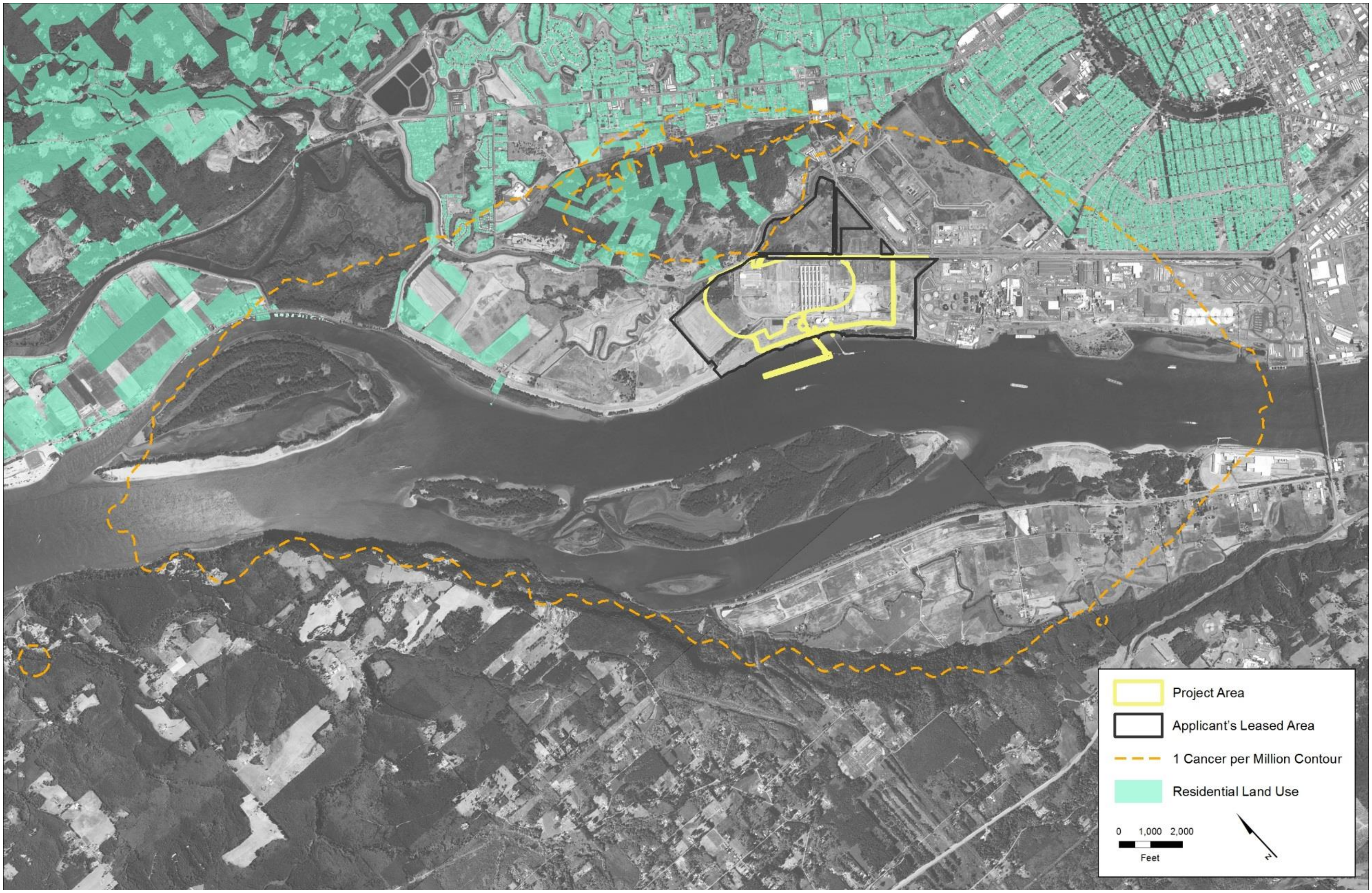


Figure 5. Increased Diesel Particulate Matter Cancer Risk from All Operations in the Project Area—Fixed Emissions Scenario

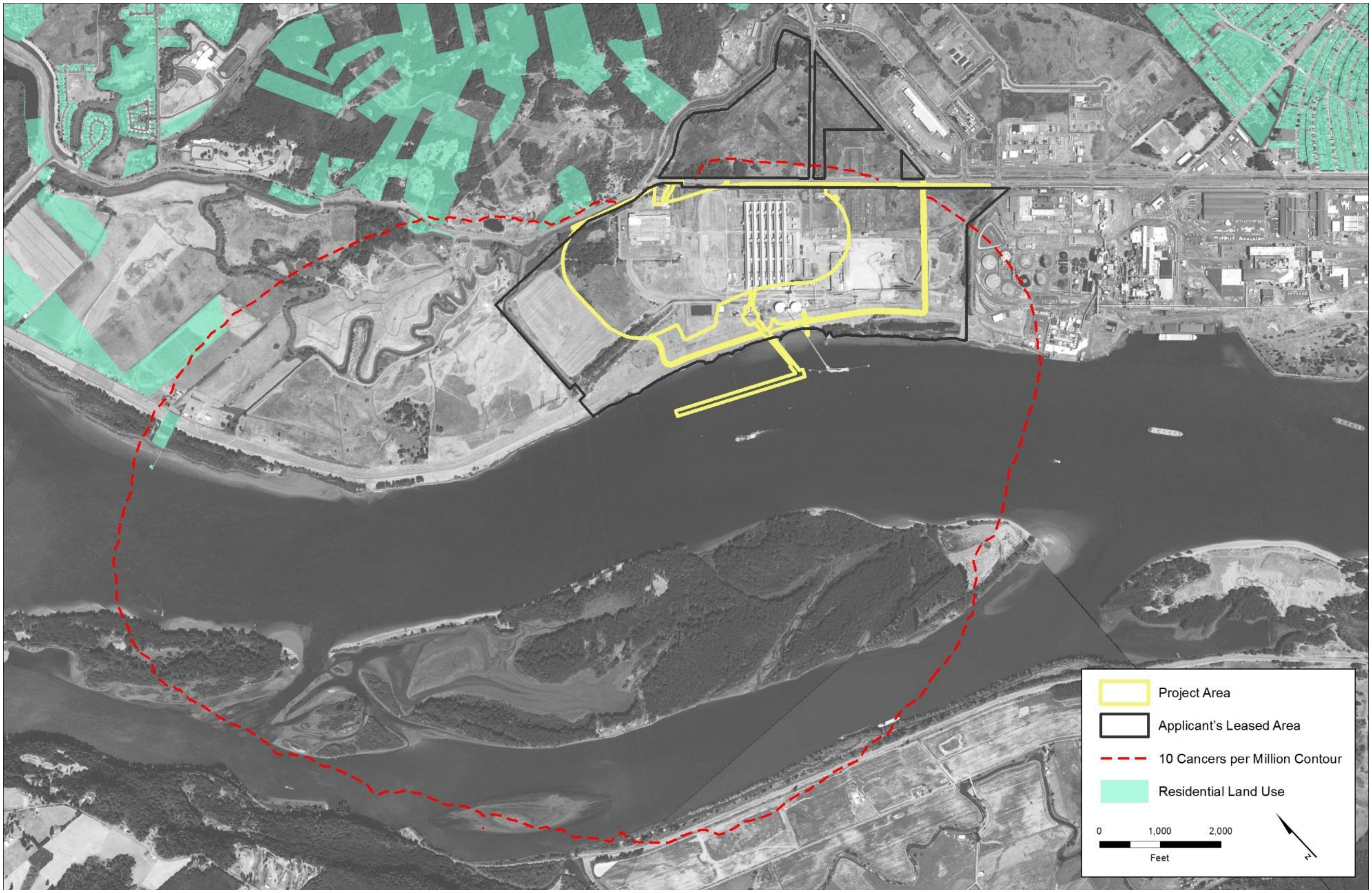


Figure 6 depicts increased inhalation cancer risk related to DPM emissions from all operation sources (terminal, rail, and vessel) in the Kelso-Longview area. The contour for increased risk of 10 cancers per million covers most of Longview south of Ocean Beach Highway as well as a portion of Kelso along the Interstate 5 corridor. The contour for increased risk of 30 cancers per million along the Reynolds Lead is approximately 3,000 feet across and extends into the Highland neighborhood. The highest increased risk level, 50 cancers per million, extends approximate 1,000 feet across along portions of the Reynolds Lead and borders the Highland neighborhood.

Figure 7 depicts increased inhalation cancer risk related to DPM emissions from all operations (terminal, rail, and vessel) in Cowlitz County. The contour for increased risk of 10 cancers per million along the BNSF main line is approximately 2 miles across throughout the county. The contour for increased risk of 30 cancers per million extends approximately 0.5 mile (or 0.25 mile on either side of the main line).

For further context, increased cancer risk related to emissions of DPM from rail locomotives can be compared to that of diesel trucks. For example, the increased risk of 30 cancers per million at 0.25 mile from the Reynolds Lead and BNSF Spur (a 7.1-mile segment of rail line) resulting from the locomotive emissions from 16 Proposed Action-related train trips per day would be equivalent to the increased risk resulting from the emissions from 1,100 diesel truck[15] trips per day along the same segment (i.e., 23 trucks per hour travelling in each direction).

Average Lifetime Emissions Scenario

This section presents cancer risk based on the average lifetime emissions scenario. Figure 8 depicts increased inhalation cancer risk related to DPM emissions from coal export terminal sources (i.e., diesel-powered operations, maintenance, and emergency equipment). The contour for increased risk of 1 cancer per million extends across the width of the Columbia River, approximately 4 miles west of the project area, and approximately 2.5 miles east of the project area. These results are essentially the same as depicted in Figure 4 for the fixed emission case, because changes in the emissions are estimated to be minimal for coal export terminal sources.

Figure 9 depicts increased inhalation cancer risk related to DPM emissions from all operation sources (i.e., terminal, rail, and vessel) in the project area. The contour for increased risk of 10 cancers per million extends across the Columbia River covering most of Lord Island, approximately 0.25 mile southeast of the project area, and crosses Industrial Way near the northwest boundary of the project area. A portion of one residential area is within this contour.

[15] Assumes current fleet heavy-duty trucks traveling at 55 miles per hour.

Figure 6. Increased Diesel Particulate Matter Cancer Risk from All Operation Sources in the Kelso-Longview Area—Fixed Emissions Scenario

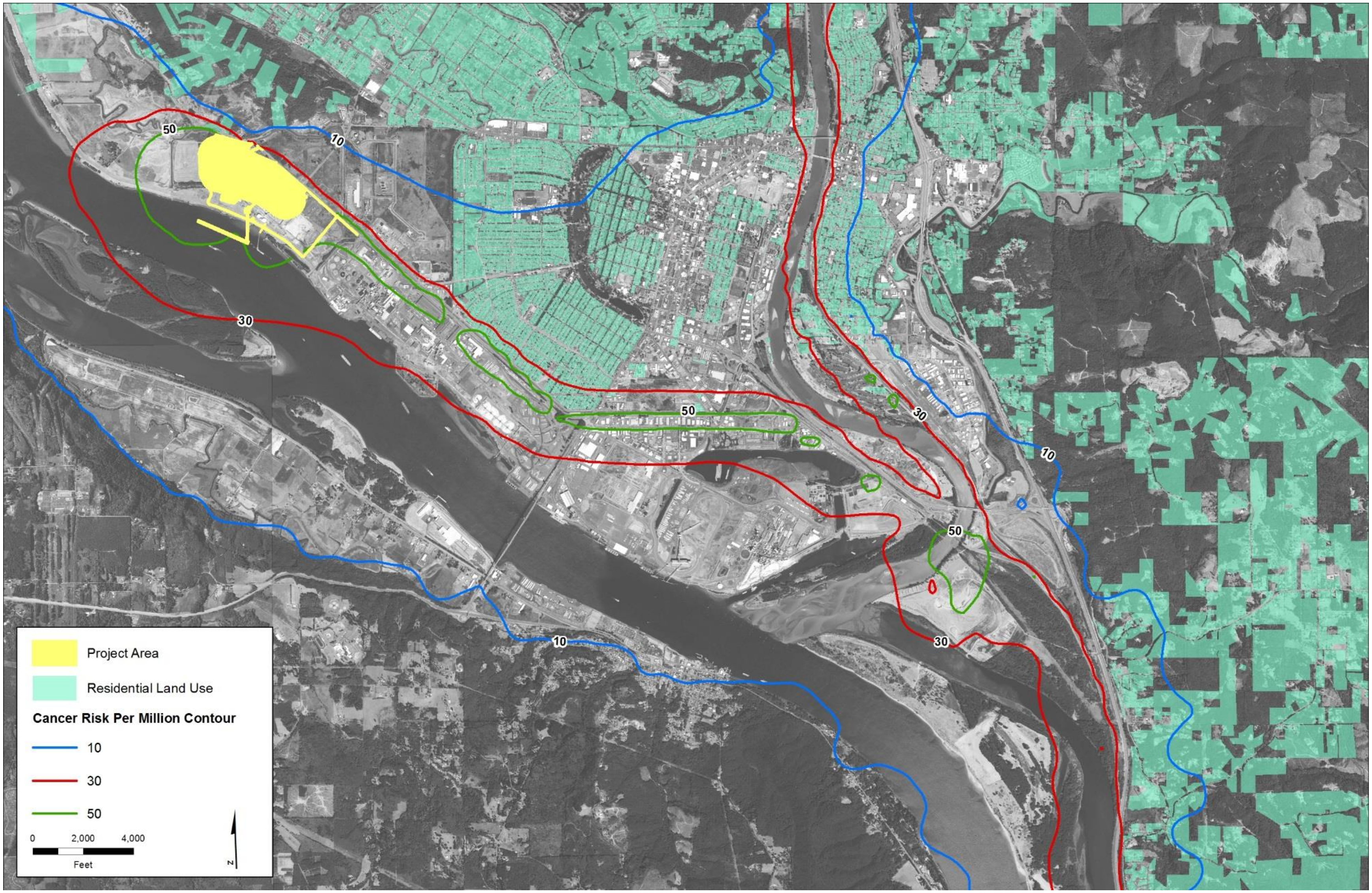


Figure 7. Increased Diesel Particulate Matter Cancer Risk from All Operation Sources in Cowlitz County—Fixed Emissions Scenario

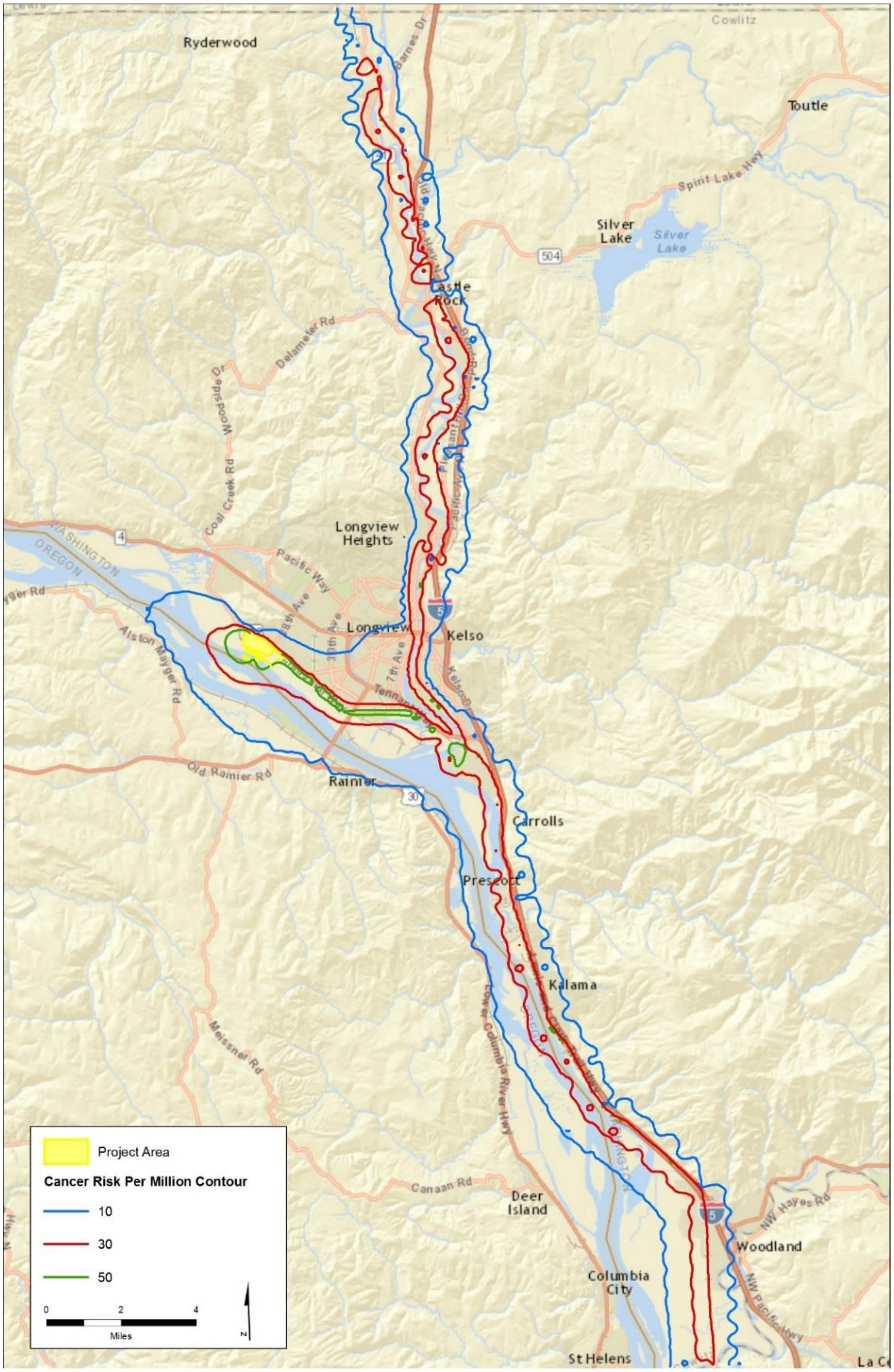


Figure 8. Increased Diesel Particulate Matter Cancer Risk from Coal Export Terminal Sources— Average Lifetime Emissions Scenario

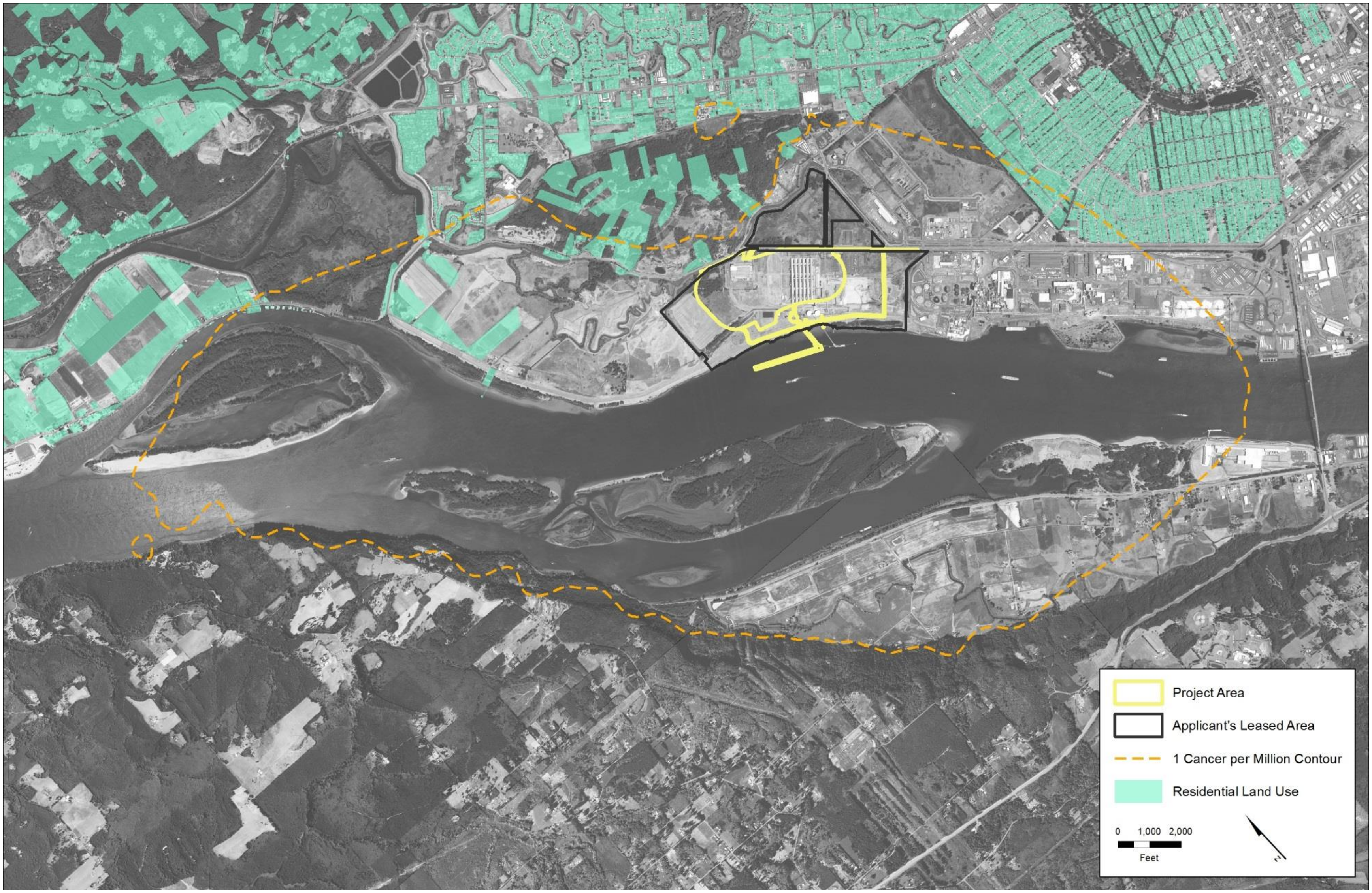


Figure 9. Increased Diesel Particulate Matter Cancer Risk from All Operation in the Project Area— Average Lifetime Emissions Scenario

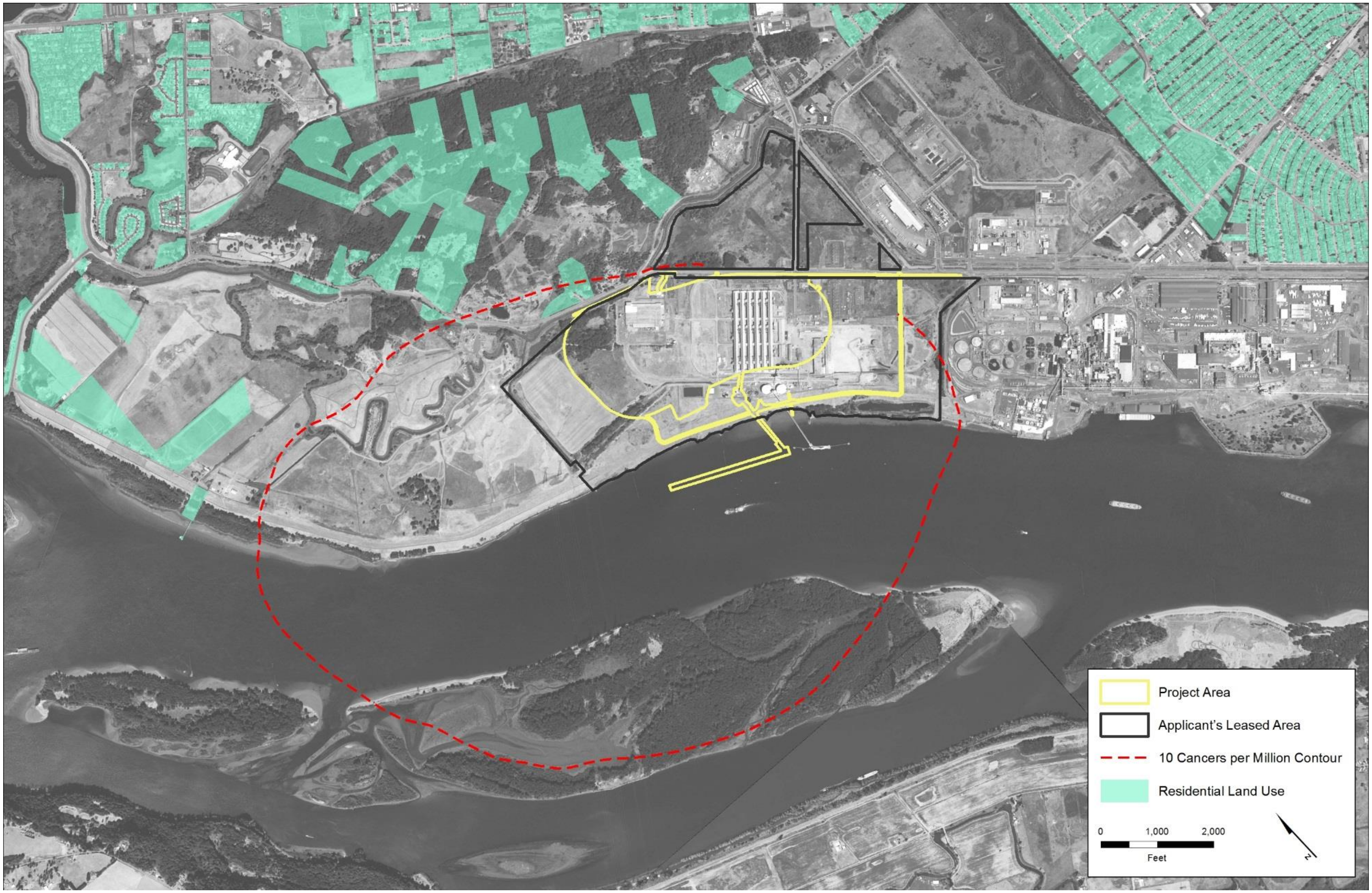


Figure 10 depicts increased inhalation cancer risk related to DPM emissions from all operation sources (i.e., terminal, rail, and vessel) in the Kelso-Longview area of Cowlitz County. The contour for increased risk of 10 cancers per million covers Longview south of Washington Way as well as a portion of Kelso along the Interstate 5 corridor. The contour for increased risk of 30 cancers per million along the Reynolds lead is approximately 2,000 feet across and extends up to approximately 600 feet into the Highland neighborhood. The highest increased risk level, 50 cancers per million, extends approximate 500 feet across along three small portions of the Reynolds Lead, approximately 1,200 feet across at the junction of the BNSF Spur and BNSF main line, and approximately 0.3 mile west and southwest of the project area boundary.

