Gateway Pacific Terminal
Air Quality Technical Report

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Acronyms, Abbreviations, and Definitions

Note that in this section and throughout the rest of this report there are active hyperlinks that will jump to the referenced material or section. General hyperlinks are formatted like this. Hyperlinks for tables and figures are highlighted like **this**.

AERMOD	Air quality dispersion modeling system used in this analysis. The AERMOD modeling system consists of two pre-processors and a dispersion model. The meteorological preprocessor (AERMET) provides meteorological information, and a terrain pre-processor (AERMAP) characterizes terrain, and generates receptor grids for the dispersion model (AERMOD).
AESS	Automatic Engine Shutoff System, used by train locomotives to shutdown unneeded units when idling occurs for more than about 10 minutes, and when ambient temperatures exceed 40°F.
Air quality standard	Health-based standard representing a pollutant concentration in the ambient air usually over some averaging period like 1-hour, intended to protect the health and welfare of people with a margin of safety. See Table 2, page 10.
Ambient air	the air in outdoor locations to which the public has access, e.g., outside the property boundary of the emissions source
Area source	an emission source type defined in AERMOD. Area source emissions are released from a two-dimensional rectangular area and typically used to represent fugitive emission sources.
Areapoly source	an emission source type defined in AERMOD. Areapoly sources are similar to area sources in that emissions are released from two-dimensional areas, but such sources are not restricted to rectangular areas and can have more than four sides.
ASIL	Acceptable Source Impact Level – a *screening* level (as opposed to a *standard*) used to evaluate the potential impact of **TAP**s based on the estimated risk of a lifetime of exposure
Attainment/Nonattainment	a determination and classification made by EPA indicating whether ambient air quality in an area complies with (i.e., attains) or fails to meet (i.e., nonattainment) the requirements of one or more **NAAQS**
Averaging time	a specific length of time (e.g., 1 hour, 24-hours, 1 year) over which measured or model-calculated concentrations of an air pollutant are averaged for comparison with the **NAAQS** based on the same averaging period. Note that some NAAQSs are also based on multi-year averages of certain percentiles of measured or calculated concentrations.
BACT	Best Available Control Technology
BNSF	Burlington Northern Santa Fe Railroad
cf	cubic foot, a measure of volume
cfm	cubic feet per minute, a measure of air flow
CO	carbon monoxide, a criteria air pollutant
CO_2	carbon dioxide
CO_2e	Greenhouse gas equivalents (emissions of all GHGs expressed in terms of their "global warning potential")
Criteria air pollutant	an air pollutant specifically governed by the Federal Clean Air Act for which ambient air quality standards have been set. Criteria air pollutants include carbon monoxide, particulate matter, sulfur dioxide, nitrogen dioxide, ozone, and lead. See Table 2, page 10.

Dispersion model ..... A computerized calculation tool used to estimate pollutant concentrations in the ambient air based on numeric simulations that consider the locations and rates of pollutant emissions and the effects of meteorological conditions, usually over specific averaging times (e.g., 8-hours)

dwt ..... Deadweight tonnage is a measure of how much weight a ship is carrying or can safely carry. It is the sum of the weights of cargo, fuel, fresh water, ballast water, provisions, passengers, and crew. The term is often used to specify a ship's maximum permissible deadweight, and is expressed in long tons or metric tons (tonnes).

Ecology ..... Washington State Department of Ecology

EPA..... US Environmental Protection Agency

Fugitive dust ..... Potential air pollutant in the form of dust (or other pollutant) emitted from a non-point or non-mobile source such as dust from a road or from a coal pile caused by wind

GHG..... Greenhouse gas (e.g., carbon dioxide or methane) that contributes to the process of a gradual warming of the atmosphere that can result in global climate change

Global warming potential ..... a measure of the potential of a gas to have an effect in the atmosphere that could lead to climate change based on the potential of the gas to cause global warming. This is a standard measure, typically based on a 100-year time horizon, used to compare each GHG with the global warming potential of carbon dioxide (CO_2), the most abundant GHG.

GPT ..... Gateway Pacific Terminal

gr..... grains, a measure of mass

gr/cf..... grains/cubic foot

hp..... horsepower

Knot ..... a unit of speed equal to one nautical mile per hour, or approximately 1.151 mph

Long ton..... also called imperial ton and equal to 2,240 pounds (1,016 kg)

Maintenance area..... An area that was once designated as nonattainment that has since come into compliance with the ambient air quality standard but where air quality control measures may remain in effect (in perpetuity).

Meteorological data set ..... a compilation of meteorological data representing conditions over some period of time and including such things as wind speed and wind direction, and formatted as required by the dispersion model being used. This analysis used a meteorological data set covering 5 years.

Metric ton ..... 1,000 kilograms (kg) = 2,204.6 pounds = tonne (see also short ton)

Micrometer/Micron ..... one millionth of a meter; typically used to distinguish particle size; typical human hair is 100 about microns in diameter

mmtpy ..... million metric tons per year

Modeling domain ..... the area included in the **dispersion-modeling** analysis, such as in this case, which used a larger than 10 kilometer by 10 kilometer domain. Modeling receptors are distributed within this domain, usually over a standard grid pattern with receptors every 100 to 500 meters.