Figure 11 depicts increased inhalation cancer risk related to DPM emissions from all operation sources (i.e., terminal, rail, and vessel) in Cowlitz County. The contour for increased risk of 10 cancers per million along the BNSF mainline is approximately 1.5 miles across throughout Cowlitz County. The contour for increased risk of 30 cancers per million along the BNSF main line is up to approximately 0.4 mile wide (0.2 mile on either side of the main line).

For further context, increased cancer risk related to emissions of DPM from rail locomotives can be compared to that of diesel trucks. For example, the increased risk of 30 cancers per million at 1,000 feet from the Reynolds Lead and BNSF spur (a 7.1-mile segment of rail line) resulting from the locomotive emissions from 16 Proposed Action-related trains trips per day would be equivalent to the increased risk resulting from the emissions from 860 diesel truck[16] trips per day along the same segment (i.e., 18 trucks per hour travelling in each direction).

[16] Assumes current fleet heavy-duty trucks traveling at 55 miles per hour.

Figure 10. Increased Diesel Particulate Matter Cancer Risk from All Operation Sources in the Kelso-Longview Area— Average Lifetime Emissions Scenario

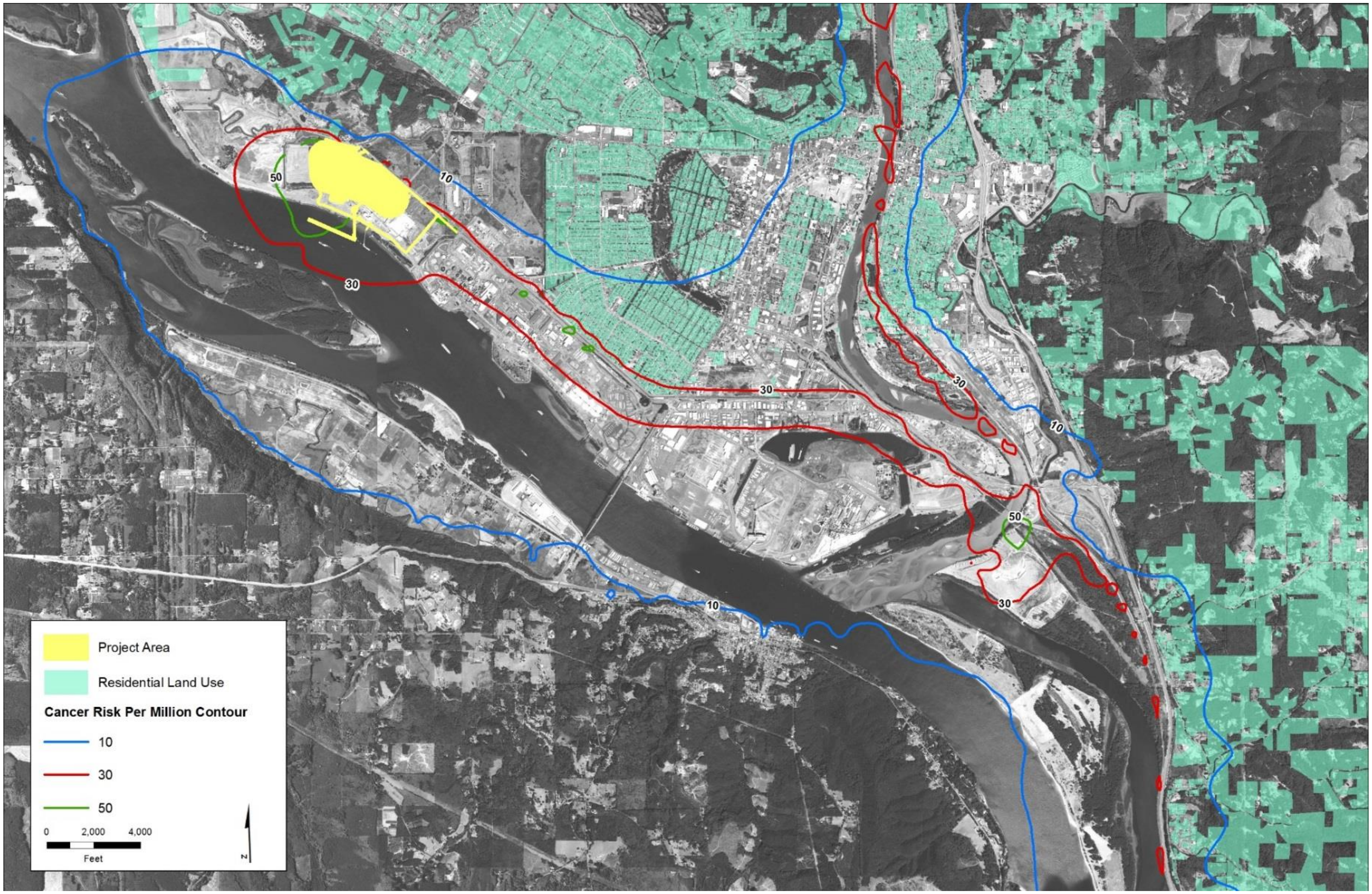
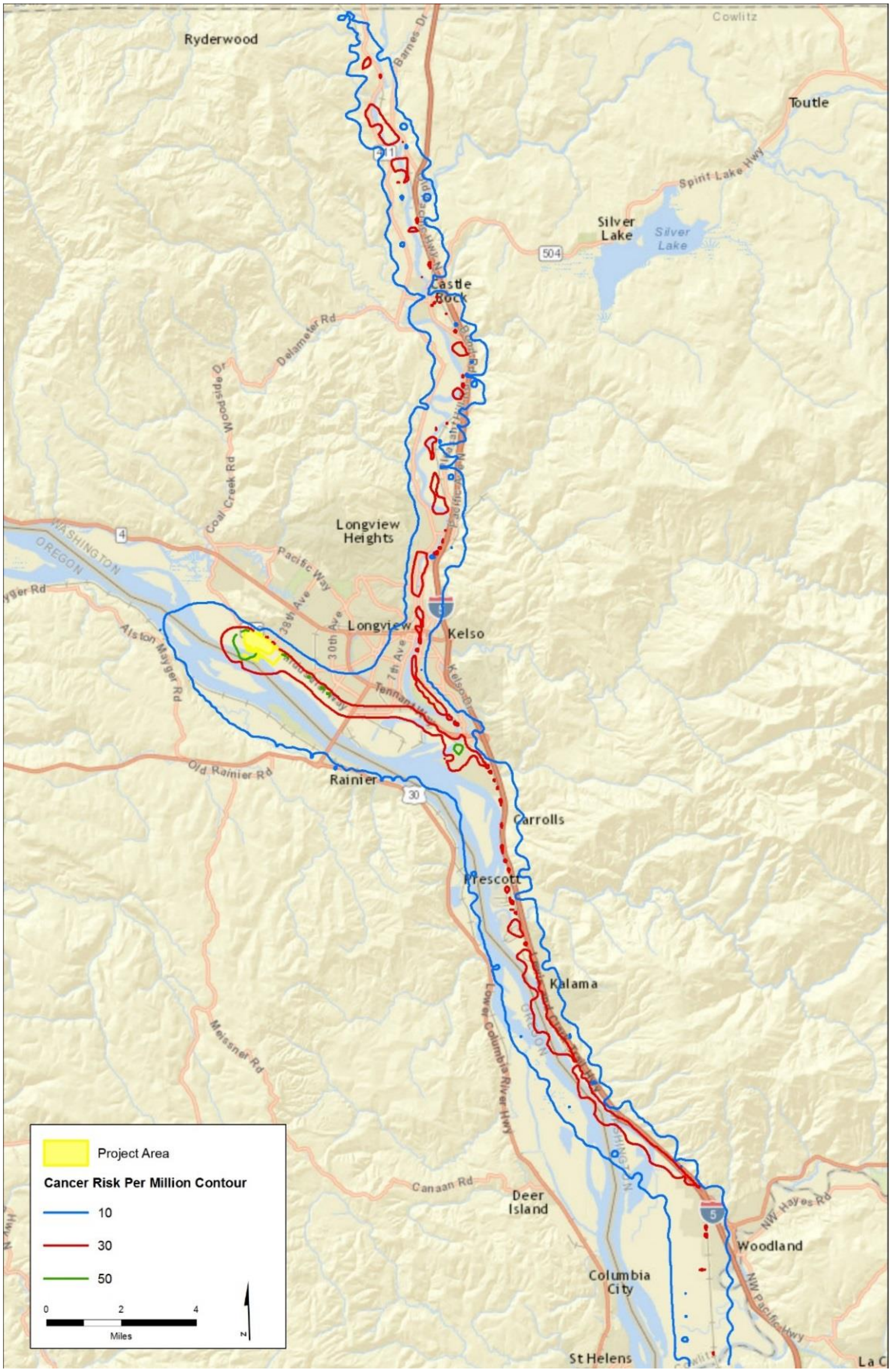


Figure 11. Increased Diesel Cancer Risk from All Operation Sources in Cowlitz County— Average Lifetime Emissions Scenario



3.1.2.3 Proposed Action and Cowlitz County Emissions Comparison

The pollutant emissions totals within Cowlitz County for the Proposed Action during maximum terminal throughput (Table 6) are shown in Table 10 with the 2011 Cowlitz County emissions inventory totals for locomotives and commercial marine vessels. Locomotive emissions would occur in the project area, on the Reynolds Lead and BNSF Spur, and on the BNSF main line in Cowlitz County. Vessel emissions would occur in the project area and on the Columbia River in Cowlitz County.

Table 10. Maximum Annual Emissions Estimates in Cowlitz County for Locomotive and Commercial Marine Vessels for the Proposed Action in Comparison with the 2011 Cowlitz County Emissions Inventory

	Maximum Annual Average Emissions (tpy)						
	NO_x	CO	VOCs	SO_2	PM10	PM2.5	DPM
Locomotive							
Proposed Action-related Emissions	51	20	1.9	0.07	3.7	1.5	1.15
Cowlitz County Emissions	789	137	43	6	23	23	23
Commercial Marine Vessels							
Proposed Action-related Emissions	48	104	29	7.6	2.8	2.7	0.6
2011 Cowlitz County Emissions	1,109	150	46	199	37	34	34

Notes:
Source: Washington State Department of Ecology 2014.
tpy = tons per year; NO_x = nitrogen oxide; CO = carbon monoxide; VOCs = volatile organic compounds; SO_2 = sulfur dioxide; PM10 = particulate matter less than or equal to 10 micrometers in diameter; PM2.5 = particulate matter less than or equal to 2.5 micrometers in diameter; DPM = diesel particulate matter

The largest locomotive emissions increase (as a percentage of existing rail emissions in Cowlitz County) for a single pollutant would be for PM10, which would increase by approximately 16%. The largest vessel emissions increase (as a percentage of existing commercial marine vessel emissions in Cowlitz County) for a single pollutant would be carbon monoxide and VOCs, which would increase approximately 69% and 63%, respectively. The increase in carbon monoxide emissions is primarily due to use of the auxiliary engines while vessels are docked. While this emission increase represents a substantial increase relative to the commercial marine vessel category, overall it represents a small increase (0.28% and 0.17%) in the total Cowlitz County carbon monoxide and VOC emissions. 0.17%) in the total Cowlitz County carbon monoxide and VOC emissions.

3.1.2.4 Proposed Action and Washington State Emissions Comparison

The pollutant emissions totals for the Proposed Action during maximum production throughout Cowlitz County combined with statewide emissions associated with the vessel and rail transport are shown in Table 11 in comparison with the 2011 Washington statewide emissions inventory totals for locomotives and commercial marine vessels. Locomotive emissions would occur along the rail routes described in Section 2.2.3, *Washington State Air Quality Conditions*.[17] Vessel emissions would

[17] For more information on the coal train routes, see the SEPA Rail Transportation Technical Report (ICF and Hellerworx 2017).

occur along the Columbia River between the project area and 3 nautical miles beyond the mouth of the Columbia River.

Table 11. Maximum Annual Emissions Estimates in Washington State for Locomotive and Commercial Marine Vessels for the Proposed Action in Comparison with the 2011 Statewide Emissions Inventory

	Maximum Annual Average Emissions (tpy)						
	NO_x	CO	VOCs	SO_2	PM10	PM2.5	DPM
Locomotive							
Proposed Action-related Emissions	2,261	984	78	3	51	47	58
2011 Statewide Emissions	15,026	2,536	810	95	430	428	428
Commercial Marine Vessels							
Proposed Action-related Emissions	161	276	93	21	11	10	10
2011 Statewide Emissions	20,486	2,521	782	11,529	1,213	1,021	1,021

Notes:
Source: Washington State Department of Ecology 2014.
tpy = tons per year; NO_x = nitrogen oxide; CO = carbon monoxide; VOCs = volatile organic compounds; SO_2 = sulfur dioxide; PM10 = particulate matter less than or equal to 10 micrometers in diameter; PM2.5 = particulate matter less than or equal to 2.5 micrometers in diameter; DPM = diesel particulate matter

The largest increase in locomotive emissions for any one pollutant would be carbon monoxide at 39%, followed by NO_x with a 15% increase. For commercial marine vessels, the relative increase is smaller with a maximum increase of 12% for VOCs and just under 11% for carbon monoxide.

3.2 No-Action Alternative

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

Expanded bulk terminal operations and maintenance would result in increased emissions of air pollutants. The Applicant has identified planned future rail and vessel operations for the No-Action Alternative. Emissions were estimated assuming that current and future operations would result in two daily trains arriving and departing the facility with an average rail car length of 30 cars carrying bulk product. Each train would be composed of two locomotives with an average of 26 vessels arriving and departing each year. In addition, truck haul emissions associated with the transport to the nearby Weyerhaeuser facility are included. The estimated emissions are shown in Table 12. The largest emissions for any single air pollutant would be NO_x at 4.4 tons per year. These emissions would be lower than emissions under the Proposed Action, which were shown not to cause a substantial change in air quality or adversely affect nearby population areas.

Table 12. Estimated No-Action Alternative Annual Average Emissions from Rail, Vessel and Haul Trucks

	Maximum Annual Average Emissions (tpy)								
Source	**NO_x**	**CO**	**VOCs**	**SO_2**	**TSP**	**PM10**	**PM2.5**	**HAPs**	**DPM**
Locomotive Combustion	3.1	1.4	0.11	0.01	0.08	0.07	0.06	0.01	0.06
Vessel Combustion	1.1	2.6	0.63	0.19	0.08	0.06	0.06	0.003	0.02
Haul Trucks	0.2	0.1	0.02	0.002	0.04	0.04	0.01	0.001	0.04
Total	**4.4**	**4.1**	**0.76**	**0.20**	**0.20**	**0.17**	**0.13**	**0.014**	**0.12**

Notes:
tpy = tons per year; NO_x = nitrogen oxide; CO = carbon monoxide; VOCs = volatile organic compounds; SO_2 = sulfur dioxide; PM10 = particulate matter less than or equal to 10 micrometers in diameter; PM2.5 = particulate matter less than or equal to 2.5 micrometers in diameter; TSP = total suspended particles; HAPs = hazardous air pollutants; DPM = diesel particulate matter

Chapter 4
Required Permits

The following permit would be required in relation to air quality for the Proposed Action.

- **Notice of Construction—Southwest Clean Air Agency.** Businesses and industries that cause, or have the potential to cause, air pollution are required to receive approval from the local air agency prior to beginning construction. These are requirements of Washington's Clean Air Act and apply statewide (Chapter 70.94 RCW). Businesses located in Cowlitz County are regulated by the SWCAA. SWCAA rules generally require an air permit for a stationary sources emitting more than 0.75 ton per year of PM10 or 0.5 ton per year of PM2.5[18]. It is anticipated that these levels would be exceeded and the Applicant would need to file a permit application and receive an approved Notice of Construction air permit prior to constructing, installing, establishing, or modifying any equipment or operations that may emit air pollution.

[18] Other criteria pollutants have higher emission threshold levels.

Chapter 5
References

5.1 Written References

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Appendix A
Air Quality Data

APPENDIX A1a
CONSTRUCTION EMISSIONS

SUMMARY

Source	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2e	CO2	CH4	N2O	DPM
	Construction Emissions (tpy) [Maximum per Year]												
COMBUSTION SOURCES													
Equipment (On-site)	24.6	9.04	2.23	0.95	2.34	1.93	1.93	4.55E-02	5,035	5,025.67	2.47E-01	1.22E-02	2.34
Haul Trucks (Off-site)[1]	9.37	2.04	0.41	0.03	0.54	0.44	0.31	0.010	3,161	3,159	5.91E-02	2.87E-03	0.54
Haul Trucks (On-site)[1]	4.06	0.88	0.18	0.01	0.23	0.19	0.13	0.004	1,369	1,368	2.56E-02	1.24E-03	0.23
Haul Trucks idle (On-site)[2]	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	0	0.00E+00	0.00E+00	0.00E+00
Passenger Commute Vehicles (off-site)	0.51	7.38	0.13	0.01	-	0.22	0.04	-	1485.28	1482.77	0.02	0.01	-
Crossing Delay (Off-Site)	0.0126	0.0798	0.0025	0.0001	-	0.0015	0.0006	0.0010	-	-	-	-	-
Barges (Off-site)	59.04	15.68	1.51E+00	2.77E-02	1.29E+00	1.06E+00	1.06E+00	7.90E-02	3,050	3,044	1.49E-01	7.38E-03	1.29
Trains:													
Combustion (Off-site)	18.48	8.06	0.64	2.85E-02	4.79E-01	3.94E-01	3.82E-01	8.57E-02	3,125	3,095	2.42E-01	7.88E-02	4.79E-01
Combustion (On-site)	0.71	3.11E-01	2.45E-02	1.10E-03	1.85E-02	1.52E-02	1.47E-02	3.31E-03	121	119	9.35E-03	3.04E-03	1.85E-02
Highest Combination for Transport (Trucks) - Combustion Only													
Total - Onsite only	28.6	9.9	2.41	0.97	2.58	2.12	2.06	4.99E-02	6,404	6,393	0.27	1.34E-02	2.58
Total - All Construction Sources in County	38.5	19.4	2.95	1.00	3.11	2.78	2.41	6.12E-02	11,051	11,035	0.35	2.34E-02	3.11
Total combustin													
FUGITIVE SOURCES													
Controlled Fugitive Earthwork	-	-	-	-	12.00	5.87	1.22	-	-	-	-	-	-
Total Fugitive Sources	-	-	-	-	12.00	5.87	1.22	-	-	-	-	-	-
Highest Combination for Transport (Trucks) - All Sources													
Total - Onsite only	28.6	9.9	2.41	0.97	14.58	7.99	3.28	4.99E-02	6,404	6,393	0.27	1.34E-02	2.58
Total - All Construction Sources in County	38.5	19.4	2.95	1.00	15.11	8.65	3.64	6.12E-02	11,051	11,035	0.35	2.34E-02	3.11
General Conformity *de minimis* levels for ozone mainte	100	100	100	100		100	100						

Note:
[1] For Haul truck TSP & HAPs, use same emission ratio as emission factor ratios for Large Diesel Engines (below): PM_{10} and $PM_{2.5}$ ratio to TSP; HAPs ratio to CO.
[2] See assumptions for surrogate idle/onsite in Tab A4 Material Transfer by Truck

INPUT DATA:

Major Construction Activities and Typical Equipment Fleets

Construction Equipment Type	Rail Infrastructure and Rotary Car Dump Station		Conveyors, Transfer Stations and Surge Bins		Shiploader, Dock, and Trestles	
	Max Qty. per Month	Duration (months)	Max Qty. per Month	Duration (months)	Max Qty. per Month	Duration (months)
Mobile Cranes (25-50t)[1]						
Mobile Cranes (50-150t)[1]						
Mobile Cranes (150-300t)[1]						
Water Trucks[2]	1	12	1	12	0	0
Dump Trucks	3	12	1	12	0	0
Dozers	1	5	0	0	0	0
Excavators[3]	1	9	2	12	1	3
Rollers	2	9	2	12	1	3
Graders	2	9	0	0	1	3
Compactors	2	9	2	12	1	3
Track Laying Machine	1	6	0	0	0	0
Drill Rigs	1	2	2	6	0	0
Impact Piling Rigs	2	6	2	6	2	6
Loaders[4]	1	12	1	12	1	9
River Barge	0	0	0	0	2	18
Generator	2	18	2	18	2	18
Air Compressor	2	18	2	18	2	18

Source: MBTL, *Noise Resource Report* , Appendix D-1 (URS, June 2014).
NOTES:
[1] Mobile cranes to be shared between the 3 areas. - removed here because not all material is onsite so crane work may not start the first year.
[2] Water truck to be shared between the 2 land areas.
[3] Excavators to be shared between the 3 areas.
[4] Loaders to be shared between the 3 areas.

Typical construction fleet may be modified with equivalent items as construction activities demand

Assume entire construction period for all 3 areas is: 18 months total
5 days/week

ONSITE EQUIPMENT (NON-BARGE) EMISSIONS

Note: using NONRoad T/Y as calculated which may assume 24/7, so conservative.

Equipment Type	Engine Size (hp)	Fuel	Maximum Units Onsite (per year)	EPA NONROAD SCC Number	EPA NONROAD model combustion emission factor (tons/yr per unit) THC-Exhaust	CO-Exhaust	NOx-Exhaust	CO2-Exhaust	SO2-Exhaust	PM-Exhaust
Crane, 50 ton	165	Diesel	0	2270002045	5.15E-02	1.65E-01	6.50E-01	120.43	2.38E-02	5.04E-02
Crane, 150 ton	280	Diesel	0	2270002045	7.69E-02	2.12E-01	9.99E-01	201.70	3.88E-02	6.33E-02
Crane, 300 ton	450	Diesel	0	2270002045	8.22E-02	3.69E-01	1.44E+00	215.37	4.28E-02	7.47E-02
Water Trucks	350	Diesel	1	2270002051	3.06E-02	9.01E-02	3.12E-01	108.922	1.86E-02	3.49E-02
Dump Trucks	350	Diesel	4	*See Notes*	*3.06E-02*	*9.01E-02*	*3.12E-01*	*108.922*	*1.86E-02*	*3.49E-02*
Dozers	185	Diesel	0.4	2270002069	1.66E-01	8.15E-01	1.96E+00	437.06	8.46E-02	2.35E-01
Excavators	230	Diesel	2	2270002036	3.15E-01	1.24E+00	3.65E+00	977.30	1.79E-01	3.62E-01
Rollers	350	Diesel	3.8	2270002015	4.20E-02	1.70E-01	5.19E-01	110.57	2.12E-02	4.42E-02
Graders	185	Diesel	1.8	2270002048	5.49E-02	2.71E-01	6.48E-01	146.26	2.83E-02	7.85E-02
Compactors	25	Diesel	3.8	2270002009	2.47E-04	1.15E-03	2.15E-03	0.26	5.65E-05	1.78E-04
Track Laying Machine	*See Notes*	Diesel	0.5	*See Notes*	*1.96E-01*	*9.29E-01*	*2.35E+00*	*459.49*	*9.05E-02*	*2.51E-01*
Drill Rigs	*NONROAD Default*	Diesel	1.2	2270002033	4.12E-02	1.48E-01	5.47E-01	62.90	1.27E-02	3.29E-02
Impact Piling Rigs	*NONROAD Default*	Diesel	3	2270002033	*4.12E-02*	*1.48E-01*	*5.47E-01*	*62.90*	*1.27E-02*	*3.29E-02*
Loaders	140	Diesel	1	2270002060	1.96E-01	9.29E-01	2.35E+00	459.49	9.05E-02	2.51E-01
Generator	30	Diesel	6	2270006005	1.10E-01	4.39E-01	1.00E+00	119.95	2.48E-02	8.80E-02
Air Compressor	25	Diesel	6	2270006015	2.27E-04	1.17E-03	2.23E-03	0.29	6.30E-05	1.77E-04

NOTES:
Assume Dump Truck size/emissions same as Water Truck.
Assume Track Laying Machine uses 1 diesel locomotive and 1 front end loader engine (Harsco Rail, New Track Construction). Assume full-time locomotive used 4 hrs/day, 5 days/wk
Horsepower and weight estimates based on capacity ratings and industry specifications, or average ratings per equipment type. Where hp could not be assumed, an average hp rate in NONROAD for the equipment type was used.

Emission Rates for Onsite Equipment (tpy)

	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Crane, 50 ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0	0.0000	0.0000	0
Crane, 150 ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0	0.0000	0.0000	0
Crane, 300 ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0	0.0000	0.0000	0
Water Trucks	0.31	0.09	0.03	0.02	0.03	0.03	0.03	0.000	109	0.0053	0.0003	109
Dump Trucks	1.25	0.36	0.12	0.07	0.14	0.11	0.11	0.002	436	0.0214	0.0011	437
Dozers	0.82	0.34	0.07	0.04	0.10	0.08	0.08	0.002	182	0.0089	0.0004	182
Excavators	7.30	2.48	0.63	0.36	0.72	0.60	0.60	0.012	1955	0.0960	0.0047	1958
Rollers	1.95	0.64	0.16	0.08	0.17	0.14	0.14	0.003	415	0.0204	0.0010	415
Graders	1.13	0.47	0.10	0.05	0.14	0.11	0.11	0.002	256	0.0126	0.0006	256
Compactors	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1	0.0000	0.0000	1
Track Laying Machine	1.17	0.46	0.10	0.05	0.13	0.10	0.10	0.002	230	0.0113	0.0006	230
Drill Rigs	0.64	0.17	0.05	0.01	0.04	0.03	0.03	0.001	73	0.0036	0.0002	74
Impact Piling Rigs	1.64	0.44	0.12	0.04	0.10	0.08	0.08	0.002	189	0.0093	0.0005	189
Loaders	2.35	0.93	0.20	0.09	0.25	0.21	0.21	0.005	459	0.0226	0.0011	460
Generator	6.02	2.63	0.66	0.15	0.53	0.43	0.43	0.013	720	0.0353	0.0017	721
Air Compressor	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.000	2	0.0001	0.0000	2
Total Onsite Construction Equipment (tpy)	24.6	9.0	2.23	0.95	2.34	1.93	1.93	0.05	5026	0.25	0.01	5035

Note:
For PM_{10}, $PM_{2.5}$, HAPs, and GHGs (CH_4 and N_2O), use same emission ratio as emission factor ratios for Large Diesel Engines (below): PM_{10} and $PM_{2.5}$ ratio to TSP; HAPs ratio to CO, and; GHGs ratio to CO_2.

BARGE EMISSIONS

Barges for Construction	2		
Engine Size (propulsion)	3500	hp	
Total Barge Engines	7000	hp	(Maximum # Units per year))
Barge Positioning Time	1	hrs/ship (in-out)	(Conservative estimate)
Total Power per "Trip"	7,000	hp-hrs	
Construction Trips:	2.90	per day	(assume 2/3 of material imported during first year)
	753	per year	
Annual Power	5,271,666	hp-hrs/yr	
Annual Diesel Fuel Use	36,902	MMBtu/yr	
	270,095	gallons/yr	

Emission Factors for Barges

	NOx	CO	VOC	SO2	TSP	PM10	PM2.5	HAPS	CO2	CH4	N2O	CO2e
						lb/MMBtu, fuel input						
Large Diesel Engines	3.20	0.8500	0.0819	0.002	0.07	0.06	0.06	0.00428	165	0.0081	0.0004	165

Source:

Emission factors from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Assume Sulfur content of 0.0015% by weight (15 ppm). Assume TSP to PM10 ratio from Table 3.4-2, and PM2.5=PM10. Sum of HAPs factors from Table 3.4-3 and 3.4-4.

Global Warming Potentials (GWPs): CO_2 - 1
CH_4 - 25
N_2O - 298

Emission Rates for Barges (tpy)

	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Construction - Barges	59.0	15.68	1.51	0.03	1.29	1.06	1.06	0.08	3044	0.15	0.007	3050

FUGITIVE DUST EMISSIONS

Methodology based on EPA AP-42 Chapter 13.2.3 Heavy Construction Operations

Assumed acreage for groundwork 100 acres
Assumed schedule for groundwork 1 year
12 months

Annual Groundwork Operations 8.33 acres/month

AP-42 Emission Factor 1.2 tons PM/acre/month

Uncontrolled PM Emissions: 120.0 tons

Controlled Emissions (assume watering only; no factor included for natural control from precipitation)
Control %: 90 *WRAP Fugitive Dust Handbook, Table 9-4, Watering.*

PM_{10} and $PM_{2.5}$ Fractions of Total PM
(CARB Appendix A CEIDARS $PM_{2.5}$ and PM_{10} fractions of TSP; Fugitive Dust - Construction and Demolition)
(http://www.aqmd.gov/docs/default-source/ceqa/handbook/localized-significance-thresholds/particulate-matter-(pm)-2.5-significance-thresholds-and-calculation-methodology/appendix-a-updated-ceidars-table-with-pm2-5-fractions.doc?sfvrsn=2)

PM_{10} Fraction of Total PM 0.489
$PM_{2.5}$ Fraction of Total PM 0.102

Emission Rates for Fugitive Dust (tpy)

	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Construction - Fugitive Dust	-	-	-	-	12.00	5.87	1.22	-	-	-	-	-

APPENDIX A1b

CONSTRUCTION EMISSIONS

SUMMARY

Source	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2e	CO2	CH4	N2O	DPM
	Construction Emissions (lb/day) [Maximum daily]												
COMBUSTION SOURCES													
Equipment (On-site)	229.6	82.89	20.39	8.67	21.49	17.66	17.66	0.42	45,519	45,431	2.23	0.11	21.49
Haul Trucks (Off-site)[1]	110.48	24.00	4.81	0.33	6.34	5.21	3.66	0.12	37,259	37,232	6.96E-01	3.39E-02	6.34
Haul Trucks (On-site and project study area)[1]	54.7	14.4	3.1	0.2	6.1	5.0	2.6	0.1	18236.0	18,214	0.5	0.0	6.12
Passenger Commute Vehicles (off-site)	1.36	19.60	0.34	0.03	0.57	0.57	0.11	-	3944.46	3,938	0.04	0.02	-
Crossing Delay (Off-Site)[3]	0.07	0.44	0.01	0.00	0.01	0.01	0.003	0.01	-	-	-	-	-
Barges (Off-site)	454.7	120.79	11.64	0.21	9.90	8.14	8.14	0.61	23,492	23,446.50	1.15E+00	5.68E-02	9.90

[1] For Haul truck TSP & HAPs, use same emission ratio as emission factor ratios for Large Diesel Engines (below): PM_{10} and $PM_{2.5}$ ratio to TSP; HAPs ratio to CO.

[2] See assumptions for surrogate idle/onsite in Tab A4 Material Transfer by Truck

[3] Original assumption was 1 min/day for each of the 365 days, so T/Y value was divided bye 365 to get value per day.

INPUT DATA:

Major Construction Activities and Typical Equipment Fleets

Construction Equipment Type	Rail Infrastructure and Rotary Car Dump Station		Conveyors, Transfer Stations and Surge Bins		Shiploader, Dock, and Trestles	
	Max Qty. per Month	Duration (months)	Max Qty. per Month	Duration (months)	Max Qty. per Month	Duration (months)
Mobile Cranes (25-50t)[1]						
Mobile Cranes (50-150t)[1]						
Mobile Cranes (150-300t)[1]						
Water Trucks[2]	1	12	1	12	0	0
Dump Trucks	3	12	1	12	0	0
Dozers	1	5	0	0	0	0
Excavators[3]	1	9	2	12	1	3
Rollers	2	9	2	12	1	3
Graders	2	9	0	0	1	3
Compactors	2	9	2	12	1	3
Track Laying Machine	1	6	0	0	0	0
Drill Rigs	1	2	2	6	0	0
Impact Piling Rigs	2	6	2	6	2	6
Loaders[4]	1	12	1	12	1	9
River Barge	0	0	0	0	2	18
Generator	2	18	2	18	2	18
Air Compressor	2	18	2	18	2	18

Source: MBTL, *Noise Resource Report* , Appendix D-1 (URS, June 2014).

NOTES:

[1] Mobile cranes to be shared between the 3 areas. - removed here because not all material is onsite so crane work may not start the first year.

[2] Water truck to be shared between the 2 land areas.

[3] Excavators to be shared between the 3 areas.

[4] Loaders to be shared between the 3 areas.

Typical construction fleet may be modified with equivalent items as construction activities demand

Assume entire construction period for all 3 areas is: 18 months total

5 days/week

ONSITE EQUIPMENT (NON-BARGE) EMISSIONS

Equipment Type	Engine Size (hp)	Fuel	Maximum Units Onsite (per max	EPA NONROAD SCC Number	THC-Exhaust	CO-Exhaust	NOx-Exhaust	CO2-Exhaust	SO2-Exhaust	PM-Exhaust
					EPA NONROAD model combustion emission factor (tons/yr per unit)					
Crane, 50 ton	165	Diesel	0	2270002045	5.15E-02	1.65E-01	6.50E-01	120.43	2.38E-02	5.04E-02
Crane, 150 ton	280	Diesel	0	2270002045	7.69E-02	2.12E-01	9.99E-01	201.70	3.88E-02	6.33E-02
Crane, 300 ton	450	Diesel	0	2270002045	8.22E-02	3.69E-01	1.44E+00	215.37	4.28E-02	7.47E-02
Water Trucks	350	Diesel	1	2270002051	3.06E-02	9.01E-02	3.12E-01	108.922	1.86E-02	3.49E-02
Dump Trucks	350	Diesel	4	*See Notes*	*3.06E-02*	*9.01E-02*	*3.12E-01*	*108.922*	*1.86E-02*	*3.49E-02*
Dozers	185	Diesel	1.0	2270002069	1.66E-01	8.15E-01	1.96E+00	437.06	8.46E-02	2.35E-01
Excavators	230	Diesel	2	2270002036	3.15E-01	1.24E+00	3.65E+00	977.30	1.79E-01	3.62E-01
Rollers	350	Diesel	5.0	2270002015	4.20E-02	1.70E-01	5.19E-01	110.57	2.12E-02	4.42E-02
Graders	185	Diesel	3.0	2270002048	5.49E-02	2.71E-01	6.48E-01	146.26	2.83E-02	7.85E-02
Compactors	25	Diesel	5.0	2270002009	2.47E-04	1.15E-03	2.15E-03	0.26	5.65E-05	1.78E-04
Track Laying Machine[5]	*See Notes*	Diesel	0.5	*See Notes*	*1.96E-01*	*9.29E-01*	*2.35E+00*	*459.49*	*9.05E-02*	*2.51E-01*
Drill Rigs	*NONROAD Default*	Diesel	3.0	2270002033	4.12E-02	1.48E-01	5.47E-01	62.90	1.27E-02	3.29E-02
Impact Piling Rigs	*NONROAD Default*	Diesel	6	2270002033	*4.12E-02*	*1.48E-01*	*5.47E-01*	*62.90*	*1.27E-02*	*3.29E-02*
Loaders	140	Diesel	1	2270002060	1.96E-01	9.29E-01	2.35E+00	459.49	9.05E-02	2.51E-01
Generator	30	Diesel	6	2270006005	1.10E-01	4.39E-01	1.00E+00	119.95	2.48E-02	8.80E-02
Air Compressor	25	Diesel	6	2270006015	2.27E-04	1.17E-03	2.23E-03	0.29	6.30E-05	1.77E-04

NOTES: 15.07692308

Assume Dump Truck size/emissions same as Water Truck.

[5] Assume Track Laying Machine uses 1 diesel locomotive and 1 front end loader engine (Harsco Rail, New Track Construction). Assume full-time locomotive used 4 hrs/day, 5 days/wk.

If max hour is needed, this should be 1.

Horsepower and weight estimates based on capacity ratings and industry specifications, or average ratings per equipment type. Where hp could not be assumed, an average hp rate in NONROAD for the equipment type was used.

factor to convert to lb/day (2000lb/T)/(5 day/week * 52 week/year) 7.692307692

Emission Rates for Onsite Equipment (lb/day)

	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Crane, 50 ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0	0.0000	0.0000	0
Crane, 150 ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0	0.0000	0.0000	0
Crane, 300 ton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0	0.0000	0.0000	0
Water Trucks	2.40	0.69	0.24	0.14	0.27	0.22	0.22	0.003	838	0.0411	0.0020	839
Dump Trucks	9.59	2.77	0.94	0.57	1.07	0.88	0.88	0.014	3351	0.1645	0.0081	3358
Dozers	15.10	6.27	1.28	0.65	1.81	1.48	1.48	0.032	3362	0.1650	0.0082	3369
Excavators	56.12	19.09	4.85	2.76	5.58	4.58	4.58	0.096	15035	0.7381	0.0364	15065
Rollers	19.97	6.54	1.61	0.81	1.70	1.40	1.40	0.033	4253	0.2088	0.0103	4261
Graders	14.95	6.25	1.27	0.65	1.81	1.49	1.49	0.031	3375	0.1657	0.0082	3382
Compactors	0.08	0.04	0.01	0.00	0.01	0.01	0.01	0.000	10	0.0005	0.0000	10
Track Laying Machine	9.03	3.57	0.75	0.35	0.96	0.79	0.79	0.018	1767	0.0868	0.0043	1771
Drill Rigs	12.63	3.41	0.95	0.29	0.76	0.63	0.63	0.017	1452	0.0713	0.0035	1454
Impact Piling Rigs	25.27	6.81	1.90	0.59	1.52	1.25	1.25	0.034	2903	0.1425	0.0070	2909
Loaders	18.06	7.14	1.50	0.70	1.93	1.59	1.59	0.036	3535	0.1735	0.0086	3541
Generator	46.27	20.26	5.07	1.14	4.06	3.34	3.34	0.102	5536	0.2718	0.0134	5547
Air Compressor	0.10	0.05	0.01	0.00	0.01	0.01	0.01	0.000	14	0.0007	0.0000	14
Max Onsite Construction Equipment (lb/day)	229.6	82.9	20.39	8.67	21.49	17.66	17.66	0.42	45431	2.23	0.11	45519

Note:
For PM_{10}, $PM_{2.5}$, HAPs, and GHGs (CH_4 and N_2O), use same emission ratio as emission factor ratios for Large Diesel Engines (below): PM_{10} and $PM_{2.5}$ ratio to TSP; HAPs ratio to CO, and; GHGs ratio to CO_2.

BARGE EMISSIONS

Barges for Construction	2		
Engine Size (propulsion)	3500	hp	
Total Barge Engines	7000	hp	(Maximum # Units per year))
Barge Positioning Time	1	hrs/ship (in-out)	(Conservative estimate for emissions at docking site)
Total Power per "Trip"	7,000	hp-hrs	
Construction Trips:	2.9	max per day	(only make deliveries 5 days per week)
Annual Power	20,300	hp-hrs/day	
Annual Diesel Fuel Use	142	MMBtu/day	
	1,040	gallons/day	

Emission Factors for Barges

	lb/MMBtu, fuel input											
	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Large Diesel Engines	3.20	0.85	0.08	0.002	0.07	0.06	0.06	0.004	165	0.0081	0.0004	165

Source:

Emission factors from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Assume Sulfur content of 0.0015% by weight (15 ppm). Assume TSP to PM10 ratio from Table 3.4-2, and PM2.5=PM10. Sum of HAPs factors from Table 3.4-3 and 3.4-4.

Global Warming Potentials (GWPs):
CO_2 - 1
CH_4 - 25
N_2O - 298

Emission Rates for Barges (lb/day)

	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Construction - Barges	454.7	120.79	11.64	0.21	9.90	8.14	8.14	0.61	23447	1.15	0.057	23492

FUGITIVE DUST EMISSIONS

Methodology based on EPA AP-42 Chapter 13.2.3 Heavy Construction Operations

Assumed acreage for groundwork	100	acres
Assumed schedule for groundwork	1	year
	12	months
Annual Groundwork Operations	8.33	acres/month
AP-42 Emission Factor	1.2	tons PM/acre/month

Uncontrolled PM Emissions: 666.7 lbs /1 day 10 tons for one month

Controlled Emissions (assume watering only; no factor included for natural control from precipitation):
Control %: 90 *WRAP Fugitive Dust Handbook, Table 9-4, Watering.*

PM_{10} and $PM_{2.5}$ Fractions of Total PM
(CARB Appendix A CEIDARS $PM_{2.5}$ and PM_{10} fractions of TSP; Fugitive Dust - Construction and Demolition)
(http://www.aqmd.gov/docs/default-source/ceqa/handbook/localized-significance-thresholds/particulate-matter-(pm)-2.5-significance-thresholds-and-calculation-methodology/appendix-a-updated-ceidars-table-with-pm2-5-fractions.doc?sfvrsn=2)

PM_{10} Fraction of Total PM 0.489
$PM_{2.5}$ Fraction of Total PM 0.102

Emission Rates for Fugitive Dust (lb/day)	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Construction - Fugitive Dust	-	-	-	-	66.67	32.60	6.80	-	-	-	-	-

APPENDIX A1c

OPERATIONS COMMUTER EMISSIONS

	Operations Commuter Emissions (tpy)												
2018	**NO_x**	**CO**	**VOC**	**SO_2**	**TSP**	**PM_{10}**	**$PM_{2.5}$**	**HAPS**	**CO2e**	**CO2**	**CH4**	**N2O**	**DPM**
Passenger Commute Vehicles, Operations (off-site)	7.34E-02	1.06E+00	1.81E-02	1.52E-03	-	3.10E-02	5.90E-03	-	213	212.38	2.24E-03	1.02E-03	-
2028													
Passenger Commute Vehicles - Operations (off-site)	3.66E-02	1.07E+00	1.23E-02	1.97E-03	-	5.40E-02	9.07E-03	-	275	274.24	2.19E-03	1.60E-03	-
Crossing Delay (Off-Site)	9.78E-02	9.73E-01	2.36E-02	1.36E-03	-	2.75E-02	6.58E-03	9.19E-03	-	-	-	-	-
sum	0.13	2.05	0.04	0.0033	-	0.08	0.02	0.01	274.77	274.24	0.0022	0.00160	
2038													
Passenger Commute Vehicles Operations (off-site)	1.71E-02	4.67E-01	4.84E-03	1.05E-03	-	4.06E-02	7.77E-03	-	158	157.88	6.36E-04	9.90E-04	-
Crossing Delay (Off-Site)	2.87E-02	2.91E-01	7.83E-03	5.36E-04	-	1.15E-02	2.38E-03	3.06E-03	-	-	-	-	-

APPENDIX A1d

Material Haul Traffic

Assume Peak Year Truck Haul Traffic is 56,000 Round Trips (MTBL Supplementary Traffic Report Construction Traffic Analysis, March 2015)
Peak trips per day is capped at 330 trips (MTBL Supplementary Traffic Report Construction Traffic Analysis, March 2015)

		Number	Miles (RT)[1]	miles/year
Haul Trucks	Freeway @ 55mph	56000	32.8	1836800
	SR432 @ 35mph	56000	14.2	795200
				miles/day
Haul Truck	Freeway @ 55mph	330	32.8	10824
	SR432 @ 35mph	330	14.2	4686

[1]16.4 miles on the I-5 and 7.1 miles on WA-432 to MBTL

Project Year **2018**	**NOx**	**PM10**	**PM2.5**	**SO2**	**CO**	**VOC**	**CO2**	**CH4**	**N2O**	**CO2eq**
Construction Annual				**T/year**						
Combo Short Haul Truck @ 55mph	9.37	0.44	0.31	0.03	2.04	0.41	3159.07	0.06	0.00	3161.40
Combo Short Haul Truck @ 35mph	4.06	0.19	0.13	0.01	0.88	0.18	1367.65	0.03	0.00	1368.66
Total:	13.43	0.63	0.44	0.04	2.92	0.58	4526.72	0.08	0.00	4530.06
Construction Max Day				**lbs/day**						
Combo Short Haul Truck @55 mph	110	5.2	3.7	0.3	24.0	4.8	37232	0.7	0.0	37259
Combo Short Haul Truck @ 35mph	55	5.0	2.6	0.2	14.4	3.1	18214	0.5	0.0	18236
Total:	165	10.2	6.3	0.5	38.4	7.9	55446	1.2	0.1	55495

Factors:	
453.59	g/lb
2000	lbs/ton
5280	ft/mile
3.78541	l/gal

Global Warming Potentials (GWPs): CO_2 - 1, CH_4 - 25, N_2O - 298

MOVES factors (g/mile) for surrogate idle were based on 2.5 mi/hr travel. So to get g/hr, multiply by 2.5 mi/hr. For onsite/idle, assume 0.25 hr. So factor is 2.5/.25 to get grams/trip.

mi/hr	2.5
hr	0.25
factor for 1/2 hr idle/trip	10

Mobile Source - Moves run for Cowlitz County, WY, 2018
Emission factors for Truck Exhaust

Emission factors for Truck Exhaust Emission Factors (gm/mile)												
Project Year	**NOx**	**PM10**	**PM2.5**	**SO2**	**CO**	**VOC**	**CO2**	**CH_4**	**N_2O**	**Benzene**	**Form**	**CO2eq**
2018												
Short Haul Combo - diesel @ 55mph (Rural restricted)	4.63	0.22	0.15	0.01	1.01	0.20	1560.24	0.03	0.00	0.00	0.02	1561.39
Short Haul Combo - diesel @ 35mph (Urban un-restricted)	5.30	0.49	0.26	0.02	1.39	0.30	1763.06	0.05	0.00	0.00	0.03	1765.19
Short Haul Combo - diesel @ idle (Rural unrestricted)	6.00	0.42	0.24	0.02	1.48	0.35	1927.59	0.06	0.00	0.00	0.03	1930.06

APPENDIX A1e Material Transfer by Rail (annual T/year)

LOCOMOTIVE EMISSIONS

5-year construction schedule (35,000 loaded rail cars)

Unit Trains (cars/train)	100	cars	=Millennium Coal Export Terminal Longview, Washington Traffic and Transportation, Resource Report, September 2014,URS Corporation'
Unit Trains Required	467	Trains/yr	6 trains per month' 'Millennium Coal Export Terminal Longview, Washington Traffic and Transportation, Resource Report, September 2014,URS Corporation'
	3	Locomotives/Train (full)	
	3	Locomotives/Train (empty)	
Engine Size:	4400	hp/locomotive	*Electro-Motive Diesel, GE Transportation* (http://www.getransportation.com/locomotives/locomotives/ac4400-and-dash-series-locomotives); GE AC4400CW (4400hp) or ElectroMotive Diesel SD70Ace (4300hp). Also consistent with DKS traffic analysis
Locomotive Fuel Use:	20.8	bhp-hr/gal	(conversion for large line-haul locomotive, *Emission Factors for Locomotives, EPA, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009*.)

Fuel Use per Train — Full Build-Out

ON SITE			
Loaded Train:	4.6%	Percent Load	Notch 1 setting and associatedd load @ 6 mph (202 hp) based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004)
	607.2	hp	
	29	gallons/hr	
Idle Train:	0.25%	Percent Load	Idle setting and associated load (11 hp) @idle based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004)
	33	hp	
	2	gallons/hr	
OFF SITE			
Loaded Train:	65.4%	Percent Load	Notch 6 setting and associatedd load @ 40 mph (2876 hp) based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004)
	8628	hp	
	415	gallons/hr	
Empty Train:	65.4%	Percent Load	Assume same notch 6 setting as loaded (conservative)
	8628	hp	
	415	gallons/hr	

Longview Short Line (Longview Switching Company (LSC) Track)

Offsite

Distance from Main Rail Line to Site:	7.10	miles	distance from GIS drawings per Danny Stratten (ICF) Feb 2014
Travel Time to Site:	0.71	hrs	DKS travel speed average of 10 mph
Total Power:	5721572	hp-hr/yr	
Total Fuel Use:	275076	gallons/yr	

Onsite

Onsite loop distance:	8727	ft	Per train average loop distance (Drawings 80552-500-GE-DLP-0020_RevA.pdf and 80552-500-ST-DAL-2019-00-RevA.pdf, WorleyParsons)
Travel Distance:	1.65	miles	(one loop onsite; does not include dump track time which is operated by electric indexing system)
Time per Train:	1.48	hours	time needed to unload the coal from 125 cars scaled from 125 coal cars
Total Power:	220776	hp-hr/yr	
Total Fuel Use:	10614	gallons/yr	

Total Fuel Use (On and Offsite) 285690 gallons/yr

Emission Factors (2028 full operation)

	NOx	CO	VOC	SO2	TSP	PM10	PM2.5	**HAPS**	**CO2**	**CH4**	**N2O**	**CO2e**
2028 National Locomotive Fleet Avera (g/gal)	61	26.6	2.1	0.094	1.58	1.3	1.26	0.28	10217	0.80	0.26	10314

Sources:

[1] NOx, CO, VOC, SO2, PM10, PM2.5 2025 emission factors from: *Emission Factors for Locomotives*, EPA, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009. Table 5,6,7, Line-Haul Emission Factors. From text: $PM_{2.5}$ = 0.97* PM_{10}.

[2]SO2 emission factor using S content of 15 ppm

[3]TSP emission factor from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Based on ratio of total particulate to PM10 in diesel engines, as given in Table 3.4-2.

[4]HAP emission factor from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Total HAPs from Tables 3.4-3 and 3.4-4, sum of HAPs as indicated by footnote b. For diesel fuel: 7000 Btu/hp-hr.

[5]*Direct Emissions from Mobile Combustion Sources*, EPA, Office of Air and Radiation, EPA-430-K-08-004, May 2008. N_2O and CH_4 from Table A-6.

[6]Global Warming Potentials (GWPs): CO_2 - 1
CH_4 - 25
N_2O - 298

Emission Rates (tpy)

Full Build-Out	**NO_x**	**CO**	**VOC**	**SO_2**	**TSP**	**PM_{10}**	**$PM_{2.5}$**	**HAPS**	**CO2**	**CH4**	**N2O**	**CO2e**
Offsite	1.85E+01	8.06E+00	6.36E-01	2.85E-02	4.79E-01	3.94E-01	3.82E-01	8.57E-02	3.10E+03	2.42E-01	7.88E-02	3.12E+03
Onsite	7.13E-01	3.11E-01	2.45E-02	1.10E-03	1.85E-02	1.52E-02	1.47E-02	3.31E-03	1.19E+02	9.35E-03	3.04E-03	1.21E+02
Total	1.92E+01	8.37E+00	6.61E-01	2.96E-02	4.98E-01	4.09E-01	3.97E-01	8.90E-02	3.21E+03	2.52E-01	8.18E-02	3.25E+03

APPENDIX A1f Material Transfer by Rail (Max Day)

LOCOMOTIVE EMISSIONS

5-year construction schedule (35,000 loaded rail cars)

Unit Trains (cars/train) 100 cars =Millennium Coal Export Terminal Longview, Washington Traffic and Transportation, Resource Report, September 2014,URS Corporation'

Unit Trains Required 1.3 Trains/day 6 trains per month' 'Millennium Coal Export Terminal Longview, Washington Traffic and Transportation, Resource Report, September 2014,URS Corporation'
3 Locomotives/Train (full) Constinet with DKS traffic analysis
3 Locomotives/Train (empty) Constinet with DKS traffic analysis

Engine Size: 4400 hp/locomotive *Electro-Motive Diesel, GE Transportation* (http://www.getransportation.com/locomotives/locomotives/ac4400-and-dash-series-locomotives); GE AC4400CW (4400hp) or ElectroMotive Diesel SD70Ace (4300hp). Also consistent with DKS traffic analysis
Locomotive Fuel Use: 20.8 bhp-hr/gal (conversion for large line-haul locomotive, *Emission Factors for Locomotives, EPA, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009*.)