Modeling receptor ..... a theoretical (i.e., often non-specific) location used in computer modeling at which air pollutant concentrations are calculated. Modeling may also use site-specific receptors representing individual locations.

Monte Carlo simulation ..... a mathematical procedure using repeated random sampling methods to develop sufficient test results to reach statistically valid conclusions; often applied in situations in which uncertainty or intermittent/ unpredictable occurrences prevent more specific examination of possible outcomes. Additional discussion **here** (pg. 38)

mtyp ..... metric tons per year

NAAQS	National Ambient Air Quality Standard
Nautical mile (nm)	The nautical mile is a unit of length that is about one minute of arc of latitude measured along any meridian, or about one minute of arc of longitude at the equator. By international agreement it is exactly 1,852 meters (approximately 6,076 feet).
NSPS	New Source Performance Standard; rules that pertain to air pollution emission sources subject to air quality permits and newly manufactured equipment
NO_2	nitrogen dioxide, a **criteria** air pollutant
Nonattainment area	An area delineated by regulatory agencies including US EPA and the Washington Department of Ecology in which an ambient air quality standards have been violated and where there is a program in place designed to reduce air pollution so that the standard attained.
NOx	oxide of nitrogen, a general class of air pollutant without a specific air quality standard but used in monitoring air quality
NWCAA	Northwest Clean Air Agency; the designated local air quality control agency in the project area
Particulate matter (PM)	air pollutant comprised of solid or liquid particles; PM is usually characterized based on the particle size. See also PM_{10} and $PM_{2.5}$.
PID	Project information document; a summary description of the GPT project components
PIT	Pacific International Terminals, Inc., a subsidiary of SSA Terminals and the proponent of the proposed GPT Project
PM_{10}	"Coarse" inhalable particulate matter with an aerodynamic size less than or equal to 10 micrometers (**microns**)
$PM_{2.5}$	"Fine" inhalable particulate matter with an aerodynamic size less than or equal to 2.5 micrometers (**microns**)
Point source	an emission source type defined in AERMOD. Point source emissions are released from a single location.
ppm	parts per million (a metric used in quantifying concentrations of air pollutants)
Receptor	See modeling receptor.
Release height	an AERMOD term defining the height above ground at which source emissions are released
Short ton	2,000 pounds (see also **metric ton** and long ton)
SO_2	Sulfur dioxide, a **criteria air pollutant**
Soiling	A non-health-related effect of air pollution such as staining or deposition of a fine film typically on exterior surfaces
TAP	Toxic air pollutant
tonne	**metric ton**
tpy	tons per year, an estimate of annual emissions
$\mu g/m^3$	micrograms per cubic meter (a metric used in quantifying concentrations of air pollutants)
Volume source	an emission source type defined in AERMOD. Volume sources emit diffuse air pollutants from a three-dimensional area. Line sources, such as emissions from transiting trains, can be simulated using multiple, adjacent volume sources.

Preface

Pacific International Terminals, Inc., a subsidiary of SSA Marine, proposes to develop the Gateway Pacific Terminal (GPT), a multimodal terminal for transfer of dry bulk commodities, at Cherry Point in Whatcom County, Washington. Construction and operation of the terminal and associated facilities require the approval of local, state, and federal agencies. Agency decision makers are to be informed of the potential environmental impacts of the proposed project by preparation of an Environmental Impact Statement (EIS). The EIS will be prepared under guidelines of the National Environmental Policy Act (NEPA) and State Environmental Policy Act (SEPA) by a lead federal agency, a lead state agency, and a lead local agency working in cooperation.

This report is one of several technical reports prepared on behalf of Pacific International Terminals, Inc. that provides technical information about the existing conditions of the proposed project site, and in some cases, the projected effects of project operations. It is provided to the lead federal, state, and local agencies for their use in preparation of a Draft EIS. Several of the technical reports have also been prepared to support specific project permit applications submitted to local, state, and federal agencies or as part of the consultation process with resource agencies and affected Indian nations.

A more detailed description of the proposed terminal, including a complete list of proposed commodities and the phasing plan, is provided in the *Revised Project Information Document* (Pacific International Terminals, Inc., 2012).

1 Summary

The air quality analysis for the proposed Gateway Pacific Terminal (GPT) Project described in this report considered air pollutant emissions and off-site concentrations that could result from the construction and operation of the proposed facility. The analysis considered operations with Phase 1 levels of activity in 2016 and with complete buildout and full capacity operations in 2026. In addition to evaluating air emissions from on-site activities, the air quality review also considered the air quality implications of locomotive operations along the Custer Spur and vessels near the site.