Fuel Use per Train — Full Build-Out

ON SITE

	Value	Unit	Note
Loaded Train:	4.6%	Percent Load	Notch 1 setting and associatedd load @ 6 mph (202 hp) based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004)
	607.2	hp	
	29	gallons/hr	
Idle Train:	0.25%	Percent Load	Idle setting and associated load (11 hp) @idle based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004)
	33	hp	
	2	gallons/hr	

OFF SITE

	Value	Unit	Note
Loaded Train:	65.4%	Percent Load	Notch 6 setting and associatedd load @ 40 mph (2876 hp) based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004)
	8628	hp	
	415	gallons/hr	
Empty Train:	65.4%	Percent Load	Assume same notch 6 setting as loaded (conservative)
	8628	hp	
	415	gallons/hr	

Longview Short Line (Longview Switching Company (LSC) Track)

Offsite

	Value	Unit	Note
Distance from Main Rail Line to Site:	7.10	miles	distance from GIS drawings per Danny Stratten (ICF) Feb 2014
Travel Time to Site:	0.71	hrs	DKS travel speed average of 10 mph
Total Power:	15927	hp-hr/yr	
Total Fuel Use:	766	gallons/yr	

Onsite

	Value	Unit	Note
Onsite loop distance:	8727	ft	Per train average loop distance (Drawings 80552-500-GE-DLP-0020_RevA.pdf and 80552-500-ST-DAL-2019-00-RevA.pdf, WorleyParsons)
Travel Distance:	1.65	miles	(one loop onsite; does not include dump track time which is operated by electric indexing system)
Time per Train:	1.48	hours	time needed to unload the coal from 125 cars — scaled from 125 coal cars
Total Power:	615	hp-hr/yr	
Total Fuel Use:	30	gallons/yr	

Total Fuel Use (On and Offsite) 795 gallons/yr

Emission Factors (2028 full operation)

	NOx	CO	VOC	SO2	TSP	PM10	PM2.5	**HAPS**	**CO2**	**CH4**	**N2O**	**CO2e**
2028 National Locomotive Fleet Avera (g/gal)	61	26.6	2.1	0.094	1.58	1.3	1.26	0.28	10217	0.80	0.26	10314

Sources:
[1] NOx, CO, VOC, SO2, PM10, PM2.5 2025 emission factors from: *Emission Factors for Locomotives*, EPA, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009. Table 5,6,7, Line-Haul Emission Factors. From text: $PM_{2.5} = 0.97* PM_{10}$.
[2] SO2 emission factor using S content of 15 ppm
[3] TSP emission factor from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Based on ratio of total particulate to PM10 in diesel engines, as given in Table 3.4-2.
[4] HAP emission factor from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Total HAPs from Tables 3.4-3 and 3.4-4, sum of HAPs as indicated by footnote b. For diesel fuel: 7000 Btu/hp-hr.
[5] *Direct Emissions from Mobile Combustion Sources*, EPA, Office of Air and Radiation, EPA-430-K-08-004, May 2008. N_2O and CH_4 from Table A-6.
[6] Global Warming Potentials (GWPs): CO_2 - 1
CH_4 - 25
N_2O - 298

Emission Rates (tpy)

Full Build-Out	**NO_x**	**CO**	**VOC**	**SO_2**	**TSP**	**PM_{10}**	**$PM_{2.5}$**	**HAPS**	**CO2**	**CH4**	**N2O**	**CO2e**
Offsite	5.14E-02	2.24E-02	1.77E-03	7.93E-05	1.33E-03	1.10E-03	1.06E-03	2.39E-04	8.62E+00	6.75E-04	2.19E-04	8.70E+00
Onsite	1.98E-03	8.66E-04	6.83E-05	3.06E-06	5.15E-05	4.23E-05	4.10E-05	9.21E-06	3.32E-01	2.60E-05	8.46E-06	3.36E-01
Total	5.34E-02	2.33E-02	1.84E-03	8.23E-05	1.39E-03	1.14E-03	1.10E-03	2.48E-04	8.95E+00	7.01E-04	2.28E-04	9.03E+00

APPENDIX A2

CONSTRUCTION - 'NONROAD' MODEL EMISSIONS

EPA`s NONROAD Emissions Model
Core Model ver 2008a, 07/06/09
Jul 25 11:58:30: 2014
MBTL
2014
Options file used: C:\NONROAD\Projects\MBTL.OPT
Total for year: 2014
Tons/Year

Cnty	Sub SCC	HP	Population	THC-Exhaust	CO-Exhaust	NOx-Exhaust	CO2-Exhaust	SO2-Exhaust	PM-Exhaust	Crankcase	Hot-Soaks	Diurnal	Displacement	Spillage	RunLoss	TankPerm	HosePerm	FuelCons.	Activity	LF	HPAvg
53015	2265003070	40	1.70E-03	1.53E-05	5.51E-04	4.18E-05	2.96E-02	6.10E-06	3.06E-06	0.00E+00	1.67E-07	7.96E-07	1.12E-05	6.70E-07	3.74E-07	0.00E+00	0.00E+00	3.01E+00	1.41E+00	7.80E-01	3.50E+01
53015	2265003070	75	6.63E-02	1.04E-03	3.81E-02	2.83E-03	1.92E+00	3.95E-04	1.96E-04	0.00E+00	6.50E-06	8.20E-05	7.25E-04	2.20E-05	1.78E-05	0.00E+00	0.00E+00	1.95E+02	5.49E+01	7.80E-01	5.82E+01
53015	2265003070	100	3.06E-02	8.13E-04	2.98E-02	2.22E-03	1.50E+00	3.09E-04	1.53E-04	0.00E+00	3.00E-06	3.79E-05	5.67E-04	1.72E-05	8.23E-06	0.00E+00	0.00E+00	1.53E+02	2.53E+01	7.80E-01	9.86E+01
53015	2265003070	175	1.19E-01	3.66E-03	1.34E-01	9.98E-03	6.76E+00	1.39E-03	6.90E-04	0.00E+00	1.17E-05	2.43E-04	2.55E-03	4.69E-05	3.20E-05	0.00E+00	0.00E+00	6.88E+02	9.85E+01	7.80E-01	1.14E+02
53015	2265003070	300	1.70E-03	1.14E-04	4.20E-03	3.12E-04	2.11E-01	4.36E-05	2.16E-05	0.00E+00	1.67E-07	7.61E-06	7.99E-05	6.70E-07	4.57E-07	0.00E+00	0.00E+00	2.15E+01	1.41E+00	7.80E-01	2.50E+02
53015	2267002057	40	3.32E-02	5.20E-05	1.84E-03	2.95E-04	1.52E-01	2.95E-06	1.60E-05	6.96E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.26E+01	1.37E+01	6.30E-01	2.90E+01
53015	2267002057	50	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
53015	2267002057	75	2.23E-01	3.06E-03	8.60E-02	1.35E-02	2.40E+00	4.67E-05	2.42E-04	5.99E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.58E+02	9.20E+01	6.30E-01	6.59E+01
53015	2267002057	100	1.33E-03	2.21E-05	6.22E-04	9.74E-05	1.74E-02	3.38E-07	1.75E-06	4.33E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.58E+00	5.48E-01	6.30E-01	8.00E+01
53015	2267002057	175	2.65E-02	6.26E-04	1.76E-02	2.76E-03	4.92E-01	9.56E-06	4.94E-05	1.23E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.32E+01	1.10E+01	6.30E-01	1.13E+02
53015	2270002009	6	3.82E+00	2.92E-03	1.94E-02	2.14E-02	2.54E+00	5.47E-04	2.21E-03	3.10E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.25E+02	1.85E+03	4.30E-01	4.94E+00
53015	2270002009	11	1.71E+00	2.26E-03	1.50E-02	1.66E-02	1.97E+00	4.24E-04	1.71E-03	2.40E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E+02	8.26E+02	4.30E-01	8.55E+00
53015	2270002009	16	1.04E+00	1.87E-03	8.73E-03	1.63E-02	1.99E+00	4.28E-04	1.35E-03	2.03E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.76E+02	5.02E+02	4.30E-01	1.42E+01
53015	2270002009	25	9.57E-02	2.47E-04	1.15E-03	2.15E-03	2.63E-01	5.65E-05	1.78E-04	2.68E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.33E+01	4.63E+01	4.30E-01	2.04E+01
53015	2270002015	6	4.11E-01	6.24E-04	5.13E-03	4.78E-03	6.57E-01	1.41E-04	4.31E-04	9.20E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.82E+01	3.13E+02	5.90E-01	5.44E+00
53015	2270002015	11	7.72E-01	1.87E-03	1.54E-02	1.43E-02	1.97E+00	4.24E-04	1.29E-03	2.76E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E+02	5.87E+02	5.90E-01	8.69E+00
53015	2270002015	16	9.24E-01	2.79E-03	1.51E-02	2.76E-02	3.68E+00	7.91E-04	2.26E-03	4.08E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.26E+02	7.02E+02	5.90E-01	1.36E+01
53015	2270002015	25	1.66E+00	7.28E-03	3.95E-02	7.19E-02	9.60E+00	2.06E-03	5.88E-03	1.06E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.49E+02	1.26E+03	5.90E-01	1.97E+01
53015	2270002015	40	2.37E+00	8.94E-03	4.83E-02	1.58E-01	2.26E+01	4.40E-03	9.69E-03	1.54E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.00E+03	1.80E+03	5.90E-01	3.25E+01
53015	2270002015	50	2.19E+00	1.17E-02	6.31E-02	2.06E-01	2.95E+01	5.74E-03	1.26E-02	2.01E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.61E+03	1.67E+03	5.90E-01	4.58E+01
53015	2270002015	75	2.22E+00	1.88E-02	1.78E-01	2.48E-01	3.97E+01	8.05E-03	2.30E-02	2.40E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.51E+03	1.69E+03	5.90E-01	6.07E+01
53015	2270002015	100	6.07E+00	7.16E-02	7.40E-01	8.22E-01	1.51E+02	2.98E-02	1.10E-01	1.24E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.34E+04	4.62E+03	5.90E-01	8.48E+01
53015	2270002015	175	5.63E+00	8.40E-02	3.99E-01	1.01E+00	1.97E+02	3.89E-02	1.08E-01	1.40E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.74E+04	4.28E+03	5.90E-01	1.32E+02
53015	2270002015	300	1.92E+00	4.20E-02	1.70E-01	5.19E-01	1.11E+02	2.12E-02	4.42E-02	6.31E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.78E+03	1.46E+03	5.90E-01	2.17E+02
53015	2270002015	600	5.70E-01	2.34E-02	1.59E-01	3.93E-01	6.35E+01	1.26E-02	2.72E-02	3.82E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.61E+03	4.33E+02	5.90E-01	4.21E+02
53015	2270002033	11	1.78E-02	2.15E-05	1.41E-04	1.57E-04	1.85E-02	3.97E-06	1.63E-05	2.37E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E+00	8.28E+00	4.30E-01	8.00E+00
53015	2270002033	16	2.73E-02	4.94E-05	2.28E-04	4.24E-04	5.15E-02	1.11E-05	3.53E-05	5.57E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.56E+00	1.27E+01	4.30E-01	1.45E+01
53015	2270002033	25	6.15E-02	1.80E-04	8.32E-04	1.54E-03	1.88E-01	4.04E-05	1.29E-04	2.03E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.66E+01	2.87E+01	4.30E-01	2.35E+01
53015	2270002033	40	1.05E+00	2.69E-03	1.22E-02	3.37E-02	4.29E+00	8.78E-04	2.61E-03	3.47E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.80E+02	4.88E+02	4.30E-01	3.15E+01
53015	2270002033	50	1.07E+00	3.91E-03	1.78E-02	4.89E-02	6.24E+00	1.28E-03	3.79E-03	5.05E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.52E+02	4.97E+02	4.30E-01	4.49E+01
53015	2270002033	75	1.73E+00	1.23E-02	6.46E-02	1.23E-01	1.39E+01	2.90E-03	1.19E-02	2.19E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E+03	8.06E+02	4.30E-01	6.18E+01
53015	2270002033	100	1.76E+00	1.71E-02	8.67E-02	1.63E-01	1.95E+01	4.00E-03	1.71E-02	3.29E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.72E+03	8.19E+02	4.30E-01	8.51E+01
53015	2270002033	175	2.58E+00	2.85E-02	1.07E-01	3.64E-01	3.99E+01	8.19E-03	2.41E-02	5.39E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.53E+03	1.20E+03	4.30E-01	1.32E+02
53015	2270002033	300	2.25E+00	4.12E-02	1.48E-01	5.47E-01	6.29E+01	1.27E-02	3.29E-02	7.60E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.57E+03	1.05E+03	4.30E-01	2.39E+02
53015	2270002033	600	1.29E+00	4.05E-02	1.88E-01	6.15E-01	6.77E+01	1.38E-02	3.33E-02	7.45E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.99E+03	6.03E+02	4.30E-01	4.47E+02
53015	2270002033	750	3.03E-01	1.42E-02	7.74E-02	2.22E-01	2.45E+01	4.98E-03	1.23E-02	2.60E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.17E+03	1.41E+02	4.30E-01	6.91E+02
53015	2270002033	1000	1.65E-01	1.39E-02	5.50E-02	1.93E-01	1.68E+01	3.42E-03	9.71E-03	2.43E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E+03	7.71E+01	4.30E-01	8.69E+02
53015	2270002033	1200	2.73E-03	2.78E-04	1.10E-03	3.85E-03	3.36E-01	6.82E-05	1.94E-04	4.86E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.97E+01	1.27E+00	4.30E-01	1.05E+03
53015	2270002033	2000	5.47E-03	7.93E-04	3.14E-03	1.10E-02	9.59E-01	1.95E-04	5.54E-04	1.39E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.49E+01	2.55E+00	4.30E-01	1.50E+03
53015	2270002036	6	2.05E-02	4.89E-05	3.97E-04	3.77E-04	5.19E-02	1.12E-05	3.22E-05	8.72E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.60E+00	2.24E+01	5.90E-01	6.00E+00
53015	2270002036	11	1.13E-01	3.59E-04	2.91E-03	2.77E-03	3.81E-01	8.20E-05	2.37E-04	6.41E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.38E+01	1.24E+02	5.90E-01	7.97E+00
53015	2270002036	16	2.34E-01	9.77E-04	5.20E-03	9.73E-03	1.30E+00	2.79E-04	7.97E-04	1.73E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E+02	2.55E+02	5.90E-01	1.31E+01
53015	2270002036	25	1.04E+00	7.14E-03	3.80E-02	7.11E-02	9.47E+00	2.04E-03	5.83E-03	1.26E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.39E+02	1.14E+03	5.90E-01	2.15E+01
53015	2270002036	40	2.16E+00	1.08E-02	5.30E-02	2.00E-01	3.01E+01	5.62E-03	1.15E-02	2.53E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.66E+03	2.35E+03	5.90E-01	3.30E+01
53015	2270002036	50	1.15E+00	8.01E-03	3.92E-02	1.47E-01	2.23E+01	4.15E-03	8.47E-03	1.87E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.97E+03	1.26E+03	5.90E-01	4.58E+01
53015	2270002036	75	8.92E-01	8.53E-03	8.81E-02	1.30E-01	2.31E+01	4.59E-03	1.10E-02	6.66E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.04E+03	9.74E+02	5.90E-01	6.13E+01
53015	2270002036	100	4.03E+00	5.70E-02	6.74E-01	7.03E-01	1.56E+02	2.98E-02	1.06E-01	8.68E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E+04	4.40E+03	5.90E-01	9.17E+01
53015	2270002036	175	1.50E+01	2.76E-01	1.39E+00	3.22E+00	7.88E+02	1.50E-01	4.20E-01	3.99E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.97E+04	1.64E+04	5.90E-01	1.38E+02
53015	2270002036	300	1.10E+01	3.15E-01	1.24E+00	3.65E+00	9.77E+02	1.79E-01	3.62E-01	3.84E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.64E+04	1.20E+04	5.90E-01	2.33E+02
53015	2270002036	600	2.91E+00	1.39E-01	8.58E-01	2.18E+00	4.56E+02	8.75E-02	1.73E-01	1.95E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.03E+04	3.18E+03	5.90E-01	4.11E+02
53015	2270002036	750	9.29E-02	7.56E-03	7.04E-02	1.22E-01	2.55E+01	4.89E-03	9.85E-03	1.05E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.25E+03	1.01E+02	5.90E-01	7.19E+02
53015	2270002036	1000	1.08E-01	1.83E-02	9.27E-02	2.72E-01	3.63E+01	6.98E-03	1.58E-02	2.22E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.21E+03	1.18E+02	5.90E-01	8.84E+02
53015	2270002036	1200	4.10E-03	9.42E-04	4.78E-03	1.40E-02	1.87E+00	3.60E-04	8.15E-04	1.14E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.66E+02	4.48E+00	5.90E-01	1.20E+03
53015	2270002036	2000	4.10E-02	1.39E-02	7.04E-02	2.07E-01	2.76E+01	5.30E-03	1.20E-02	1.69E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.44E+03	4.48E+01	5.90E-01	1.77E+03
53015	2270002036	3000	1.37E-03	6.15E-04	3.12E-03	9.16E-03	1.22E+00	2.35E-04	5.32E-04	7.47E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E+02	1.49E+00	5.90E-01	2.35E+03
53015	2270002045	25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
53015	2270002045	40	1.72E-01	7.55E-04	3.82E-03	1.33E-02	1.88E+00	3.66E-04	7.96E-04	1.53E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.66E+02	1.70E+02	4.30E-01	3.94E+01
53015	2270002045	50	2.73E-03	1.27E-05	6.42E-05	2.24E-04	3.15E-02	6.15E-06	1.34E-05	2.57E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.79E+00	2.71E+00	4.30E-01	4.17E+01
53015	2270002045	75	9.16E-02	7.91E-04	5.87E-03	1.07E-02	1.62E+00	3.30E-04	8.59E-04	1.04E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E+02	9.06E+01	4.30E-01	6.40E+01
53015	2270002045	100	8.85E-01	1.04E-02	7.08E-02	1.24E-01	2.16E+01	4.27E-03	1.25E-02	1.80E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E+03	8.77E+02	4.30E-01	8.81E+01
53015	2270002045	175	3.33E+00	5.15E-02	1.65E-01	6.50E-01	1.20E+02	2.38E-02	5.04E-02	8.61E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E+04	3.30E+03	4.30E-01	1.45E+02
53015	2270002045	300	3.41E+00	7.69E-02	2.12E-01	9.99E-01	2.02E+02	3.88E-02	6.33E-02	1.17E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.78E+04	3.38E+03	4.30E-01	2.38E+02
53015	2270002045	600	2.10E+00	8.22E-02	3.69E-01	1.44E+00	2.15E+02	4.28E-02	7.47E-02	1.36E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.90E+04	2.08E+03	4.30E-01	4.12E+02
53015	2270002045	750	9.02E-02	5.44E-03	3.35E-02	1.01E-01	1.50E+01	2.98E-03	5.42E-03	8.90E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.33E+03	8.93E+01	4.30E-01	6.69E+02
53015	2270002045	1000	2.60E-02	3.56E-03	1.27E-02	5.47E-02	5.70E+00	1.13E-03	2.53E-03	5.50E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.04E+02	2.57E+01	4.30E-01	8.83E+02
53015	2270002045	1200	1.37E-03	2.27E-04	8.08E-04	3.49E-03	3.64E-01	7.23E-05	1.62E-04	3.51E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.22E+01	1.35E+00	4.30E-01	1.07E+03
53015	2270002048	40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
53015	2270002048	50	5.47E-03	3.69E-05	1.88E-04	6.67E-04	9.84E-02	1.87E-05	3.90E-05	2.15E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.70E+00	5.26E+00	5.90E-01	4.83E+01
53015	2270002048	75	3.96E-02	3.54E-04	3.56E-03	5.14E-03	8.79E-01	1.76E-04	4.47E-04	3.46E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	3.81E+01	5.90E-01	5.95E+01
53015	2270002048	100	3.03E-01	3.80E-03	4.30E-02	4.59E-02	9.52E+00	1.84E-03	6.55E-03	6.11E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.41E+02	2.92E+02	5.90E-01	8.42E+01
53015	2270002048	175	3.10E+00	5.49E-02	2.71E-01	6.48E-01	1.46E+02	2.83E-02	7.85E-02	8.43E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.29E+04	2.98E+03	5.90E-01	1.41E+02
53015	2270002048	300	5.19E+00	1.36E-01	5.51E-01	1.62E+00	4.02E+02	7.51E-02	1.54E-01	1.80E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.56E+04	4.99E+03	5.90E-01	2.31E+02
53015	2270002048	600	5.93E-01	2.19E-02	1.40E-01	3.57E-01	6.80E+01	1.32E-02	2.66E-02	3.27E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.01E+03	5.71E+02	5.90E-01	3.42E+02
53015	2270002048	750	3.55E-02	2.78E-03	2.63E-02	4.68E-02	8.94E+00	1.74E-03	3.57E-03	4.09E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.90E+02	3.42E+01	5.90E-01	7.50E+02
53015	2270002051	175	8.20E-03	2.28E-04	1.04E-03	2.45E-03	7.53E-01	1.36E-04	3.56E-04	2.48E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.66E+01	1.35E+01	5.90E-01	1.61E+02
53015	2270002051	300	7.79E-01	3.06E-02	9.01E-02	3.12E-01	1.09E+02	1.86E-02	3.49E-02	2.22E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.63E+03	1.28E+03	5.90E-01	2.44E+02
53015	2270002051	600	1.65E+00	1.13E-01	5.80E-01	1.45E+00	3.97E+02	7.29E-02	1.44E-01	1.25E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.51E+04	2.71E+03	5.90E-01	4.20E+02
53015	2270002051	750	9.35E-01	1.04E-01	8.34E-01	1.35E+00	3.68E+02	6.76E-02	1.34E-01	1.15E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.25E+04	1.53E+03	5.90E-01	6.88E+02
53015	2270002051	1000	4.54E-01	1.03E-01	5.26E-01	1.41E+00	2.25E+02	4.13E-02	9.12E-02	8.40E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.99E+04	7.44E+02	5.90E-01	8.68E+02
53015	2270002051	1200	1.43E-01	4.34E-02	2.21E-01	5.93E-01	9.46E+01	1.74E-02	3.83E-02	3.53E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.37E+03	2.35E+02	5.90E-01	1.15E+03
53015	2270002051	2000	7.27E-01	3.41E-01	1.73E+00	4.66E+00	7.43E+02	1.36E-01	3.01E-01	2.77E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.57E+04	1.19E+03	5.90E-01	1.79E+03
53015	2270002051	3000	1.78E-01	1.13E-01	5.75E-01	1.54E+00	2.46E+02	4.52E-02	9.97E-02	9.19E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.18E+04	2.92E+02	5.90E-01	2.42E+03
53015	2270002057	16	5.47E-03	1.44E-05	7.92E-05	1.42E-04	1.89E-02	4.06E-06	1.16E-05	3.31E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.67E+00	3.62E+00	5.90E-01	1.35E+01
53015	2270002057	25	6.15E-02	2.70E-04	1.48E-03	2.65E-03	3.53E-01	7.60E-05	2.18E-04	6.20E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.13E+01	4.07E+01	5.90E-01	2.25E+01
53015	2270002057	40	1.42E+00	4.98E-03	2.78E-02	8.61E-02	1.22E+01	2.39E-03	5.50E-03	1.35E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E+03	9.42E+02	5.90E-01	3.34E+01
53015	2270002057	50	1.58E+00	7.50E-03	4.18E-02	1.29E-01	1.83E+01	3.60E-03	8.27E-03	2.03E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.62E+03	1.05E+03	5.90E-01	4.51E+01
53015	2270002057	75	3.14E+00	2.62E-02	2.34E-01	3.24E-01	4.94E+01	1.01E-02	3.18E-02	3.70E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.37E+03	2.08E+03	5.90E-01	6.14E+01
53015	2270002057	100	1.80E+01	2.08E-01	2.01E+00	2.28E+00	3.94E+02	7.84E-02	3.05E-01	3.70E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.49E+04	1.19E+04	5.90E-01	8.56E+01
53015	2270002057	175	9.23E+00	1.23E-01	5.82E-01	1.49E+00	2.68E+02	5.34E-02	1.49E-01	2.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.37E+04	6.11E+03	5.90E-01	1.26E+02
53015	2270002057	300	4.78E-01	1.04E-02	4.25E-02	1.30E-01	2.53E+01	4.90E-03	1.05E-02	1.64E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.24E+03	3.17E+02	5.90E-01	2.29E+02
53015	2270002057	600	6.30E-01	2.12E-02	1.47E-01	3.40E-01	5.03E+01	1.01E-02	2.41E-02	3.62E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.45E+03	4.17E+02	5.90E-01	3.46E+02

53015	2270002060	11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
53015	2270002060	16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
53015	2270002060	25	1.37E-02	6.97E-05	3.78E-04	6.88E-04	9.18E-02	1.98E-05	5.63E-05	1.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.13E+00	1.04E+01	5.90E-01	2.28E+01
53015	2270002060	40	7.20E-01	2.88E-03	1.56E-02	5.08E-02	7.30E+00	1.42E-03	3.12E-03	4.92E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.45E+02	5.48E+02	5.90E-01	3.44E+01
53015	2270002060	50	8.27E-01	4.37E-03	2.36E-02	7.72E-02	1.11E+01	2.15E-03	4.73E-03	7.46E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.79E+02	6.29E+02	5.90E-01	4.54E+01
53015	2270002060	75	1.17E+00	1.01E-02	9.51E-02	1.33E-01	2.12E+01	4.31E-03	1.23E-02	1.28E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.88E+03	8.89E+02	5.90E-01	6.17E+01
53015	2270002060	100	5.02E+00	5.98E-02	6.18E-01	6.86E-01	1.27E+02	2.49E-02	9.20E-02	1.03E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.12E+04	3.82E+03	5.90E-01	8.55E+01
53015	2270002060	175	1.27E+01	1.96E-01	9.29E-01	2.35E+00	4.59E+02	9.05E-02	2.51E-01	3.25E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.06E+04	9.67E+03	5.90E-01	1.36E+02
53015	2270002060	300	1.21E+01	2.81E-01	1.14E+00	3.47E+00	7.40E+02	1.42E-01	2.96E-01	4.22E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.55E+04	9.23E+03	5.90E-01	2.30E+02
53015	2270002060	600	8.90E+00	3.63E-01	2.47E+00	6.14E+00	9.91E+02	1.96E-01	4.24E-01	5.92E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.76E+04	6.77E+03	5.90E-01	4.19E+02
53015	2270002060	750	6.72E-01	4.28E-02	4.07E-01	7.67E-01	1.24E+02	2.45E-02	5.47E-02	6.88E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.09E+04	5.12E+02	5.90E-01	6.92E+02
53015	2270002060	1000	3.28E-01	4.54E-02	2.40E-01	6.64E-01	7.53E+01	1.49E-02	3.85E-02	6.86E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.67E+03	2.50E+02	5.90E-01	8.66E+02
53015	2270002060	1200	6.83E-02	1.18E-02	6.25E-02	1.73E-01	1.96E+01	3.88E-03	1.00E-02	1.79E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.73E+03	5.20E+01	5.90E-01	1.08E+03
53015	2270002060	2000	4.02E-01	1.20E-01	6.34E-01	1.75E+00	1.99E+02	3.94E-02	1.02E-01	1.81E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.76E+04	3.06E+02	5.90E-01	1.87E+03
53015	2270002060	3000	1.50E-02	5.38E-03	2.85E-02	7.88E-02	8.94E+00	1.77E-03	4.57E-03	8.14E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.91E+02	1.14E+01	5.90E-01	2.24E+03
53015	2270002069	40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
53015	2270002069	50	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
53015	2270002069	75	1.52E-01	1.30E-03	1.30E-02	1.87E-02	3.19E+00	6.39E-04	1.64E-03	1.31E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.82E+02	1.42E+02	5.90E-01	5.80E+01
53015	2270002069	100	4.35E+00	5.62E-02	6.31E-01	6.77E-01	1.39E+02	2.68E-02	9.57E-02	9.10E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E+04	4.07E+03	5.90E-01	8.79E+01
53015	2270002069	175	9.84E+00	1.66E-01	8.15E-01	1.96E+00	4.37E+02	8.46E-02	2.35E-01	2.57E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.86E+04	9.21E+03	5.90E-01	1.36E+02
53015	2270002069	300	8.52E+00	2.23E-01	9.06E-01	2.67E+00	6.55E+02	1.23E-01	2.51E-01	2.99E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.79E+04	7.97E+03	5.90E-01	2.36E+02
53015	2270002069	600	4.31E+00	1.96E-01	1.26E+00	3.19E+00	5.99E+02	1.17E-01	2.35E-01	2.95E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.29E+04	4.04E+03	5.90E-01	4.25E+02
53015	2270002069	750	1.70E+00	1.23E-01	1.17E+00	2.09E+00	3.93E+02	7.65E-02	1.58E-01	1.83E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.47E+04	1.59E+03	5.90E-01	7.07E+02
53015	2270002069	1000	3.53E-01	5.68E-02	2.90E-01	8.52E-01	1.06E+02	2.07E-02	4.84E-02	7.67E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.39E+03	3.30E+02	5.90E-01	9.23E+02
53015	2270002069	1200	6.12E-01	1.14E-01	5.81E-01	1.71E+00	2.13E+02	4.14E-02	9.70E-02	1.54E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.88E+04	5.73E+02	5.90E-01	1.07E+03
53015	2270002069	2000	2.73E-03	7.03E-04	3.58E-03	1.05E-02	1.31E+00	2.56E-04	5.99E-04	9.49E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E+02	2.56E+00	5.90E-01	1.47E+03
53015	2270006005	6	1.90E+01	1.32E-02	7.54E-02	9.35E-02	9.55E+00	2.05E-03	1.01E-02	1.84E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.47E+02	6.41E+03	4.30E-01	5.35E+00
53015	2270006005	11	1.89E+01	2.07E-02	1.18E-01	1.47E-01	1.50E+01	3.23E-03	1.58E-02	2.89E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.33E+03	6.40E+03	4.30E-01	8.42E+00
53015	2270006005	16	1.46E+01	2.30E-02	9.59E-02	1.70E-01	1.86E+01	4.01E-03	1.58E-02	3.36E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.65E+03	4.93E+03	4.30E-01	1.36E+01
53015	2270006005	25	2.30E+01	5.70E-02	2.37E-01	4.20E-01	4.61E+01	9.91E-03	3.90E-02	8.31E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.09E+03	7.77E+03	4.30E-01	2.13E+01
53015	2270006005	40	3.80E+01	1.10E-01	4.39E-01	1.00E+00	1.20E+02	2.48E-02	8.80E-02	1.77E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E+04	1.29E+04	4.30E-01	3.34E+01
53015	2270006005	50	5.20E+00	2.03E-02	8.10E-02	1.85E-01	2.21E+01	4.58E-03	1.62E-02	3.27E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.96E+03	1.76E+03	4.30E-01	4.52E+01
53015	2270006005	75	1.92E+01	9.86E-02	5.03E-01	9.35E-01	1.08E+02	2.26E-02	8.99E-02	1.77E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.60E+03	6.48E+03	4.30E-01	6.00E+01
53015	2270006005	100	2.33E+01	1.72E-01	8.48E-01	1.55E+00	1.90E+02	3.91E-02	1.62E-01	3.31E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.68E+04	7.88E+03	4.30E-01	8.64E+01
53015	2270006005	175	7.96E+00	6.81E-02	2.53E-01	8.19E-01	9.17E+01	1.89E-02	5.46E-02	1.29E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.12E+03	2.69E+03	4.30E-01	1.36E+02
53015	2270006005	300	4.43E+00	6.13E-02	2.17E-01	7.61E-01	8.95E+01	1.81E-02	4.66E-02	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.92E+03	1.50E+03	4.30E-01	2.38E+02
53015	2270006005	600	2.30E+00	4.83E-02	2.15E-01	6.95E-01	8.19E+01	1.66E-02	3.70E-02	8.83E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.24E+03	7.77E+02	4.30E-01	4.19E+02
53015	2270006005	750	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
53015	2270006005	1000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
53015	2270006005	1200	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
53015	2270006005	2000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
53015	2270006005	3000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
53015	2270006015	6	1.11E-01	1.36E-04	1.06E-03	1.05E-03	1.40E-01	3.01E-05	9.69E-05	4.97E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E+01	9.02E+01	4.30E-01	5.57E+00
53015	2270006015	11	2.71E-01	5.68E-04	4.42E-03	4.35E-03	5.84E-01	1.26E-04	4.03E-04	2.07E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.17E+01	2.21E+02	4.30E-01	9.47E+00
53015	2270006015	16	3.69E-02	8.67E-05	4.49E-04	8.54E-04	1.12E-01	2.41E-05	6.77E-05	3.09E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.91E+00	3.01E+01	4.30E-01	1.33E+01
53015	2270006015	25	5.68E-02	2.27E-04	1.17E-03	2.23E-03	2.93E-01	6.30E-05	1.77E-04	8.09E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.59E+01	4.63E+01	4.30E-01	2.27E+01
53015	2270006015	40	2.09E+00	6.72E-03	3.45E-02	1.16E-01	1.59E+01	3.15E-03	7.31E-03	2.83E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.41E+03	1.70E+03	4.30E-01	3.35E+01
53015	2270006015	50	1.44E+00	6.14E-03	3.15E-02	1.06E-01	1.46E+01	2.88E-03	6.69E-03	2.59E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.29E+03	1.18E+03	4.30E-01	4.43E+01
53015	2270006015	75	9.25E+00	7.19E-02	4.81E-01	9.03E-01	1.28E+02	2.62E-02	7.58E-02	1.06E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E+04	7.54E+03	4.30E-01	6.08E+01
53015	2270006015	100	1.20E+01	1.28E-01	7.97E-01	1.45E+00	2.30E+02	4.60E-02	1.46E-01	2.30E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.03E+04	9.82E+03	4.30E-01	8.39E+01
53015	2270006015	175	1.38E+00	1.73E-02	5.52E-02	2.25E-01	3.66E+01	7.31E-03	1.60E-02	3.01E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.23E+03	1.13E+03	4.30E-01	1.29E+02
53015	2270006015	300	1.24E+00	2.61E-02	7.35E-02	3.54E-01	6.18E+01	1.21E-02	2.09E-02	4.24E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.47E+03	1.01E+03	4.30E-01	2.43E+02
53015	2270006015	600	3.55E-01	1.43E-02	6.63E-02	2.31E-01	3.11E+01	6.23E-03	1.26E-02	2.49E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.75E+03	2.89E+02	4.30E-01	4.27E+02
53015	2270006015	750	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

APPENDIX A3a

SUMMARY OF EMISSIONS

Based on:

1 metric tonne = 1.1023 ton (short ton)

Facility Material Handling System Rating

Materials Handling System/Train Unload:	7500	metric tonnes/hr	8267	tons/hr
Reclaim and Vessel Loading:	6500	metric tonnes/hr	7165	tons/hr

Projected Operation

Operating hours	365	days/yr	
	Full Build-Out		
Coal Throughput	44	MM metric tons per year	
	49	MM tpy	
Unit Trains	8	trains/day	
Cars per Unit Train	125	cars/train	
Coal per Car	122.1	tons/car	
Onsite Tracks	8	number of tracks	
	840	ships/yr	Latest assumption on number of cargo ships Handymax size to move tl
tons of coal per ship	57,740	tons/vessel	
Hours to Unload one unit train	1.85	hours	

Source	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	DPM
	Full Build-Out Pollutant Emissions (tpy)								
FUGITIVE SOURCES									
Coal Transfer (except piles):									
Material Handling	-	-	-	-	5.25	1.84	0.28	-	-
Coal Piles:									
Wind Erosion	-	-	-	-	3.05	2.59	0.40	-	-
Material Handling	-	-	-	-	2.62	0.92	0.14	-	-
MOBILE SOURCES									
Maint/Ops/Emergency Equipment:									
Combustion	4.36	1.45	0.37	0.20	0.38	0.31	0.31	0.01	0.38
Trains:									
Combustion (Off-site)	23.3	10.18	0.80	0.036	0.60	0.50	0.48	0.11	0.60
Fugitive (Off-site)	-	-	-	-	1.03	0.88	0.13	-	-
Conbustion (on-site)	13.95	5.04	0.56	0.02	0.36	0.30	0.29	0.05	0.27
Combustion unloading trani (On-site)	7.43	3.24	0.26	1.15E-02	0.19	0.16	0.15	3.45E-02	0.19
Combustion Idle (On-site)	2.07	0.90	7.14E-02	3.20E-03	5.38E-02	4.42E-02	4.29E-02	9.62E-03	5.38E-02
Combustion Switching (On-site)	4.44	0.90	0.23	3.17E-03	0.11	9.43E-02	9.15E-02	9.53E-03	2.69E-02
Fugitive (On-site)	-	-	-	-	3.68	3.13	0.48	-	-
Ships:									
Combustion (Off-site)	24.8	37.9	14.10	3.04	2.17	1.78	1.64	0.03	0.00
Combustion (On-site)	23.3	65.9	15.32	4.52	1.27	1.05	1.02	0.08	0.56
Total - All Sources, Onsite and Offsite	89.8	120.5	31.1	7.81	20.4	13.3	5.17	0.28	1.82
Total - Onsite Sources	41.6	72.4	16.24	4.74	16.62	10.13	2.91	0.14	1.22
Fugitives Only	-	-	-	-	14.60	8.47	1.29	-	-
Facility Equipment Combustion Only	4.36	1.45	0.37	0.20	0.38	0.31	0.31	0.01	0.38
Mobile Combustion Sources Only	41.58	72.43	16.24	4.74	2.02	1.66	1.62	0.14	1.22

PM From Combustion (tpy):	TSP	PM_{10}	$PM_{2.5}$
Total - Offsite Combustion	2.77	2.28	2.13
Total - Onsite Combustion	1.85	1.52	1.48
Total - Combustion	4.62	3.80	3.61

Washington State Emissions in tons per year

2011 Emissions Inventory for Cowlitz County

Select Sources (full summary in separate worksheet)	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	DPM
Point Sources	3,616	2,507	671	791	-	182	172	-	-
Non-Road Mobile (Land-based, non-locomotive)	389	3,718	592	1	-	48	46	-	24
Railroad	789	137	43	6	-	23	23	-	23
Ships (commercial marine vessels)	1,109	150	46	199	-	37	34	-	34
Total All Source Categories	10,382	36,142	16,919	1,020	-	1,872	971	-	164

APPENDIX A3b

SUMMARY OF EMISSIONS

Based on:

1 metric tonne = 1.1023 ton (short ton)

Facility Material Handling System Rating

Materials Handling System/Train Unload:	7500	metric tonnes/hr	8267	tons/hr
Reclaim and Vessel Loading:	6500	metric tonnes/hr	7165	tons/hr

Projected Operation

Operating hours	365	days/yr
	Full Build-Out	
Coal Throughput	44	MM metric tons per year
	49	MM tpy
Unit Trains	8	trains/day
Cars per Unit Train	125	cars/train
Coal per Car	100	tons/car
Onsite Tracks	8	number of tracks
	840	ships/yr
tons of coal per ship	57,740	tons/vessel
Hours to Unload one unit train	1.85	hours

Latest assumption on number of cargo ships Handymax size to move the coal (also see URS resrouce report on rail and transport Dec 2014

Source	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2e
					Full Build-Out Pollutant Emissions (tpy)				
FUGITIVE SOURCES									
Coal Transfer (except piles):									
Material Handling	-	-	-	-	5.25	1.84	0.28	-	-
Coal Piles:									
Wind Erosion	-	-	-	-	3.05	2.59	0.40	-	-
Material Handling	-	-	-	-	2.62	0.92	0.14	-	-
					5.67	3.51	0.54		
MOBILE SOURCES									
Maint/OpS/Emergency Equipment:									
Combustion	4.36	1.43	0.37	0.20	0.38	0.31	0.31	0.01	1,000
Trains:									
Combustion (Off-site)	23.3	10.18	0.80	0.04	0.60	0.50	0.48	0.11	3,946
Fugitive (Off-site)	-	-	-	-	1.03	0.88	0.13	-	-
Combustion (On-site)	7.43	3.24	0.26	1.15E-02	1.93E-01	0.16	0.15	3.45E-02	1,257
Combustion Idle (On-site)	2.07	0.90	7.14E-02	3.20E-03	5.38E-02	4.42E-02	4.29E-02	9.62E-03	351
Combustion Switching (On-site)	4.44	0.90	0.23	3.17E-03	0.11	9.43E-02	9.15E-02	9.53E-03	344
Fugitive (On-site)	-	-	-	-	3.68	3.13	0.48	-	-
Ships: (for diesel PM this only includes tugs)									
Combustion (Off-site)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0
Combustion (On-site)	14	39	1.46	3.08	0.56	0.46	0.46	3.30E-02	5,335
Total - All Sources, Onsite and Offsite	56	55	3	3.33	23	14	3.51	0.20	12,232
Total - Onsite Sources	32.2	45.0	2.39	3.30	21.58	13.06	2.89	0.09	8,287
Fugitives Only	-	-	-	-	14.60	8.47	1.29	-	-
Facility Equipment Combusion Only	4.36	1.43	0.37	0.20	0.38	0.31	0.31	0.01	1,000
Mobile Combustion Sources Only	21.30	41.77	1.72	3.09	0.76	0.62	0.62	0.07	6,591.74

PM From Combustion (tpy):	TSP	PM_{10}	$PM_{2.5}$
Total - Offsite Combustion	0.60	0.50	0.48
Total - Onsite Combustion	1.14	0.94	0.93
Total - Combustion	1.74	1.43	1.41

Washington State Emissions in tons per year
2011 Emissions Inventory for Cowlitz County

Select Sources (full summary in separate worksheet)	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2e	DPM
Point Sources	3,616	2,507	671	791	-	182	172	-	-	-
Non-Road Mobile (Land-based, non-locomotive)	389	3,718	592	1	-	48	46	-	-	24
Railroad	789	137	43	6	-	23	23	-	-	23
Ships (commercial marine vessels)	1,109	150	46	199	-	37	34	-	-	34
Total All Source Categories	10,382	36,142	16,919	1,020	-	1,872	971	-	-	164

APPENDIX A4

PILE INFORMATION

Bulk Density of Coal: 817 kg/m3 min (PRB coal; source Description of Facilites, September 2011)
929 kg/m3 max

Pile Dimensions:

	average L (ft)	Sfc W (ft)	Sfc Acres	Peak H (ft)	Mean H (ft)
Pile 1	2350	233	12.57	85	25
Pile 2	2350	233	12.57	85	25
Pile 3	2350	233	12.57	85	25
Pile 4	2350	233	12.57	85	25

From Millennium Coal Export Terminal, Applicant's Purpose and Need Description, Dec 2013
Coal pads vary between 2200 to 2500 ft in length
85 approximate coal stack height

	metric tonne	ton	
Pile 1	367,000	404,548	*(Stage 1 and 2)*
Pile 2	394,000	434,311	*(Stage 1 and 2)*
Pile 3	375,000	413,367	*(Full Build-Out Only)*
Pile 4	368,000	405,651	*(Full Build-Out Only)*

1,504,000 metric tonnes, total storage capacity

	Full Build-Out	
Annual Coal Throughput:	48,501,697	tpy
Average Pile Turnovers/yr:	29	

Pile Throughput:

Pile 1	11,835,188	tpy
Pile 2	12,705,897	tpy
Pile 3	12,093,176	tpy
Pile 4	11,867,437	tpy

APPENDIX A5

PILE - WIND EROSION

(Methodology from AP-24, Section 13.2.5 and WRAP Fugitive Dust Handbook, Section 9.3)
Industrial Wind Erosion

Wind Erosion (emissions from pile activity are covered in Materials Handling (MH) section)
(Equation based on Western Regional Air Partnership [WRAP] Fugitive Dust Handbook, Section 9.3)

$$E(lbTSP/acre/yr) = 1.7 * \frac{s}{1.5} * \frac{365*(365-p)}{235} * \frac{f}{15} * r$$

Where:

s=	6.2	Silt Content, weight %. *(Mean value from EPA AP-42, Section 13.2.4, Table 13.2.4-1, Western Surface Coal Mining)*
p=	175	Number of Days with >= 0.01 inches of precipitation per year. (NCDC Climate Summary for Longview, 1931-2006.)
f=	8.78	Percentage of Time that the unobstructed wind speed exceeds 12 mph at mean pile height. *(Calculated from Weyerhaeuser Mint Farm Met Station Data, 2001-2003 (wind speed monitor at 10 meter height; mean pile height (by exposed area) ~ 25 ft*
r=		Particulate Matter Size Ratios (WRAP Fugitive Dust Handbook, Section 9.3).
	1	TSP
	0.85	PM10
	0.13	PM2.5

Uncontrolled Emission Rates:

TSP	1214	lb/acre/yr
PM10	1032	lb/acre/yr
PM2.5	158	lb/acre/yr

Controlled Emissions:

Control %: 90 *WRAP Fugitive Dust Handbook, Table 9-4, Watering.*

Exposed Pile Area	Acres
Pile 1	12.57
Pile 2	12.57
Pile 3	12.57
Pile 4	12.57

	Full Build-Out	
Total Area	50.28	acres

Total Controlled Emissions:		
Pollutant	Full Build-Out	
TSP	3.05	tpy
PM10	2.59	tpy
PM2.5	0.40	tpy

APPENDIX A6

MATERIAL HANDLING

Transfer Operations (Pile Construction, Pile Removal)

(Methodology from AP-24, Section 13.2.4)

Aggregate Handling and Storage Piles

$$E(lb/ton) = k * 0.0032 * \left\{ \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \right\}$$

Where:

k=		Aerodynamic Particle Size Multiplier.*(EPA AP-42 Section 13.2.4.)*
	1	TSP
	0.35	PM10
	0.053	PM2.5
U=	5.04	Mean Wind Speed, mph. *(Calculated from Weyerhaeuser Mint Farm Met Station Data, 2001-2003 (wind speed monitor at 10 meter*
M=	4.5	Material Moisture Content, percent. (Mean value from EPA AP-42, Section 13.2.4, Table 13.2.4-1, Coal-fired Power Plants (as received). This value fits range given in Description of Facilities, September 2011 (1-6% surface; 13-18% total).)

Uncontrolled Emission Rates:

TSP	1.04E-03	lb/ton
PM10	3.64E-04	lb/ton
PM2.5	5.51E-05	lb/ton

Controlled Emissions:

Control %: 90 *WRAP Fugitive Dust Handbook, Table 9-4, Watering.*

Natural Precipitation Mitigation Factor (365-P)/365 *EPA AP-42, Section 13.2.2*

P= 175 Number of Days with >= 0.01 inches of precipitation per year.*(NCDC Climate Summary for Longview, 1931-2006.)*

	Full Build-Out	
Annual Coal Throughput	48501697	tpy
Annual Coal Throughput x2 (pile construct and reclaim)	97003394	tpy

Total Controlled Emissions:

Pollutant	Full Build-Out	
TSP	2.62	tpy
PM10	0.92	tpy
PM2.5	0.14	tpy

All Other Coal Handling Operations (Transfers, Conveyors)

All enclosed operations with dry fogging. Equipment is cleaned using a wet scraping technique; assumed cleaning particulate emissions are zer

Uncontrolled Emission Rates (same methodology as above)

TSP	1.04E-03	lb/ton
PM10	3.64E-04	lb/ton
PM2.5	5.51E-05	lb/ton

Controlled Emissions:

Control %: 95 Changed from 99%. (ICF) This reduced efficiency is consistent with a similar proposed facility in

Natural Precipitation Mitigation Factor (365-P)/365 *EPA AP-42, Section 13.2.2*

P= 175 Number of Days with >= 0.01 inches of precipitation per year. (NCDC Climate Summary for Longview, 1931-2006.

	Full Build-Out	
Annual Coal Throughput	48501697	tpy

Emission/Transfer Points:

Rail Dump	1
Transfer Tower 1	1
Transfer Towers 2-4	1
Transfer Towers 5-7	1
Surge Bin (WP9)	1
Surge Bin (WP10)	1
Transfer Tower 8	1
Conveyor to Ship	1

Total Controlled Emissions:

Pollutant	Full Build-Out	
TSP	5.25	tpy
PM10	1.84	tpy
PM2.5	0.28	tpy

APPENDIX A7

COAL CAR FUGITIVE EMISSIONS

(Methodology from AP-24, Section 13.2.5 and WRAP Fugitive Dust Handbook, Section 9.3)
Industrial Wind Erosion

Wind-related losses from Train Transport of Open Coal Cars
(Equation based on WRAP Fugitive Dust Handbook, Section 9.3))

$$E(lbTSP/acre/yr) = 1.7 * \frac{s}{1.5} * \frac{365*(365-p)}{235} * \frac{f}{15} * r$$

Where:

s=	6.2	Silt Content, weight %. *(Mean value from EPA AP-42, Section 13.2.4, Table 13.2.4-1, Western Surface Coal Mining,*
p=	175	Number of Days with >= 0.01 inches of precipitation per year. *(Calculated from Weyerhaeuser Mint Farm Met Station Data, 2001-2003. (Note: AP-42 Figure 13.2.2-1 shows 180 days, and NCDC Climate data indicates ~ 177 days.))*
f (moving train)=	100	Percentage of Time that the unobstructed wind speed exceeds 12 mph at mean pile height. *(Assumed 100% of time for moving train.)*
f (sitting train)=	8.78	Percentage of Time that the unobstructed wind speed exceeds 12 mph at mean 'pile' height. *(Calculated from Weyerhaeuser Mint Farm Met Station Data, 2001-2003 (wind speed monitor at 10 meter height; train car height with coal load = ~15 ft (4.6 m).)*
r=		Particulate Matter Size Ratios (WRAP Fugitive Dust Handbook, Section 9.3).
	1	TSP
	0.85	PM10
	0.13	PM2.5

Uncontrolled Emission Rates for Moving Trains:

TSP	13824	lb/acre/yr
PM10	11750	lb/acre/yr
PM2.5	1797	lb/acre/yr

Uncontrolled Emission Rates for Sitting Trains:

TSP	1214	lb/acre/yr
PM10	1032	lb/acre/yr
PM2.5	158	lb/acre/yr

Train car exposed surface area:	518	ft2
Area/coal amount (by 1 car):	4.24	ft2/ton coal

	Full Build-Out	
Annual Coal Throughput:	48501697	tpy
Coal/car:	122.1	tons
Cars/train:	125	cars
Total Exposed Area:	4720	acres

Off-site	Full Build-Out	
Distance from main rail line to site:	7.10	miles
Time Moving Car Exposed:	0.71	hrs

Surfactant Efficiency Factor (control) 0.61 (Based on Cowlitz County monitoring study from moving coal trains prior to Pasco surfacta

---

Offsite Emissions:

Pollutant	Full Build-Out	
TSP	1.03	tpy
PM10	0.88	tpy
PM2.5	0.13	tpy

On-site	Full Build-Out		
Onsite loop distance:	1.65	miles	
Dumper facility loop:	13236	ft	Drawing 80552-500-ST-DAL-2019-00-RevA.pdf, WorleyParsons
	2.51	miles	
Total onsite distance for transport:	4.16	miles	Includes only loaded travel; assumes full cars for complete staging loop and dump loop distances.
Train Speed:	2	mph	
Time Moving Car Exposed:	2.25	hrs	
Time Moving Car Exposed:	2.25	hrs	Heyl & Patterson, Martin Engineering (coal dumper and chute mnftrs), BNSI
Unloading Time:	1.85	hrs	Railway [total time]; apply a conservative estimate for time waiting to unloa
Time Sitting Car Exposed:	3.18	hrs	Assume time of exposure during unloading is only 1/2 of tota unloading time.

Onsite Emissions:

Pollutant	Full Build-Out	
TSP	3.68	tpy
PM10	3.13	tpy
PM2.5	0.48	tpy

APPENDIX A8a

LOCOMOTIVE EMISSIONS - Moving and Unloading

	Full Build-Out		
Coal Throughput	48501697	tons/yr	='D:\Documents\millineum\URS Air Qualty Studies for Millineum Coal Terminal\January 2015 appx L\[4 - Air Quality Appendix L-Mod ICF.xlsx]Operations Summary (ICF)'!C
Coal/car	122.1	tons	'='D:\Documents\millineum\URS Air Qualty Studies for Millineum Coal Terminal\January 2015 appx L\[4 - Air Quality Appendix L-Mod ICF.xlsx]Operations Summary (ICF)'!!
Unit Trains (cars/train)	125	cars	'='D:\Documents\millineum\URS Air Qualty Studies for Millineum Coal Terminal\January 2015 appx L\[4 - Air Quality Appendix L-Mod ICF.xlsx]Operations Summary (ICF)'!!
Unit Trains Required	2920	Trains/yr	
	4	Locomotives/Train (full)	
	4	Locomotives/Train (empty)	
Engine Size:	4400	hp/locomotive	*Electro-Motive Diesel, GE Transportation* (http://www.getransportation.com/locomotives/locomotives/ac4400-and-dash-series-locomotives); GE AC4400CW (4400hp) or ElectroMotive Diesel SD70Ace (4300hp). Also consistent with DKS traffic analysis
Locomotive Fuel Use:	20.8	bhp-hr/gal	(conversion for large line-haul locomotive, *Emission Factors for Locomotives, EPA, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009*.)

Fuel Use per Train — Full Build-Out

ON SITE			
Loaded Train:	4.6%	Percent Load	Notch 1 setting and associatedd load @ 6 mph (202 hp) based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004
	809.6	hp	
	39	gallons/hr	
Idle Train:	0.25%	Percent Load	Idle setting and associated load (11 hp) @idle based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004
	44	hp	
	2	gallons/hr	
OFF SITE			
Loaded Train:	9.9%	Percent Load	Notch 2 setting and associatedd load @ 12 mph (435 hp) based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004
	1742.4	hp	
	84	gallons/hr	
Empty Train:	9.9%	Percent Load	Assume same notch 2 setting as loaded (conservative)
	1742.4	hp	
	84	gallons/hr	

Longview Short Line (Longview Switching Company (LSC) Track

Offsite			
Distance from Main Rail Line to Site:	7.10	miles	distance from GIS drawings per Danny Stratten (ICF) Feb 2014
Travel Time to Site:	0.71	hrs	DKS travel speed average of 10 mph
Total Power:	7224687	hp-hr/yr	
Total Fuel Use:	347341	gallons/yr	
Onsite			
Onsite loop distance:	8727	ft	Per train average loop distance (Drawings 80552-500-GE-DLP-0020_RevA.pdf and 80552-500-ST-DAL-2019-00-RevA.pdf, WorleyParsons)
Travel Distance:	1.65	miles	(one loop onsite; does not include dump track time which is operated by electric indexing system
Time per Train:	1.85	hours	time needed to unload the coal from 125 cars
Total Power:	2300739	hp-hr/yr	
Total Fuel Use:	110612	gallons/yr	
Total Fuel Use (On and Offsite)	457953	gallons/yr	

Emission Factors (2028 full operation)

	NOx	CO	VOC	SO2	TSP	PM10	PM2.5	HAPS	CO2	CH4	N2O	CO2e
2028 National Locomotive Fleet Avera (g/gal)	61	26.6	2.1	0.094	1.58	1.3	1.26	0.28	10217	0.80	0.26	10314

Sources:
[1] NOx, CO, VOC, SO2, PM10, PM2.5 2025 emission factors from: *Emission Factors for Locomotives*, EPA, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009. Table 5,6,7, Line-Haul Emission Factors. From text: $PM_{2.5} = 0.97 * PM_{10}$.
[2] SO2 emission factor using S content of 15 ppm
[3] TSP emission factor from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Based on ratio of total particulate to PM10 in diesel engines, as given in Table 3.4-2
[4] HAP emission factor from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Total HAPs from Tables 3.4-3 and 3.4-4, sum of HAPs as indicated by footnote b. For diesel fuel: 7000 Btu/hp-h
[5] *Direct Emissions from Mobile Combustion Sources*, EPA, Office of Air and Radiation, EPA-430-K-08-004, May 2008. N_2O and CH_4 from Table A-6.
[6] Global Warming Potentials (GWPs): CO_2 - 1, CH_4 - 25, N_2O - 298

Emission Rates (tpy)

Full Build-Out	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Offsite	23	10.2	0.80	0.04	0.60	0.50	0.48	0.11	3908	0.31	0.10	3946
Onsite	7	3.2	0.26	0.01	0.19	0.16	0.15	0.03	1245	0.10	0.03	1257
Total	31	13.4	1.06	0.05	0.80	0.66	0.64	0.14	5153	0.40	0.13	5202

APPENDIX A8b

LOCOMOTIVE EMISSIONS - Trains waiting to leave (on-site) 5 hours

		Full Build-Out		
Coal Throughput		48501697	tons/yr	='D:\Documents\millineum\URS Air Qualty Studies for Millineum Coal Terminal\January 2015 appx L\[4 - Air Quality Appendix L-Mod ICF.xlsx]Operations Summary (ICF)'!C17*1000000
Coal/car		122.1	tons	'='D:\Documents\millineum\URS Air Qualty Studies for Millineum Coal Terminal\January 2015 appx L\[4 - Air Quality Appendix L-Mod ICF.xlsx]Operations Summary (ICF)'!C20
Unit Trains (cars/train)		125	cars	'='D:\Documents\millineum\URS Air Qualty Studies for Millineum Coal Terminal\January 2015 appx L\[4 - Air Quality Appendix L-Mod ICF.xlsx]Operations Summary (ICF)'!C19
Unit Trains Required		2920	Trains/yr	
		4	Locomotives/Train (full)	
		4	Locomotives/Train (empty)	
	Engine Size:	4400	hp/locomotive	*Electro-Motive Diesel, GE Transportation* (http://www.getransportation.com/locomotives/locomotives/ac4400-and-dash-series-locomotives); GE AC4400CW (4400hp) or ElectroMotive Diesel SD70Ace (4300hp). Also consistent with DKS traffic analysis
	Locomotive Fuel Use:	20.8	bhp-hr/gal	(conversion for large line-haul locomotive, *Emission Factors for Locomotives, EPA, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009*.)
Fuel Use per Train		Full Build-Out		
ON SITE				
	Idle Train:	0.25%	Percent Load	Idle setting and associated load (11 hp) @idle based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004)
		44	hp	
		2	gallons/hr	
Onsite				
	Time per Train:	5.00	hours	time idling
	Total Power:	642400	hp-hr/yr	
	Total Fuel Use:	30885	gallons/yr	
Total Fuel Use (Onsite, idle)		30885	gallons/yr	

Emission Factors (2028 full operation)

	NOx	CO	VOC	SO2	TSP	PM10	PM2.5	**HAPS**	**CO2**	**CH4**	**N2O**	**CO2e**
2028 National Locomotive Fleet Avera (g/gal)	61	26.6	2.1	0.094	1.58	1.3	1.26	0.28	10217	0.80	0.26	10314

Sources:
[1] NOx, CO, VOC, SO2, PM10, PM2.5 2025 emission factors from: *Emission Factors for Locomotives*, EPA, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009. Table 5,6,7, Line-Haul Emission Factors. From text: $PM_{2.5}$ = 0.97* PM_{10}.
[2] SO2 emission factor using S content of 15 ppm
[3] TSP emission factor from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Based on ratio of total particulate to PM10 in diesel engines, as given in Table 3.4-2.
[4] HAP emission factor from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Total HAPs from Tables 3.4-3 and 3.4-4, sum of HAPs as indicated by footnote b. For diesel fuel: 7000 Btu/hp-hr.
[5] *Direct Emissions from Mobile Combustion Sources*, EPA, Office of Air and Radiation, EPA-430-K-08-004, May 2008. N_2O and CH_4 from Table A-6.
[6] Global Warming Potentials (GWPs): CO_2 - 1, CH_4 - 25, N_2O - 298

Emission Rates (tpy)

Full Build-Out	**NO_x**	**CO**	**VOC**	**SO_2**	**TSP**	**PM_{10}**	**$PM_{2.5}$**	**HAPS**	**CO2**	**CH4**	**N2O**	**CO2e**
Onsite	2	0.9	0.07	0.00	0.05	0.04	0.04	0.01	348	0.03	0.01	351
Total	2	0.9	0.07	0.00	0.05	0.04	0.04	0.01	348	0.03	0.01	351

APPENDIX A8c

SWITCH LOCOMOTIVE EMISSIONS

	Full Build-Out	
Days/year	365	Trains/yr
Hours/day	8	hours
	1	Locomotives/Train (empty)

Engine Size:	4400	hp/locomotive	*Electro-Motive Diesel, GE Transportation* (http://www.getransportation.com/locomotives/ac4400-and-dash-series-locomotives); GE AC4400CW (4400hp) or ElectroMotive Diesel SD70Ace (4300hp). Also consistent with DKS traffic analysis
Locomotive Fuel Use:	20.8	bhp-hr/gal	(conversion for large line-haul locomotive, *Emission Factors for Locomotives, EPA, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009*.)

Fuel Use per Train	Full Build-Out		
ON SITE			
Loaded Train:	4.6%	Percent Load	Notch 1 setting and associatedd load @ 6 mph (202 hp) based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004)
	1619.2	hp	
	78	gallons/hr	
Idle Train:	0.25%	Percent Load	Idle setting and associated load (11 hp) @idle based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004)
	11	hp	
	1	gallons/hr	
Empty Train:	9.9%	Percent Load	Assume same notch 2 setting as loaded (conservative)
	435.6	hp	
	21	gallons/hr	

Emission Factors (2028 full operation) — g/gal

	NOx	CO	VOC	SO2	TSP	PM10	PM2.5	HAPS	CO2	CH4	N2O	CO2e
2028 National Locomotive Fleet Avera (g/gal)	61	26.6	2.1	0.094	1.58	1.3	1.26	0.28	10217	0.80	0.26	10314
2028 Large Switch (g/gal)	132	26.6	6.9	0.094	3.41	2.8	2.72	0.28	10217	0.80	0.26	10314

Sources:

[1] NOx, CO, VOC, SO2, PM10, PM2.5 2028 emission factors from: *Emission Factors for Locomotives*, EPA, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009. Table 5,6,7, Line-Haul Emission Factors. From text: $PM_{2.5}$ = 0.97* PM_{10}.

[2] SO2 emission factor using S content of 15 ppm

[3] TSP emission factor from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Based on ratio of total particulate to PM10 in diesel engines, as given in Table 3.4-2.

[4] HAP emission factor from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Total HAPs from Tables 3.4-3 and 3.4-4, sum of HAPs as indicated by footnote b. For diesel fuel: 7000 Btu/hp-hr.

[5] *Direct Emissions from Mobile Combustion Sources*, EPA, Office of Air and Radiation, EPA-430-K-08-004, May 2008. N_2O and CH_4 from Table A-6.

[6] Global Warming Potentials (GWPs): CO_2 - 1, CH_4 - 25, N_2O - 298

Emission Rates (tpy)

Full Build-Out	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Switch - Move (50%)	0.11	2.26E-02	5.87E-03	7.99E-05	2.90E-03	2.38E-03	2.31E-03	2.41E-04	8.69	6.80E-04	2.21E-04	8.77
Switch - Idle (50%)	4.44	0.90	0.23	3.17E-03	0.11	9.43E-02	9.15E-02	9.53E-03	344.04	2.69E-02	8.76E-03	347.33
Total	4.56	0.92	0.24	3.25E-03	0.12	9.67E-02	9.38E-02	9.77E-03	353	2.76E-02	8.98E-03	356

APPENDIX A8d

LOCOMOTIVE EMISSIONS Emissions in Washington State Except Cowlitz County

Locomotive Fuel Use: 20.8 bhp-hr/gal (conversion for large line-haul locomotive, *Emission Factors for Locomotives, EPA, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009.*)

Fuel Consumption

31,470,397 gallons 2028 fully operational (consistent with GHG analysis **for total train fuel consumption within state (diesel) other than in Cowlitz county per GHG report/analysis based on 402 miles inbound and 490.2 miles outbound**

1,386,221 gallons **additional fuel consumption within Cowlitz County main line (17.9 miles in bound to Longview Jct; 21.4 miles outbound from Longview Jct to north county line)**

total 32,856,619 gallons

Factors

453.6 grams per lb

2000 lb per ton

Emission Factors (2028 full operation)

	NOx	CO	VOC	SO2	TSP	PM10	PM2.5	**HAPS**	**CO2**	**CH4**	**N2O**	**CO2e**
2028 National Locomotive Fleet Average (g/gal)	61	26.6	2.1	0.094	1.58	1.3	1.26	0.28	10217	0.80	0.26	10314

Sources:

[1] NOx, CO, VOC, SO2, PM10, PM2.5 2025 emission factors from: *Emission Factors for Locomotives*, EPA, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009. Table 5,6,7, Line-Haul Emission Factors. From text: $PM_{2.5}$ = 0.97* PM_{10}.

[2] SO2 emission factor using S content of 15 ppm

[3] TSP emission factor from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Based on ratio of total particulate to PM10 in diesel engines, as given in Table 3.4-2

[4] HAP emission factor from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Total HAPs from Tables 3.4-3 and 3.4-4, sum of HAPs as indicated by footnote b. For diesel fuel: 7000 Btu/hp-hr

[5] *Direct Emissions from Mobile Combustion Sources*, EPA, Office of Air and Radiation, EPA-430-K-08-004, May 2008. N_2O and CH_4 from Table A-6.

[6] Global Warming Potentials (GWPs): CO_2 - 1; CH_4 - 25; N_2O - 298

Emission Rates (tpy)

Full Build-Out	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Offsite	2,209	963	76	3	57	47	45.7	10.25	370035	29.0	9	373,565.85

APPENDIX A8e

LOCOMOTIVE EMISSIONS (No Action Alternative)

	Full Build-Out		
Coal Moved	2,673,990	tons/yr	
Coal/car	122.1	tons	'='D:\Documents\millineum\URS Air Qualty Studies for Millineum Coal Terminal\January 2015 appx L\[4 - Air Quality Appendix L-Mod ICF.xlsx]Operations Summary (ICF)'!C
Unit Trains (cars/train)	30	cars	Same assumption as Noise Study
30-car Trains Required	730	Trains/yr	
	2	Locomotives/Train (full)	
	2	Locomotives/Train (empty)	
Engine Size:	4400	hp/locomotive	*Electro-Motive Diesel, GE Transportation* (http://www.getransportation.com/locomotives/locomotives/ac4400-and-dash-series-locomotives); GE AC4400CW (4400hp) or ElectroMotive Diesel SD70Ace (4300hp). Also consistent with DKS traffic analysis
Locomotive Fuel Use:	20.8	bhp-hr/gal	(conversion for large line-haul locomotive, *Emission Factors for Locomotives, EPA, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009*.)

Fuel Use per Train	Full Build-Out		
ON SITE			
Loaded Train:	4.6%	Percent Load	Notch 1 setting and associatedd load @ 6 mph (202 hp) based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004)
	404.8	hp	
	19	gallons/hr	
Idle Train:	0.25%	Percent Load	Idle setting and associated load (11 hp) @idle based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004)
	22	hp	
	1.1	gallons/hr	
OFF SITE			
Loaded Train:	9.9%	Percent Load	Notch 2 setting and associatedd load @ 12 mph (435 hp) based on data from CARB Roseville Railyard Study for 4300 HP loco engine (October, 2004)
	871.2	hp	
	42	gallons/hr	
Empty Train:	9.9%	Percent Load	Assume same notch 2 setting as loaded (conservative)
	871.2	hp	
	42	gallons/hr	

Longview Short Line (Longview Switching Company (LSC) Track)

Offsite			
Distance from Main Rail Line to Site:	7.10	miles	distance from GIS drawings per Danny Stratten (ICF) Feb 2014
Travel Time to Site:	0.71	hrs	DKS travel speed average of 10 mph
Total Power:	903086	hp-hr/yr	
Total Fuel Use:	43418	gallons/yr	
Onsite			
Time per Train:	0.44	hours	time needed to unload the coal from 125 cars under action is 1.85 hours, assume 30/125 *1.85 = 0.444 hours to unload No Action coal train
Total Power:	68544	hp-hr/yr	
Total Fuel Use:	3295	gallons/yr	
Total Fuel Use (On and Offsite)	46713	gallons/yr	

Emission Factors (2028 full operation)

	NOx	CO	VOC	SO2	TSP	PM10	PM2.5	HAPS	CO2	CH4	N2O	CO2e
2028 National Locomotive Fleet Avera (g/gal)	61	26.6	2.1	0.094	1.58	1.3	1.26	0.28	10217	0.80	0.26	10314

Sources:

[1] NOx, CO, VOC, SO2, PM10, PM2.5 2025 emission factors from: *Emission Factors for Locomotives*, EPA, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009. Table 5,6,7, Line-Haul Emission Factors. From text: $PM_{2.5} = 0.97 * PM_{10}$.

[2] SO2 emission factor using S content of 15 ppm

[3] TSP emission factor from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Based on ratio of total particulate to PM10 in diesel engines, as given in Table 3.4-2.

[4] HAP emission factor from: *EPA AP-42, Section 3.4 Large Stationary Diesel and All Stationary Duel-fuel Engines* (10/96). Total HAPs from Tables 3.4-3 and 3.4-4, sum of HAPs as indicated by footnote b. For diesel fuel: 7000 Btu/hp-hr.

[5] *Direct Emissions from Mobile Combustion Sources*, EPA, Office of Air and Radiation, EPA-430-K-08-004, May 2008. N_2O and CH_4 from Table A-6.

[6] Global Warming Potentials (GWPs): CO_2 - 1, CH_4 - 25, N_2O - 298

Emission Rates (tpy)

Full Build-Out	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Offsite	3	1.3	0.10	0.004	0.08	0.06	0.06	0.01	489	0.04	0.01	493
Onsite	0	0.1	0.01	0.000	0.01	0.00	0.00	0.00	37	0.00	0.00	37
Total	3.14	1.4	0.11	0.005	0.08	0.07	0.06	0.01	526	0.04	0.01	531

APPENDIX A9a

CARGO VESSEL EMISSIONS

Tugs/Ship	3		(Conservative estimate)
Tug Engine Size (propulsion)	4000	hp	
Tug Positioning Time	3	hrs/ship (in-out)	(Conservative estimate)
Tug Load Factor (Manuvering)	31%	Percent Load	(Engine load factor for Assist Tugs, from Port of Long Beach Air Emissions Inventory - 2011 (POLB, July 2012).)
Panamax Size Engine	16368	hp	
Handymax Size Engine	10153	hp	
Panamax auxillary engine size	3039	hp	
Handymax Auxilliary Engine Size	1885	hp	
Main Engine Load (loaded in transit)	37%	Percent Load	Main Engine Load (manuvering) 2% Percent Load*
Main Engine Load (unloaded in transit)	37%	Percent Load	
Auxillary Engine Load (transit)	17%	Percent Load	Auxillary Engine Load (manuvering) 45% Percent Load
Number of ship call in 2028	840		
Percent of calls by Panamax	80	percent	
Percent of call by Handymax	20	percent	
Ship Berth Time ((Hoteling)	13	hrs	
Main Ship (Manuvering)	1.0	hrs	
Trannsit Time within Cowlitz county	0.90	hrs	Lower bound speeds in the open reaches of the Columbia River Channel are 12 knots, somewhat slower speeds when fully loaded (assumed 10 knots). See: Marine Traffic Technical Report, Feb 2015 , pages 37 and page 49.

On-site Full Operation (2028)

Coal Throughput		48,501,697	tons/yr	
Ships/yr (Panamax)		672	number	
	Annual Power (aux eng)	3,574,005	hp-hrs/yr	0.1 %S Marine Distillate Fuel (2015 onward)
	Annual Power (main eng)	219,987	hp-hrs/yr	0.1 %S Marine Distillate Fuel
Ships/yr (Handymax)		168	number	
	Annual Power (aux eng)	554,302	hp-hrs/yr	0.1 %S Marine Distillate Fuel
	Annual Power (main eng)	34,115	hp-hrs/yr	0.1 %S Marine Distillate Fuel (or 1000 ppm)
Tugs/yr		2,520	number	
	Annual Power	9,374,400	hp-hrs/yr	diesel low sulfur (15 ppm S)

Off-site

Ships/yr (Panamax)				
	Annual Power (main)	7,363,914	hp-hrs/yr	0.1 %S Marine Distillate Fuel
	(aux)	628,211		
Ships/yr (Handymax)				
	Annual Power (main)	1,141,964	hp-hrs/yr	0.1 %S Marine Distillate Fuel (or 1000 ppm)
	(aux)	97,431		

Emission Factors

	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Maine Engine Manuvering (g/KW-hr)	3.4	5.0	2.0	0.40	0.3041	0.25	0.23	0.00428	588	0.07	0.0004	590
Maine Engine Manuvering (lb/hp-hr))	0.006	0.00822	0.003	0.001	0.000500	0.000411	0.000378	0.000007	0.967	0.0001151	0.0000007	0.970
Aux Engine T4 Transit, Manuver , Hotel (g/KW-hr)	1.8	5.0	0.19	0.40	0.073	0.060	0.060	0.004	690.0	0.09	0.0004	692
Aux Engine T4 Transit, Manuver , Hotel (lb/hp-hr))	0.0030	0.0082	0.0003	0.0007	0.0001	0.0001	0.0001	0.00001	1.13	0.00015	0.00000	1.14
Main Engine Transit Mode (g/KW-hr)	3.4	5.0	2.0	0.40	0.3041	0.25	0.23	0.00428	588	0.07	0.0004	590
Main Engine Transit Mode (lb/hp-hr)	0.006	0.00822	0.00329	0.00066	0.00050	0.00041	0.00038	0.00001	0.967	0.000115	0.000001	0.970
Tug (Tier 4 compliant post 2016) (g/kW-hr)	1.8	5.0	0.19	0.40	0.073	0.060	0.060	0.004	690.0	0.09	0.0004	692
Tug (Tier 4 compliant post 2016) (lb/bhp-hr)	0.003	0.00822	0.00031	0.00066	0.00012	0.00010	0.00010	0.000007	1.13	0.00015	0.00000	1.14

Source:
ARB, 2011a. Initial Statement of Reasons for Proposed Rulemaking, Proposed Amendments to the Regulations “Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Bas
Appendix D, Emission Estimation Methodology for Ocean Going Vessels, May 2011. Tables II-6, II-7 (main engines) and Table II-8 Auxilary Engine only for PM10, PM2.5 and CO2;
Other Emissions Factros from USEPA Marine Compression Ignition Exhaust Emission Standards for highest Tier engines (auxillary and Tugs C2; main engine C3) all standars fully impletemented by 2016 assume all engines by 2028 comply with these sta
For C3 engines assume lowest engine speed which corresponds with highest emission rate See: http://www.epa.gov/otaq/standards/nonroad/marineci.htm

HAP Emission factors from: *EPA AP-42, Section 3.4;* Sum of HAPs factors from Table 3.4-3 and 3.4-4.
Global Warming Potentials (GWPs): CO_2 - 1
CH_4 - 25
N_2O - 298

Travel Distance:

Ship Miles 11.35 miles Travel distance from berth site in Longview, west along Columbia River to Cowlitz County line (one-way

Emission Rates (tpy)

	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
2028 Operational Emissions Marine Vessels												
Ships (Cargo and Tugs) - (Onsite)	23	66	15.3	4.5	1.3	1.0	1.0	0.08	8062	1.0	0.0047	8089
Ships (cargo transit) - (Offsite)	25	38	14.1	3.0	2.2	1.8	1.6	0.03	4523	0.5	0.0030	4537
Total	48	104	29.4	7.6	3.4	2.8	2.7	0.11	12584	1.6	0.01	12627

Table II-5: OGV Auxiliary Engine Load Characteristics (percent load)
Bulk Carrier/General Cargo
Load Factor (%)

Hoteling	10%
Maneuvering	45%
Transit	17%

ARB, 2011a. Initial Statement of Reasons for Proposed Rulemaking, Proposed Amendments to the Regulations “Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baseline” Appendix D, Emission Estimation Methodology for Ocean Going Vessels, May 2011.
Data http://www.arb.ca.gov/msei/categories.htm#ogv_category

Load Factors for Main Engine based on Propeller Law Equation assuming 11 knots transit in river and 4 kno

Engine	Cruise	Transit	Maneuver
Propulsion	83%	37%	2%

At full cruise engines run at 83% of capacity with maximum speed of 15.3 knots
Propeller equation **$LF = (AS/MS)^3$**
where **LF** = Load Factor (percent)
AS = Actual Speed (knots)
MS = Maximum Speed (knots)

* Need to apply low load adjustment factor to main engine manuvering
Low load adjustment factor for low load manuvering

Auxillary Engine Load (hoteling) 10% Percent Load

Classification	DWT Range	Main Engine (kW)	Auxiliary Engine (kW)	Main Engine (hp)	Auxiliary Engine (kW)
HandyMax	40,000 - 60,000	7577	1407	10153.18	1885.38
PanaMax	60,000 - 100,000	12215	2268	16368.1	3039.12

Source: Sea-Web (http://www.sea-web.com)
The sea-web data is produced by IHS Global Limited, headquartered in Bracknell, England. The data is based on Lloyd’s Register of Ships Sea-ewb provided shi characteristics c
Based on the ships currently in service (2014) that have stopped at US ports.

Low Speed Adjustment for Main Engine During Ship Manuvering
Based on the Propeller law used to estimate shps propulsion loads, based on law that the propulsion power varies by the cube of the speed. Transit speed was assumed to average 11 knots and maneuver speed 4 knots.

		NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2
	2% load	54.8	41.9	23.6			2.34			2853.6
	20% load	11.9	4.2	0.7			0.32			869.1
Adjustment	Ratio Increase	4.6	10	31.6	1	7.29	7.29	7.29	31.62	3.28

Pollutant	Exponent (x)	ntercept (b)	efficient (a)
PM	1.5	0.2551	0.0059
NOx	1.5	10.4496	0.1255
CO	1	0	0.8378
HC	1.5	0	0.0667
SO2			2.3735
CO2	1	648.6	44.1

SO2: only applies to fuel sulfur flow no adjustment for low loads

Slow speed adjustment Ratio of emision rates at 20% load to manuvering Load 2%
emission rate (g/kW-hr) = a (fractional load)^-x + b

Source: USEPA, 2000. US Environmental Protection Agency, Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data, February, 2000, EPA420-R-00-002.

APPENDIX A9b

CARGO VESSEL EMISSIONS

Tugs/Ship	3		(Conservative estimate)
Tug Engine Size (propulsion)	4000	hp	
Tug Positioning Time	3	hrs/ship (in-out)	(Conservative estimate)
Tug Load Factor (Manuvering)	31%	Percent Load	(Engine load factor for Assist Tugs, from Port of Long Beach Air Emissions Inventory - 2011 (POLB, July 2012).)
Panamax Size Engine		hp	
Handymax Size Engine		hp	
Panamax auxillary engine size		hp	
Handymax Auxilliary Engine Size		hp	
Main Engine Load (loaded in transit)		Percent Load	Main Engine Load (manuvering) 2% Percent Load*
Main Engine Load (unloaded in transit)		Percent Load	
Auxillary Engine Load (transit)	17%	Percent Load	Auxillary Engine Load (manuvering) 45% Percent Load
Number of ship call in 2028	840		
Percent of calls by Panamax	80	percent	
Percent of call by Handymax	20	percent	
Ship Berth Time ((Hoteling)	13	hrs	
Main Ship (Manuvering)	1.0	hrs	
Trannsit Time within Cowlitz county	0.90	hrs	Lower bound speeds in the open reaches of the Columbia River Channel are 12 knots, somewhat slower speeds when fully loaded (assumed 10 knots). See: Marine Traffic Technical Report, Feb 2015 , pages 37 and page 49.

On-site		Full Operation (2028)		
Coal Throughput		48,501,697	tons/yr	
Ships/yr (Panamax)			number	
	Annual Power (aux eng)		hp-hrs/yr	0.1 %S Marine Distillate Fuel (2015 onward)
	Annual Power (main eng)		hp-hrs/yr	0.1 %S Marine Distillate Fuel
Ships/yr (Handymax)			number	
	Annual Power (aux eng)		hp-hrs/yr	0.1 %S Marine Distillate Fuel
	Annual Power (main eng)		hp-hrs/yr	0.1 %S Marine Distillate Fuel (or 1000 ppm)
Tugs/yr		2,520	number	
	Annual Power	9,374,400	hp-hrs/yr	diesel low sulfur (15 ppm S)
Off-site				
Ships/yr (Panamax)				
	Annual Power (main)	-	hp-hrs/yr	0.1 %S Marine Distillate Fuel
	(aux)	-		
Ships/yr (Handymax)				
	Annual Power (main)	-	hp-hrs/yr	0.1 %S Marine Distillate Fuel (or 1000 ppm)
	(aux)	-		

Emission Factors

	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Maine Engine Manuvering (g/KW-hr)	3.4	5.0	2.0	0.40	0.3041	0.25	0.23	0.00428	588	0.07	0.0004	590
Maine Engine Manuvering (lb/hp-hr))	0.006	0.008	0.003	0.001	0.000500	0.000411	0.000378	0.000007	0.967	0.0001151	0.0000007	0.970
Aux Engine T4 Transit, Manuver , Hotel (g/KW-hr)	1.8	5.0	0.19	0.40	0.073	0.060	0.060	0.004	690.0	0.09	0.0004	692
Aux Engine T4 Transit, Manuver , Hotel (lb/hp-hr))	0.0030	0.0082	0.0003	0.0007	0.0001	0.0001	0.0001	0.00001	1.13	0.00015	0.00000	1.14
Main Engine Transit Mode (g/KW-hr)	3.4	5.0	2.0	0.40	0.3041	0.25	0.23	0.00428	588	0.07	0.0004	590
Main Engine Transit Mode (lb/hp-hr)	0.006	0.00822	0.00329	0.00066	0.00050	0.00041	0.00038	0.00001	0.967	0.000115	0.000001	0.970
Tug (Tier 4 compliant post 2016) (g/kW-hr)	1.8	5.0	0.19	0.40	0.073	0.060	0.060	0.004	690.0	0.09	0.0004	692
Tug (Tier 4 compliant post 2016) (lb/bhp-hr)	0.003	0.00822	0.00031	0.00066	0.00012	0.00010	0.00010	0.000007	1.13	0.00015	0.00000	1.14

Source:
ARB, 2011a. Initial Statement of Reasons for Proposed Rulemaking, Proposed Amendments to the Regulations “Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baselin
Appendix D, Emission Estimation Methodology for Ocean Going Vessels, May 2011. Tables II-6, II-7 (main engines) and Table II-8 Auxilary Engine only for PM10, PM2.5 and CO2;
Other Emissions Factros from USEPA Marine Compression Ignition Exhaust Emission Standards for highest Tier engines (auxillary and Tugs C2; main engine C3) all standars fully impletemented by 2016 assume all engines by 2028 comply with these standar
For C3 engines assume lowest engine speed which corresponds with highest emission rate See: http://www.epa.gov/otaq/standards/nonroad/marineci.htm

HAP Emission factors from: *EPA AP-42, Section 3.4;* Sum of HAPs factors from Table 3.4-3 and 3.4-4.
Global Warming Potentials (GWPs): CO_2 - 1
CH_4 - 25
N_2O - 298

Travel Distance:

Ship Miles 11.35 miles — Travel distance from berth site in Longview, west along Columbia River to Cowlitz County line (one-way)

Emission Rates (tpy)

	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
2028 Operational Emissions Marine Vessels												
Ships (Cargo and Tugs) - (Onsite)	14	39	1.5	3.1	0.6	0.5	0.5	0.03	5317	0.7	0.0031	5335
Ships (cargo transit) - (Offsite)	0	0	0.0	0.0	0.0	0.0	0.0	0.00	0	0.0	0.0000	0
Total	14	39	1.5	3.1	0.6	0.5	0.5	0.03	5317	0.7	0.00	5335

Table II-5: OGV Auxiliary Engine Load Characteristics (percent load)
Bulk Carrier/General Cargo
Load Factor (%)

Hoteling	10%
Maneuvering	45%
Transit	17%

ARB, 2011a. Initial Statement of Reasons for Proposed Rulemaking, Proposed Amendments to the Regulations “Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baseline” Appendix D, Emission Estimation Methodology for Ocean Going Vessels, May 2011.
Data http://www.arb.ca.gov/msei/categories.htm#ogv_category

* Need to apply low load adjustment factor to main engine manuvering
Low load adjustment factor for low load manuvering

Auxillary Engine Load (hoteling) 10% Percent Load

Load Factors for Main Engine based on Propeller Law Equation assuming 11 knots transit in river and 4 knots manuvering

Engine	Cruise	Transit	Maneuver
Propulsion	83%	37%	2%

At full cruise engines run at 83% of capacity with maximum speed of 15.3 knots
Propeller equation **$LF = (AS/MS)^3$**
where **LF** = Load Factor (percent)
AS = Actual Speed (knots)
MS = Maximum Speed (knots)

Classification	DWT Range	Main Engine (kW)	Auxiliary Engine (kW)	Main Engine (hp)	Auxiliary Engine (kW)
HandyMax	40,000 - 60,000	7577	1407	10153.18	1885.38
PanaMax	60,000 - 100,000	12215	2268	16368.1	3039.12

Source: Sea-Web (http://www.sea-web.com)
The sea-web data is produced by IHS Global Limited, headquartered in Bracknell, England. The data is based on Lloyd’s Register of Ships Sea-ewb provided shi characteristics data for shios over 100 gross tons.
Based on the ships currently in service (2014) that have stopped at US ports.

Low Speed Adjustment for Main Engine During Ship Manuvering
Based on the Propeller law used to estimate shps propulsion loads, based on law that the propulsion power varies by the cube of the speed. Transit speed was assumed to average 11 knots and maneuver speed 4 knots.

		NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2
	2% load	54.8	41.9	23.6			2.34			2853.6
	20% load	11.9	4.2	0.7			0.32			869.1
Adjustment	Ratio Increase	4.6	10	31.6	1	7.29	7.29	7.29	31.62	3.28

Pollutant	Exponent (x)	ntercept (b)	efficient (a)	
PM	1.5	0.2551	0.0059	
NOx	1.5	10.4496	0.1255	
CO	1	0	0.8378	
HC	1.5	0	0.0667	
SO2			2.3735	only applies to fuel sulfur flow no adjustment for low loads
CO2	1	648.6	44.1	

Slow speed adjustment Ratio of emision rates at 20% load to manuvering Load 2%
emission rate (g/kW-hr) = a (fractional load)^-x + b

Source: USEPA, 2000. US Environmental Protection Agency, Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data, February, 2000, EPA420-R-00-002.

APPENDIX A9c

CARGO VESSEL EMISSIONS (CAP emissions within State of WA except Cowlitz County)

Panamax Size Engine	16368	hp			
Handymax Size Engine	10153	hp			
Panamax auxillary engine size	3039	hp			
Handymax Auxilliary Engine Size	1885	hp			
Main Engine Load (loaded in transit)	37%	Percent Load	Main Engine Load (manuvering)	2%	Percent Load*
Main Engine Load (unloaded in transit)	37%	Percent Load			
Auxillary Engine Load (transit)	17%	Percent Load	Auxillary Engine Load (manuvering)	45%	Percent Load

Number of ship call in 2028	840	
Percent of calls by Panamax	80	percent
Percent of call by Handymax	20	percent
Ship Berth Time ((Hoteling)	13	hrs
Main Ship (Manuvering)	1.0	hrs
Trannsit Time round trip Cowlitz county line to 3 nn	4.10	hrs

Lower bound speeds in the open reaches of the Columbia River Channel are 12 knots, somewhat slower speeds when moving upriver (assumed 10 knots). See: Marine Traffic Technical Report, Feb 2015 , pages 37 and page 49.

On-site Full Operation (2028)

Ships/yr (Panamax)		672	number	
Ships/yr (Handymax)		168	number	
Off-site				
Ships/yr (Panamax)				
Annual Power	(main)	33,406,867	hp-hrs/yr	0.1 %S Marine Distillate Fuel
	(aux)	2,849,919		
Ships/yr (Handymax)				
Annual Power	(main)	5,180,594	hp-hrs/yr	0.1 %S Marine Distillate Fuel (or 1000 ppm)
	(aux)	442,001		

Emission Factors

	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Maine Engine Manuvering (g/KW-hr)	3.4	5.0	2.0	0.40	0.3041	0.25	0.23	0.00428	588	0.07	0.0004	590
Maine Engine Manuvering (lb/hp-hr))	0.006	0.008	0.003	0.001	0.000500	0.000411	0.000378	0.000007	0.967	0.0001151	0.0000007	0.970
Aux Engine T4 Transit, Manuver , Hotel (g/KW-hr)	1.8	5.0	0.19	0.40	0.073	0.060	0.060	0.004	690.0	0.09	0.0004	692
Aux Engine T4 Transit, Manuver , Hotel (lb/hp-hr))	0.0030	0.0082	0.0003	0.0007	0.0001	0.0001	0.0001	0.00001	1.13	0.00015	0.00000	1.14
Main Engine Transit Mode (g/KW-hr)	3.4	5.0	2.0	0.40	0.3041	0.25	0.23	0.00428	588	0.07	0.0004	590
Main Engine Transit Mode (lb/hp-hr)	0.006	0.00822	0.00329	0.00066	0.00050	0.00041	0.00038	0.00001	0.967	0.000115	0.000001	0.970
Tug (Tier 4 compliant post 2016) (g/kW-hr)	1.8	5.0	0.19	0.40	0.073	0.060	0.060	0.004	690.0	0.09	0.0004	692
Tug (Tier 4 compliant post 2016) (lb/bhp-hr)	0.003	0.00822	0.00031	0.00066	0.00012	0.00010	0.00010	0.000007	1.13	0.00015	0.00000	1.14

Source:
ARB, 2011a. Initial Statement of Reasons for Proposed Rulemaking, Proposed Amendments to the Regulations “Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baselir
Appendix D, Emission Estimation Methodology for Ocean Going Vessels, May 2011. Tables II-6, II-7 (main engines) and Table II-8 Auxilary Engine only for PM10, PM2.5 and CO2;

For C3 engines assume lowest engine speed which corresponds with highest emission rate See: http://www.epa.gov/otaq/standards/nonroad/marineci.htm

HAP Emission factors from: *EPA AP-42, Section 3.4;* Sum of HAPs factors from Table 3.4-3 and 3.4-4.
Global Warming Potentials (GWPs): CO_2 - 1, CH_4 - 25, N_2O - 298

Travel Distance:

Ship Miles 51.49 miles Travel distance from Cowlitz County line to 3 nautical miles beyond the mouth of the Columbia River (one-way)

Emission Rates (tpy)

	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
2028 Operational Emissions Marine Vessels												
Ships (cargo transit) - (Offsite)	113	172	64.0	13.8	9.8	8.1	7.5	0.15	20518	2.5	0.0138	20584
Total	113	172	64.0	13.8	9.8	8.1	7.5	0.15	20518	2.5	0.01	20584

Table II-5: OGV Auxiliary Engine Load Characteristics (percent load)
Bulk Carrier/General Cargo
Load Factor (%)

Hoteling	10%
Maneuvering	45%
Transit	17%

ARB, 2011a. Initial Statement of Reasons for Proposed Rulemaking, Proposed Amendments to the Regulations “Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baseline” Appendix D, Emission Estimation Methodology for Ocean Going Vessels, May 2011.
Data http://www.arb.ca.gov/msei/categories.htm#ogv_category

Load Factors for Main Engine based on Propeller Law Equation assuming 11 knots transit in river and 4 knots manuvering

Engine	Cruise	Transit	Maneuver
Propulsion	83%	37%	2%

At full cruise engines run at 83% of capacity with maximum speed of 15.3 knots

Propeller equation $LF = (AS/MS)^3$

where **LF** = Load Factor (percent)
AS = Actual Speed (knots)
MS = Maximum Speed (knots)

* Need to apply low load adjustment factor to main engine manuvering
Low load adjustment factor for low load manuvering

Auxillary Engine Load (hoteling) 10% Percent Load

Classification	DWT Range	Main Engine (kW)	Auxiliary Engine (kW)	Main Engine (hp)	Auxiliary Engine (kW)
HandyMax	40,000 -	7577	1407	10153.18	1885.38
PanaMax	60,000 -	12215	2268	16368.1	3039.12

Source: Sea-Web (http://www.sea-web.com)
The sea-web data is produced by IHS Global Limited, headquartered in Bracknell, England. The data is based on Lloyd’s Register of Ships Sea-ewb provided shi characteristics data for shios over 100 gross tons.
Based on the ships currently in service (2014) that have stopped at US ports.

Low Speed Adjustment for Main Engine During Ship Manuvering
Based on the Propeller law used to estimate shps propulsion loads, based on law that the propulsion power varies by the cube of the speed. Transit speed was assumed to average 11 knots and maneuver speed 4 knots.

		NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2
	2% load	54.8	41.9	23.6			2.34			2853.6
	20% load	11.9	4.2	0.7			0.32			869.1
Adjustment	Ratio Increase	4.6	10	31.6	1	7.29	7.29	7.29	31.62	3.28

Pollutant	Exponent (x)	Intercept (b)	Coefficient (a)	
PM	1.5	0.2551	0.0059	
NOx	1.5	10.4496	0.1255	
CO	1	0	0.8378	
HC	1.5	0	0.0667	
SO2			2.3735	only applies to fuel sulfur flow no adjustment for low loads
CO2	1	648.6	44.1	

Slow speed adjustment Ratio of emision rates at 20% load to manuvering Load 2%
emission rate (g/kW-hr) = a (fractional load)^-x + b

Source: USEPA, 2000. US Environmental Protection Agency, Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data, February, 2000, EPA420-R-00-002.

APPENDIX A9d

CARGO VESSEL EMISSIONS

Tugs/Ship	3		(Conservative estimate)
Tug Engine Size (propulsion)	4000	hp	
Tug Positioning Time	3	hrs/ship (in-out)	(Conservative estimate)
Tug Load Factor (Manuvering)	31%	Percent Load	(Engine load factor for Assist Tugs, from Port of Long Beach Air Emissions Inventory - 2011 (POLB, July 2012).)
Panamax Size Engine	16368	hp	
Handymax Size Engine	10153	hp	
Panamax auxillary engine size	3039	hp	
Handymax Auxilliary Engine Size	1885	hp	
Main Engine Load (loaded in transit)	37%	Percent Load	Main Engine Load (manuvering) 2% Percent Load*
Main Engine Load (unloaded in transit)	37%	Percent Load	
Auxillary Engine Load (transit)	17%	Percent Load	Auxillary Engine Load (manuvering) 45% Percent Load
Number of ship call in 2028	26		
Percent of calls by Panamax	0	percent	
Percent of call by Handymax	100	percent	
Ship Berth Time ((Hoteling)	13	hrs	
Main Ship (Manuvering)	1.0	hrs	
Trannsit Time within Cowlitz county	0.90	hrs	Lower bound speeds in the open reaches of the Columbia River Channel are 12 knots, somewhat slower speeds when fully loaded (assumed 10 knots). See: Marine Traffic Technical Report, Feb 2015 , pages 37 and page 49.

On-site		Full Operation (2028)		
Coal Throughput		48,501,697	tons/yr	
Ships/yr (Panamax)		0	number	
	Annual Power (aux eng)	-	hp-hrs/yr	0.1 %S Marine Distillate Fuel (2015 onward)
	Annual Power (main eng)	-	hp-hrs/yr	0.1 %S Marine Distillate Fuel
Ships/yr (Handymax)		26	number	
	Annual Power (aux eng)	85,785	hp-hrs/yr	0.1 %S Marine Distillate Fuel
	Annual Power (main eng)	5,280	hp-hrs/yr	0.1 %S Marine Distillate Fuel (or 1000 ppm)
Tugs/yr		78	number	
	Annual Power	290,160	hp-hrs/yr	diesel low sulfur (15 ppm S)
Off-site				
Ships/yr (Panamax)				
	Annual Power (main)	-	hp-hrs/yr	0.1 %S Marine Distillate Fuel
	(aux)	-		
Ships/yr (Handymax)				
	Annual Power (main)	176,733	hp-hrs/yr	0.1 %S Marine Distillate Fuel (or 1000 ppm)
	(aux)	15,079		

Emission Factors

	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
Marine Engine Manuvering (g/KW-hr)	3.4	5.0	2.0	0.40	0.3041	0.25	0.23	0.00428	588	0.07	0.0004	590
Marine Engine Manuvering (lb/hp-hr))	0.006	0.00822	0.003	0.001	0.000000	0.000411	0.000378	0.000007	0.967	0.0001151	0.0000007	0.970
Aux Engine T4 Transit, Manuver , Hotel (g/KW-hr)	1.8	5.0	0.19	0.40	0.073	0.060	0.060	0.004	690.0	0.09	0.0004	692
Aux Engine T4 Transit, Manuver , Hotel (lb/hp-hr))	0.0030	0.0082	0.0003	0.0007	0.0001	0.0001	0.0001	0.00001	1.13	0.00015	0.00000	1.14
Main Engine Transit Mode (g/KW-hr)	3.4	5.0	2.0	0.40	0.3041	0.25	0.23	0.00428	588	0.07	0.0004	590
Main Engine Transit Mode (lb/hp-hr)	0.006	0.00822	0.00329	0.00066	0.00050	0.00041	0.00038	0.00001	0.967	0.000115	0.000001	0.970
Tug (Tier 4 compliant post 2016) (g/kW-hr)	1.8	5.0	0.19	0.40	0.073	0.060	0.060	0.004	690.0	0.09	0.0004	692
Tug (Tier 4 compliant post 2016) (lb/bhp-hr)	0.003	0.00822	0.00031	0.00066	0.00012	0.00010	0.00010	0.000007	1.13	0.00015	0.00000	1.14

Source:
ARB, 2011a. Initial Statement of Reasons for Proposed Rulemaking, Proposed Amendments to the Regulations “Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baselir
Appendix D, Emission Estimation Methodology for Ocean Going Vessels, May 2011. Tables II-6, II-7 (main engines) and Table II-8 Auxilary Engine only for PM10, PM2.5 and CO2;
Other Emissions Factros from USEPA Marine Compression Ignition Exhaust Emission Standards for highest Tier engines (auxillary and Tugs C2; main engine C3) all standards fully impletemented by 2016 assume all engines by 2028 comply with these standa
For C3 engines assume lowest engine speed which corresponds with highest emission rate See: http://www.epa.gov/otaq/standards/nonroad/marineci.htm

HAP Emission factors from: *EPA AP-42, Section 3.4;* Sum of HAPs factors from Table 3.4-3 and 3.4-4.

Global Warming Potentials (GWPs): CO_2 - 1
CH_4 - 25
N_2O - 298

Travel Distance:

Ship Miles	11.35	miles	Travel distance from berth site in Longview, west along Columbia River to Cowlitz County line (one-way)

Emission Rates (tpy)

	NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2	CH4	N2O	CO2e
2028 Operational Emissions Marine Vessels												
Ships (Cargo and Tugs) - (Onsite)	0.6	1.8	0.3	0.1	0.02	0.03	0.03	0.00	221.61	0.03	0.00	222.4
Ships (cargo transit) - (Offsite)	0.5	0.8	0.3	0.1	0.05	0.04	0.03	0.00	93.97	0.01	0.00	94.3
Total	1.1	2.6	0.63	0.19	0.07	0.06	0.06	0.003	315.6	0.04	0.0002	316.6

Table II-5: OGV Auxiliary Engine Load Characteristics (percent load)
Bulk Carrier/General Cargo

Load Factor (%)	
Hoteling	10%
Maneuvering	45%
Transit	17%

ARB, 2011a. Initial Statement of Reasons for Proposed Rulemaking, Proposed Amendments to the Regulations “Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels within California Waters and 24 Nautical Miles of the California Baseline” Appendix D, Emission Estimation Methodology for Ocean Going Vessels, May 2011.
Data http://www.arb.ca.gov/msei/categories.htm#ogv_category

Load Factors for Main Engine based on Propeller Law Equation assuming 11 knots transit in river and 4 knots manuvering

Engine	Cruise	Transit	Maneuver
Propulsion	83%	37%	2%

At full cruise engines run at 83% of capacity with maximum speed of 15.3 knots

Propeller equation $\mathbf{LF = (AS/MS)^3}$

where **LF** = Load Factor (percent)
AS = Actual Speed (knots)
MS = Maximum Speed (knots)

* Need to apply low load adjustment factor to main engine manuvering
Low load adjustment factor for low load manuvering

Auxillary Engine Load (hoteling) 10% Percent Load

Classification	DWT Range	Main Engine (kW)	Auxiliary Engine (kW)	Main Engine (hp)	Auxiliary Engine (kW)
HandyMax	40,000 - 60,000	7577	1407	10153.18	1885.38
PanaMax	60,000 - 100,000	12215	2268	16368.1	3039.12

Source: Sea-Web (http://www.sea-web.com)
The sea-web data is produced by IHS Global Limited, headquartered in Bracknell, England. The data is based on Lloyd’s Register of Ships Sea-ewb provided shi characteristics data for shios over 100 gross tons.
Based on the ships currently in service (2014) that have stopped at US ports.

Low Speed Adjustment for Main Engine During Ship Manuvering

Based on the Propeller law used to estimate shps propulsion loads, based on law that the propulsion power varies by the cube of the speed. Transit speed was assumed to average 11 knots and maneuver speed 4 knots.

		NO_x	CO	VOC	SO_2	TSP	PM_{10}	$PM_{2.5}$	HAPS	CO2
	2% load	54.8	41.9	23.6			2.34			2853.6
	20% load	11.9	4.2	0.7			0.32			869.1
Adjustment	Ratio Increase	4.6	10	31.6	1	7.29	7.29	7.29	31.62	3.28

Pollutant	Exponent (x)	Intercept (b)	Coefficient (a)
PM	1.5	0.2551	0.0059
NOx	1.5	10.4496	0.1255
CO	1	0	0.8378
HC	1.5	0	0.0667
SO2			2.3735
CO2	1	648.6	44.1

SO2: only applies to fuel sulfur flow no adjustment for low loads

Slow speed adjustment Ratio of emision rates at 20% load to manuvering Load 2%
emission rate (g/kW-hr) = a (fractional load)^-x + b

Source: USEPA, 2000. US Environmental Protection Agency, Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data, February, 2000, EPA420-R-00-002.

APPENDIX A9e

Material Haul Traffic MTBL to Weyerhauser

	Full Build-Out	
Coal Moved	2,673,990	tons/yr
Carrying Capacity of Haul Truck	51000	lbs/load	Based on 77,000 lb GVWR for a 26,000 lb curb weight haul truck Large Capacity Dump Truck
Loads per year	104,862	trips per year
	287	trips per day
Round trip distance	2.0	miles	Weyerhauser to Milleneum

Haul Trucks		Number	Miles (RT)[1]	miles/year
	SR432 @ 35mph	104,862	2.0	209,725

Project Year **2028**	NOx	PM10	PM2.5	SO2	CO	VOC	CO2	CH4	N2O	CO2eq	HAP
Construction Annual				**T/year**							
Combo Short Haul Truck @ 35mph	0.23	0.04	0.01	0.00	0.10	0.02	237.87	0.01	0.00	238.41	0.001
Total:	0.23	0.04	0.01	0.002	0.10	0.02	237.87	0.01	0.00	238.41	

Factors:

453.59	g/lb
2000	lbs/ton
5280	ft/mile
3.78541	l/gal

Global Warming Potentials (GWPs): CO_2 - 1, CH_4 - 25, N_2O - 298

MOVES factors (g/mile) for surrogate idle were based on 2.5 mi/hr travel. So to get g/hr, multiply by 2.5 mi/hr. For onsite/idle, assume 0.25 hr. So factor is 2.5/.25 to get grams/trip.

mi/hr	2.5
hr	0.25
factor for 1/2 hr idle/trip	10

Mobile Source - Moves run for Cowlitz County, WY, 2028
Emission factors for Truck Exhaust

Emission factors for Truck Exhaust
Emission Factors (gm/mile)

Project Year	NOx	PM10	PM2.5	SO2	CO	VOC	CO2	CH_4	N_2O	Benzene	Form	CO2eq
2018												
Short Haul Combo - diesel @ 35mph (Urban un-restricted)	9.82E-01	1.71E-01	4.41E-02	8.86E-03	4.38E-01	9.24E-02	1.03E+03	6.01E-02	2.77E-03	9.16E-04	1.41E-02	1.03E+03
Short Haul Combo - diesel @ idle (Rural unrestricted)	6.00	0.42	0.24	0.02	1.48	0.35	1927.59	0.06	0.00	0.00	0.03	1930.06

APPENDIX A10a

OPERATIONS AND MAINTENANCE EQUIPMENT

Equipment Information

Equipment Type	Estimated Engine Size (hp)	Fuel	Number of Units Full Build-Out	EPA SCC Number	EPA NONROAD model combustion emission factor (tons/yr per unit) THC-Exhaust	CO-Exhaust	NOx-Exhaust	CO2-Exhaust	SO2-Exhaust	PM-Exhaust
Loader (miscellaneous use)	300	Diesel	1	2270002060	2.81E-01	1.14E+00	3.47E+00	7.40E+02	1.42E-01	2.96E-01
Bobcat (sump cleaning)	50	Diesel	2	2270002057	7.50E-03	4.18E-02	1.29E-01	1.83E+01	3.60E-03	8.27E-03
10-Ton Truck (sump cleaning)	300	Diesel	2	2270002051	3.06E-02	9.01E-02	3.12E-01	1.09E+02	1.86E-02	3.49E-02
Crane (miscellaneous use)	50	Diesel	1	2270002045	1.27E-05	6.42E-05	2.24E-04	3.15E-02	6.15E-06	1.34E-05
Forklift (miscellaneous use)	40	Propane	1	2267002057	5.20E-05	1.84E-03	2.95E-04	1.52E-01	2.95E-06	1.60E-05
Maintenance Trucks (eg. Ford F150)	300	Gasoline	4	2265003070	1.14E-04	4.20E-03	3.12E-04	2.11E-01	4.36E-05	2.16E-05

Note:
For PM_{10}, $PM_{2.5}$, and HAPs, use same emission ratio as emission factor ratios for Large Diesel Engines (see Construction worksheet): PM_{10} and $PM_{2.5}$ ratio to TSP, and; HAPs ratio to CO.

Annual Emissions (tpy)

Full Build-Out (tpy)	NO_x	CO	VOC	SO_2	TSP	PM10	PM2.5	HAPS	CO2e
Loader (miscellaneous use)	3.47	1.14	0.28	0.14	0.30	0.24	0.24	0.01	740
Bobcat (sump cleaning)	0.26	0.08	0.01	0.01	0.02	0.01	0.01	0.00	37
10-Ton Truck (sump cleaning)	0.62	0.18	0.06	0.04	0.07	0.06	0.06	0.00	218
Crane (miscellaneous use)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Forklift (miscellaneous use)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Maintenance Trucks (eg. Ford F150)	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	1
Full Build-Out Total (tpy)	4.36	1.42	0.36	0.19	0.38	0.31	0.31	0.01	996

EMERGENCY EQUIPMENT

Emergency Diesel Fire Water Pump and Emergency Generator Emission Rates (Tier 4 compliant non-road engines) Required by 2015

One 200 Hp (149 KW) Fire Water Pump and Two (2) 30 Hp (22.37 kW) Emergency Generator; Planned operation of the units will be limited to a half hour per week for readiness testing, and one eight-hour test per year, as specified by the National Fire P
Both generator and fire water pump will be fueled with ultra low sulfur diesel.

Pollutant	NO_x	CO	VOC	SO_2	TSP	PM10	PM2.5	HAPS	CO2e
Emission Factor (g/KWH)	0.4	3.5	0.19	1.25	0.02	0.02	0.0194	2.47E-03	699.1
Equipment Number	1	1	1	1	1	1	1	1	1
Hours per year	34	34	34	34	34	34	34	34	34
Rating (KW)	149.14	149.14	149.14	149.14	149.14	149.14	149.14	149.14	149.14
Emission Rate (g/yr)	2028.3	17747.7	963.4	6338.5	101.4	101.4	98.4	12.5	3.54E+06
Emission Rate (ton/yr)	0.002236	0.019563	0.001062	0.006987	0.000112	0.000112	0.000108	0.000014	3.91
Emission Factor (g/KWH)	0.335	5.5	4.335	1.25	0.03	0.03	0.0291	2.47E-03	699.1
Equipment Number	2	2	2	2	2	2	2	2	2
Hours per year	34	34	34	34	34	34	34	34	34
Rating (KW)	22.371	22.371	22.371	22.371	22.371	22.371	22.371	22.371	22.371
Emission Rate (g/yr)	509.61	8366.75	6594.52	1901.54	45.64	45.64	44.27	3.76	1.06E+06
Emission Rate (tpy)	5.62E-04	9.22E-03	7.27E-03	2.10E-03	0.0000503	0.0000503	0.0000488	0.0000041	1.17
Total (tpy)	0.00280	0.02879	0.00833	0.00908	0.00016	0.00016	0.00016	1.79481E-05	5.08

Sources: AP-42, Chapter 3.3, Table 3.3-1 for emission factors other than NOX, VOC, and PM. USEPA, Nonroad Emission Factors for Tier 4 engines for Nox, PM, CO and VOC. (Office of Transportation and Air Quality EPA-420-B-16-022, March 2016)

Grand Total Full Build-Out	4.36	1.45	0.37	0.20	0.38	0.31	0.31	0.01	1001

APPENDIX A10b

OPERATIONS AND MAINTENANCE EQUIPMENT

Equipment Information

Equipment Type	Estimated Engine Size (hp)	Fuel	Number of Units Full Build-Out	EPA SCC Number	EPA NONROAD model combustion emission factor (tons/yr per unit) THC-Exhaust	CO-Exhaust	NOx-Exhaust	CO2-Exhaust	SO2-Exhaust	PM-Exhaust
Loader (miscellaneous use)	300	Diesel	1	2270002060	2.81E-01	1.14E+00	3.47E+00	7.40E+02	1.42E-01	2.96E-01
Bobcat (sump cleaning)	50	Diesel	2	2270002057	7.50E-03	4.18E-02	1.29E-01	1.83E+01	3.60E-03	8.27E-03
10-Ton Truck (sump cleaning)	300	Diesel	2	2270002051	3.06E-02	9.01E-02	3.12E-01	1.09E+02	1.86E-02	3.49E-02
Crane (miscellaneous use)	50	Diesel	1	2270002045	1.27E-05	6.42E-05	2.24E-04	3.15E-02	6.15E-06	1.34E-05
Forklift (miscellaneous use)	40	Propane	0	2267002057	5.20E-05	1.84E-03	2.95E-04	1.52E-01	2.95E-06	1.60E-05
Maintenance Trucks (eg. Ford F150)	300	Gasoline	0	2265003070	1.14E-04	4.20E-03	3.12E-04	2.11E-01	4.36E-05	2.16E-05

Note:
For PM_{10}, $PM_{2.5}$, and HAPs, use same emission ratio as emission factor ratios for Large Diesel Engines (see Construction worksheet): PM_{10} and $PM_{2.5}$ ratio to TSP, and; HAPs ratio to CO.

Annual Emissions (tpy)

Full Build-Out (tpy)	NO_x	CO	VOC	SO_2	TSP	PM10	PM2.5	HAPS	CO2e
Loader (miscellaneous use)	3.47	1.14	0.28	0.14	0.30	0.24	0.24	0.01	740
Bobcat (sump cleaning)	0.26	0.08	0.01	0.01	0.02	0.01	0.01	0.00	37
10-Ton Truck (sump cleaning)	0.62	0.18	0.06	0.04	0.07	0.06	0.06	0.00	218
Crane (miscellaneous use)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Forklift (miscellaneous use)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Maintenance Trucks (eg. Ford F150)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Full Build-Out Total (tpy)	4.36	1.40	0.36	0.19	0.38	0.31	0.31	0.01	995

EMERGENCY EQUIPMENT

Emergency Diesel Fire Water Pump and Emergency Generator Emission Rates (Tier 4 compliant non-road engines) Required by 2015

One 200 Hp (149 KW) Fire Water Pump and Two (2) 30 Hp (22.37 kW) Emergency Generator; Planned operation of the units will be limited to a half hour per week for readiness testing, and one eight-hour test per year, as specified by the National Fire Protection Association's NFPA 25.
Both generator and fire water pump will be fueled with ultra low sulfur diesel.

Pollutant	NO_x	CO	VOC	SO_2	TSP	PM10	PM2.5	HAPS	CO2e
Emission Factor (g/KWH)	0.4	3.5	0.19	1.25	0.02	0.02	0.0194	2.47E-03	699.1
Equipment Number	1	1	1	1	1	1	1	1	1
Hours per year	34	34	34	34	34	34	34	34	34
Rating (KW)	149.14	149.14	149.14	149.14	149.14	149.14	149.14	149.14	149.14
Emission Rate (g/yr)	2028.3	17747.7	963.4	6338.5	101.4	101.4	98.4	12.5	3.54E+06
Emission Rate (ton/yr)	0.002236	0.019563	0.001062	0.006987	0.000112	0.000112	0.000108	0.000014	3.91
Emission Factor (g/KWH)	0.335	5.5	4.335	1.25	0.03	0.03	0.0291	2.47E-03	699.1
Equipment Number	2	2	2	2	2	2	2	2	2
Hours per year	34	34	34	34	34	34	34	34	34
Rating (KW)	22.371	22.371	22.371	22.371	22.371	22.371	22.371	22.371	22.371
Emission Rate (g/yr)	509.61	8366.75	6594.52	1901.54	45.64	45.64	44.27	3.76	1.06E+06
Emission Rate (tpy)	5.62E-04	9.22E-03	7.27E-03	2.10E-03	0.0000503	0.0000503	0.0000488	0.0000041	1.17
Total (tpy)	0.00280	0.02879	0.00833	0.00908	0.00016	0.00016	0.00016	1.79481E-05	5.08

Sources: AP-42, Chapter 3.3, Table 3.3-1 for emission factors other than NOX, VOC, and PM. USEPA, Nonroad Emission Factors for Tier 4 engines for Nox, PM, CO and VOC. (Office of Transportation and Air Quality EPA-420-B-16-022, March 2016)

Grand Total Full Build-Out	4.36	1.43	0.37	0.20	0.38	0.31	0.31	0.01	1000

APPENDIX A11

Washington State Emissions in tons per year
2011 Emissions Inventory

COWLITZ COUNTY EMISSIONS							
Category	**CO**	**NOx**	**PM10**	**PM2.5**	**DSPM2.5**	**SO2**	**VOC**
AIR	125	2	3	2		0	4
BOAT	887	74	5	5	0	0	298
CONS							549
CONST			523	55			
F_COMM	6	2	5	5		0	0
F_RES	5	13	0	0	0	3	1
FERT							
FIRE	68	1	7	6		1	16
FOOD	14		35	33			5
GAS_TRANS							696
GASSTN							138
LIVE							
MISC	8	1	2	2		0	2
NAT	3,361	59					11,443
NRM	3,718	389	48	46	24	1	592
OB_nonRES	117	6	24	21		0	7
OB_Res	162	8	38	33		1	22
ORM	22,852	4,281	157	130	83	13	1,649
POTW							2
PT	2,507	3,616	182	172	0	791	671
ROADS			381	93			
RR	137	789	23	23	23	6	43
RWC	2,026	31	290	290		5	346
SHIP	150	1,109	37	34	34	199	46
SOLV							390
TILL_HARV			109	22			
Total	**36,142**	**10,382**	**1,872**	**971**	**164**	**1,020**	**16,919**

Source: Compiled from data in Ecology's *Washington State 2011 County Emissions Inventory* (April 25,
(http://www.ecy.wa.gov/programs/air/EmissionInventory/AirEmissionInventory.htm)

NOTES:
1) Source Category Abbreviations

Abbreviation	**Source Category Description**
AIR	Aircraft: military, commercial, general aviation
BOAT	Recreational boats
CONS	Commercial and consumer solvents
CONST	Construction
F_COMM	Commercial fuel use: natural gas, oil, LPG
F_RES	Residential fuel use: natural gas, oil, LPG
FERT	Fertilizer application
FIRE	Wildfires
FOOD	Food and Kindred Products
GAS_TRANS	Aviation gas storage and transport, petroleum gas cans, bulk plants, and truck transport
GASSTN	Gasoline stations
LIVE	Livestock wastes
MISC	Structure and motor vehicle fires, Cremation, Dental alloy production, Bench scale reagents, Fluor
NAT	Natural emissions from soil and vegetation
NRM	Nonroad mobile except locomotives
OB_nonRES	Agricultural and silvicultural burning
OB_Res	Residential outdoor burning: yard waste, trash
ORM	Onroad mobile sources
POTW	Publicly owned treatment works
PT	Point sources
ROADS	Paved and unpaved road dust
RR	Locomotives
RWC	Woodstoves, fireplaces, inserts
SHIP	Commercial marine vessels
SOLV	Dry cleaning, graphic arts, surface coating: industrial
TILL_HARV	Agricultural tilling and harvesting

2) Pollutant Abbreviations

Abbreviation	**Pollutant Name**
PM10	particulate matter less than or equal to 10 microns in diameter
PM2.5	particulate matter less than or equal to 2.5 microns in diameter
DSPM 2.5	particulate matter less than or equal to 2.5 microns in diameter from diesel combustion
SO2	sulfur dioxide
NOx	nitrogen oxides
VOC	volatile organic hydrocarbons
CO	carbon monoxide

APPENDIX A12

MBTL EIS -- GRADE CROSSING EMISSIONS INVENTORY -- SUMMARY OF EXHAUST EMISSIONS BY GRADE CROSSING (TONS/YEAR)

Pollutants (tons/year)	2018		2028		2038	
	No Action	Incremental Increase	No Action	Incremental Increase	No Action	Incremental Increase
Criteria Pollutants						
CO	3.28E-02	4.70E-02	3.60E-02	9.37E-01	1.30E-02	2.78E-01
NOx	5.19E-03	7.43E-03	3.62E-03	9.42E-02	1.29E-03	2.74E-02
PM10	6.31E-04	9.03E-04	1.02E-03	2.64E-02	5.17E-04	1.10E-02
PM2.5	2.33E-04	3.34E-04	2.44E-04	6.33E-03	1.07E-04	2.28E-03
SO2	3.19E-05	4.56E-05	5.03E-05	1.31E-03	2.40E-05	5.12E-04
VOC	1.04E-03	1.49E-03	8.72E-04	2.27E-02	3.51E-04	7.48E-03
Hazardous Pollutants						
Acetaldehyde	7.20E-05	1.03E-04	6.05E-05	1.57E-03	2.44E-05	5.19E-04
Acrolein	1.04E-05	1.49E-05	8.72E-06	2.27E-04	3.51E-06	7.48E-05
Benzene	1.34E-05	1.92E-05	1.13E-05	2.93E-04	4.53E-06	9.66E-05
1,3-Butadiene	8.31E-07	1.19E-06	6.98E-07	1.81E-05	2.81E-07	5.99E-06
Ethylbenzene	6.51E-06	9.32E-06	5.47E-06	1.42E-04	2.20E-06	4.69E-05
Formaldehyde	2.26E-04	3.23E-04	1.90E-04	4.93E-03	7.64E-05	1.63E-03
n-Hexane	5.62E-06	8.04E-06	4.72E-06	1.23E-04	1.90E-06	4.05E-05
Toluene	3.12E-05	4.46E-05	2.62E-05	6.80E-04	1.05E-05	2.24E-04
Xylene	3.95E-05	5.65E-05	3.32E-05	8.62E-04	1.33E-05	2.84E-04

Data from: MTBL EIS grade xing emission

APPENDIX A13a

Commuter traffic

Assume a mean travel time of 24.1 minutes (http://quickfacts.census.gov/qfd/states/53/53015.html)

Assumed each worker is a single occupant; Used the on-road average emission rate for 2018 MOVES - 35 mph.

Labor	Number					
Phase 1&2		Time (min) - round trip	Speed (miles/hr)	Days/year	miles/year	miles/day
Peak Employees	200	48.2	35	753.0952	4234905	5623.333

Assume a 50/50 Split between gasoline and E-85

Project Year **2018**	**NOx**	**PM10**	**PM2.5**	**SO2**	**CO**	**VOC**	**CO2**	**CH4**	**N2O**	**CO2eq**
Construction Annual				**T/year**						
Passenger Vehicle - Gas+E-85	5.13E-01	2.16E-01	4.12E-02	1.06E-02	7.38E+00	1.26E-01	1.48E+03	1.57E-02	7.11E-03	1.49E+03
Construction Max Day				**lbs/day**						
Passenger Vehicle - Gas+E-85	1.36E+00	5.75E-01	1.09E-01	2.82E-02	1.96E+01	3.35E-01	3.94E+03	4.16E-02	1.89E-02	3.94E+03

Conversion Factors:

453.59	g/lb
2000	lbs/ton
5280	ft/mile
3.78541	l/gal
24	hrs/day
Global Warming Potentials (GWPs):	CO_2 - 1
	CH_4 - 25
	N_2O - 298

Mobile Source - Moves run for Cowlitz County, WA, 2018
Emission factors for Commuting Vehicles Exhaust

Emission Factors for Commuting Vehicles **Emission Factors (gm/mile)**												
Project Year	**NOx**	**PM10**	**PM2.5**	**SO2**	**CO**	**VOC**	**CO2**	**CH_4**	**N_2O**	**Benzene**	**Form**	**CO2eq**
2018												
Passenger Gas (at 35mph)	1.61E-01	4.77E-02	1.01E-02	2.14E-03	1.96	3.61E-02	321.38	2.71E-03	1.75E-03	1.19E-03	4.44E-04	321.97
Passenger E-85 (at35 mph)	5.88E-02	4.50E-02	7.59E-03	2.42E-03	1.20	1.80E-02	313.88	4.00E-03	1.30E-03	2.92E-04	3.59E-04	314.37

APPENDIX A13b

Commuter traffic

Assume a mean travel time of 24.1 minutes (http://quickfacts.census.gov/qfd/states/53/53015.html)

Assumed each worker is a single occupant; Used the on-road average emission rate for 2018 MOVES - 35 mph.

Labor	Number					
	75	Time (min) - round trip	Speed (miles/hr)	Days/year	miles/year	miles/day
Employees: 5 day/week	14	48.2	35	260	102344.7	
Employees: 7 day/week	61	48.2	35	294	504244.3	
Total					606589	

Assume a 50/50 Split between gasoline and E-85 (tons per year)

Project Year	NOx	PM10	PM2.5	SO2	CO	VOC	CO2	CH4	N2O	CO2eq
2018										
Construction Annual				**T/year**						
Passenger Vehicle - Gas+E-85	0.073440066	0.030989402	0.005901277	0.0015225	1.056885	0.018075	212.3848	0.002244	0.00101911	212.7446

Conversion Factors:

453.59	g/lb
2000	lbs/ton
5280	ft/mile
3.78541	l/gal
24	hrs/day
Global Warming Potentials (GWPs)	CO_2 - 1
	CH_4 - 25
	N_2O - 298

Mobile Source - Moves run for Cowlitz County, WA, 2018

Emission factors for Commuting Vehicles Exhaust

Emission Factors for Commuting Vehicles

Emission Factors (gm/mile)

Project Year	NOx	PM10	PM2.5	SO2	CO	VOC	CO2	CH_4	N_2O	Benzene	Form	CO2eq
2018												
Passenger Gas (at 35mph)	1.61E-01	4.77E-02	1.01E-02	2.14E-03	1.96	3.61E-02	321.38	2.71E-03	1.75E-03	1.19E-03	4.44E-04	321.97
Passenger E-85 (at35 mph)	5.88E-02	4.50E-02	7.59E-03	2.42E-03	1.20	1.80E-02	313.88	4.00E-03	1.30E-03	2.92E-04	3.59E-04	314.37

APPENDIX A13c

Commuter traffic

Assume a mean travel time of 24.1 minutes (http://quickfacts.census.gov/qfd/states/53/53015.html)

Assumed each worker is a single occupant; Used the on-road average emission rate for 2028 MOVES - 35 mph.

Labor	Number					
	135	Time (min) - round trip	Speed (miles/hr)	Days/year	miles/year	miles/day
Employees: 5 day/week	25	48.2	35	260	182758.3333	
Employees: 7 day/week	110	48.2	35	294	909293	
Total					1092051.333	

Assume a 50/50 Split between gasoline and E-85

Project Year	**NOx**	**PM10**	**PM2.5**	**SO2**	**CO**	**VOC**	**CO2**	**CH4**	**N2O**	**CO2eq**
2028										
Construction Annual				**T/year**						
Passenger Vehicle - Gas+E-85	0.037	0.054	0.009	0.002	1.073	0.012	274.24	0.0022	0.0016	274.77

Conversion Factors:

453.59	g/lb
2000	lbs/ton
5280	ft/mile
3.78541	l/gal
24	hrs/day
Global Warming Potentials (GWPs)	CO_2 - 1
	CH_4 - 25
	N_2O - 298

`

Mobile Source - Moves run for Cowlitz County, WA, 2028

Emission factors for Commuting Vehicles Exhaust

Emission Factors for Commuting Vehicles
Emission Factors (gm/mile)

Project Year	**NOx**	**PM10**	**PM2.5**	**SO2**	**CO**	**VOC**	**CO2**	**CH_4**	**N_2O**	**Benzene**	**Form**	**CO2eq**
2028												
Passenger Gas (at 35mph)	3.35E-02	4.54E-02	7.98E-03	1.52E-03	1.01	9.15E-03	228.62	1.35E-03	1.33E-03	3.08E-04	1.09E-04	229.05
Passenger E-85 (at35 mph)	2.74E-02	4.44E-02	7.09E-03	1.75E-03	0.77	1.12E-02	227.01	2.29E-03	1.33E-03	1.93E-04	2.14E-04	227.46

APPENDIX A13d

Commuter traffic

Assume a mean travel time of 24.1 minutes (http://quickfacts.census.gov/qfd/states/53/53015.html)

Assumed each worker is a single occupant; Used the on-road average emission rate for 2038 MOVES - 35 mph.

Labor	Number					
	135	Time (min) - round trip	Speed (miles/hr)	Days/year	miles/year	miles/day
Employees: 5 day/week	25	48.2	35	260	182758.3	
Employees: 7 day/week	110	48.2	35	294	909293	
Total					1092051	

Assume a 50/50 Split between gasoline and E-85

Project Year	NOx	PM10	PM2.5	SO2	CO	VOC	CO2	CH4	N2O	CO2eq
2038										
Construction Annual				**T/year**						
Passenger Vehicle - Gas+E-85	0.0171	0.0406	0.0078	0.0011	0.4673	0.0048	157.8767	0.0006	0.0010	158.2

Conversion Factors:

453.59	g/lb
2000	lbs/ton
5280	ft/mile
3.78541	l/gal
24	hrs/day
Global Warming Potentials (GWPs):	CO_2 - 1
	CH_4 - 25
	N_2O - 298

Mobile Source - Moves run for Cowlitz County, WY, 2038
Emission factors for Commuting Vehicles Exhaust

Emission Factors for Commuting Vehicles
Emission Factors (gm/mile)

Project Year	NOx	PM10	PM2.5	SO2	CO	VOC	CO2	CH_4	N_2O	Benzene	Form	CO2eq
2038												
Passenger Gas (at 35mph)	2.84E-02	6.75E-02	1.09E-02	1.75E-03	0.78	8.05E-03	262.30	1.06E-03	1.65E-03	2.44E-04	8.62E-05	262.82
Passenger E-85 (at 35 mph)	0.00E+00	0.00E+00	2.00E-03	0.00E+00	0.00	0.00E+00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00

APPENDIX A13e

	Construction Emissions (tpy) [Maximum per Year]								
Source	**NOx**	**CO**	**VOC**	**SO2**	**TSP**	**PM10**	**PM2.5**	**HAPS**	**DPM**
COMBUSTION SOURCES									
Equipment (Onsite)	24.6	9.04	2.23	0.95	2.34	1.93	1.93	0.05	2.34
Haul Trucks (Onsite & Offsite)	13.43	2.92	0.585	0.040	0.77	0.63	0.44	0.015	0.77
Passenger Vehicles (Offsite)	0.53	7.46	0.129	0.0107	0.218	0.218	0.042		
Barges (Offsite)	59.04	15.68	1.511	0.028	1.29	1.06	1.06	0.08	1.29
Total Combustion Sources	97.59	35.1	4.46	1.03	4.62	3.84	3.47	0.14	4.40
Total (on-site and off-site)	38.5	19.4	2.9	1.0	3.3	2.8	2.4	0.1	3.1
FUGITIVE SOURCES									
Controlled Fugitive Earthwork	-	-	-	-	12.0	5.87	1.22	-	
Total Fugitive Sources	-	-	-	-	12.0	5.87	1.22	-	
Total - All Construction Sources	97.6	35.1	4.46	1.03	16.6	9.70	4.69	0.14	4.40

	Construction Emissions (lb/day) [Maximum daily]								
Source	**NOx**	**CO**	**VOC**	**SO2**	**TSP**	**PM10**	**PM2.5**	**HAPS**	**DPM**
COMBUSTION SOURCES									
Equipment (Onsite)	229.6	82.9	20.4	8.67	21.5	17.66	17.66	0.42	21.5
Haul Trucks (Onsite & Offsite)	165.22	38.41	7.93	0.48	12.45	10.24	6.29	0.19	12.45
Passenger Vehicles (Offsite)	1.431	20.033	0.349	0.029		0.583	0.113		
Barges (Offsite)	454.7	120.8	11.6	0.21	9.90	8.14	8.14	0.61	9.9
Total Combustion Sources	850.9	262.1	40.3	9.40	43.8	36.6	32.2	1.22	43.8
Total minus barges	396.22	141.33	28.66	9.18	33.94	28.48	24.07	0.61	33.94
	54.7	14.4	3.1	0.2	6.1	5	2.6	0.1	
	284.26	97.29	23.49	8.87	27.59	22.66	20.26	0.52	21.49
FUGITIVE SOURCES									
Controlled Fugitive Earthwork	-	-	-	-	66.7	32.6	6.8	-	
Total Fugitive Sources	-	-	-	-	66.7	32.6	6.80	-	
Total - All Construction Sources	850.9	262.1	40.3	9.40	110.5	69.2	39.0	1.22	43.8

Facility Only (Material Handling, Maintenance and On-site Equipment) Pollutant Emissions (tpy)									
Source	**NOx**	**CO**	**VOC**	**SO2**	**TSP**	**PM10**	**PM2.5**	**HAPs**	**DPM**
FUGITIVE SOURCES									
Coal Transfer (except piles):									
Material Handling	-	-	-	-	5.25	1.84	0.28	-	-
Coal Piles:									
Wind Erosion	-	-	-	-	3.05	2.59	0.40	-	-
Material Handling	-	-	-	-	2.62	0.92	0.14	-	-
MOBILE SOURCES									
Maintenance/Operations Equipment:									
Combustion	4.36	1.45	0.37	0.20	0.38	0.31	0.31	7.17E-03	0.38
Total - onsite	4.36	1.45	0.37	0.20	11.30	5.66	1.13	7.15E-03	0.38

	On-Site Ship and Train Pollutant Emissions (tpy)								
Source	**NOx**	**CO**	**VOC**	**SO2**	**TSP**	**PM10**	**PM2.5**	**HAPs**	**DPM**
Trains:									
Combustion (On-site)	13.95	5.04	0.56	1.78E-02	0.36	0.30	0.29	5.36E-02	0.27
Fugitive (On-site)	-	-	-	-	3.68	3.13	0.48	-	-
Ships:									
Combustion (On-site)	23.3	65.9	15.3	4.52	1.27	1.05	1.02	7.58E-02	0.56
Total - transport	37.2	71.0	15.9	4.54	5.31	4.47	1.78	3.75E-02	0.84

	Total Pollutant Emissions (tpy)								
Source	**NOx**	**CO**	**VOC**	**SO2**	**TSP**	**PM10**	**PM2.5**	**HAPS**	**DPM**
FUGITIVE SOURCES									
Coal Transfer (except piles):									
Material Handling	-	-	-	-	5.25	1.84	0.28	-	-
Coal Piles:									
Wind Erosion	-	-	-	-	3.05	2.59	0.40	-	-
Material Handling	-	-	-	-	2.62	0.92	0.14	-	-
MOBILE SOURCES									
Maintenance/Operations Equipment:									
Combustion	4.36	1.45	0.37	0.20	0.38	0.31	0.31	7.17E-03	0.38
Trains:									
Combustion (Off-site)	23.3	10.2	0.80	3.60E-02	0.60	0.50	0.48	0.11	0.60
Fugitive (Off-site)	-	-	-	-	1.03	0.88	0.13	-	-
Combustion (On-site)	14.0	5.04	0.56	1.78E-02	0.36	0.30	0.29	5.36E-02	0.27
Fugitive (On-site)	-	-	-	-	3.68	3.13	0.48	-	-
Ships:									
Combustion (Off-site)	24.8	37.9	14.1	3.04	2.17	1.78	1.64	3.25E-02	0.00
Combustion (On-site)	23.3	65.9	15.3	4.52	1.27	1.05	1.02	0.08	0.56
Total - All Sources, Onsite and Offsite	89.8	120.5	31.1	7.81	20.4	13.3	5.17	0.28	1.82