The air quality assessment of facility operations included development of detailed emission inventories based on spatially and temporally distributed emissions from the following sources:

- transiting and hotelling ocean-going commodity transport vessels
- harbor assist vessels (tugs)
- project-related locomotive operations along the Custer Spur and on the GPT site were analyzed; other potential future traffic on Custer Spur was not included in the analysis of project effects
- railcar commodity unloading within on-site buildings
- conveyor transport of coal to pile stackers
- coal stackers creating piles
- coal-pile fugitive emissions including wind erosion
- mechanized reclaimers removing coal from piles and placing it onto conveyors
- conveyor transport of coal and other commodities (e.g., potash) to vessel loaders on the facility wharf
- vessel loading of coal and other commodities

Emissions from these sources and activities were then evaluated with air quality dispersion modeling. The air quality analysis considered emissions and concentrations of "criteria" air pollutants (e.g., particulate matter) and one selected toxic air pollutant, diesel particulate matter.

This report does not assess the potential for coal dust emissions from unit trains traveling on the Custer Spur. Additional information on this issue will be provided during the EIS process for the GPT.

The air quality analysis indicated emissions from on-site activities and off-site commodity transport would not result in any off-site air pollutant concentrations exceeding the health-based ambient air quality standards for criteria pollutants. All

model-calculated air pollutant concentrations except short-term NO_2 are far less than the respective standards. Dispersion modeling coupled with statistical post-processing to represent a reasonable worst-case situation indicated NO_2 concentrations in a small area near the transiting train tracks could rise to near the level of the 1-hour ambient standard in 2016, but would not exceed the standard. By 2026, reduced emissions from locomotives would result in significantly lower modeled NO_2 levels.

There are no ambient air quality standards for diesel engine exhaust particulate matter (DPM). However, an analysis of DPM indicated facility operations and commodity transport would result in DPM concentrations exceeding the Washington State screening level for this pollutant in both 2016 and 2026. This report presents further information to put these concentrations into context.

In addition, this report analyzes the GPT project's emissions of greenhouse gases (GHG). A tabulation of GHG emissions associated with operations of the facility, train transport along the Custer Spur, and vessel transport out 3 nautical miles indicated annual GHG emissions would exceed 25,000 metric tons per year. Because the project includes features that would reduce GHG emissions by far more than suggested in Washington State Department of Ecology guidance for a reduction "threshold," no additional impact assessment of GHG emissions is warranted.

2 Introduction

This report documents the air quality impact and mitigation assessment performed by ENVIRON International Corporation (ENVIRON) as part of the environmental review for the proposed Gateway Pacific Terminal project at Cherry Point in Ferndale, WA.

3 Project Description

Pacific International Terminals, Inc. (Pacific International Terminals) is proposing to develop the Gateway Pacific Terminal (GPT) at Cherry Point in Whatcom County, Washington (**Figure 1**, page 59). Designed for export and import of dry bulk commodities, the proposed terminal would include a deep-draft wharf with access trestle, dry bulk materials handling and storage facilities, and rail transportation access.

The proposed Gateway Pacific Terminal would serve as a deep-water, multimodal terminal for the export and import of dry bulk commodities between rail and oceangoing vessels. [(1)] The project area encompasses 1,200 acres out of which the terminal infrastructure would be developed on approximately 334 acres. The project area is located in the Cherry Point Industrial Urban Growth Area (UGA), which is zoned for heavy-impact industrial land use. Under the Whatcom County Shoreline Management Program, the property is designated as part of the Cherry Point Management Area, where port and water-dependent industrial facilities are permitted.

The terminal layout and design have evolved from the project design previously permitted by Whatcom County. The current design reflects changes in international dry bulk commodity demand and vessel size and incorporates changes based on requests from regulatory authorities and ongoing discussions with stakeholders. The proposed design and operational plan for the GPT reflect considerations of potential environmental impacts and Tribal concerns, and the resulting design includes proposed measures to mitigate those impacts and concerns. The design also includes measures required to meet existing regulatory standards regarding environmental protection.

3.1 Terminal Design Elements

The proposed terminal layout is depicted in **Figure 2**. It would include the following key facilities:

> **Wharf and Trestle** – The proposed terminal's wharf and trestle would be located in an area where deep water is close to shore allowing the terminal to accept the largest and most economic dry bulk carriers currently in service. The wharf would include three

[(1)] Dry bulk commodities include forest, agricultural, and mining products that are particulate in nature that are not processed on site nor packaged in any way. Dry bulk commodities are mainly transported as shiploads or trainloads, and handled using large-capacity containers or storage pads and dedicated transfer machinery generally incorporating conveyor systems. Dry bulk commodities include, for example, grain, iron ore, salts, coal, potash, and alumina. Bulk commodities are the "raw materials" upon which many industrial processes depend.

deep-water berths suitable for calls by Panamax and Capesize bulk carriers. [2] The ability to accommodate large vessels would minimize vessel traffic and maximize the efficiency of terminal operations.

Materials Handling and Storage – The terminal material handling and storage areas would consist of two areas: one for open air commodity storage and the other for covered and silo storage. [3] The storage areas would be serviced by two rail loops and other miscellaneous support facilities, including stormwater systems. Materials unloading, handling, and loading equipment would be installed that best protects the safety of employees and protects the environment during terminal operations.

Rail Connection – The project area is served by BNSF Railway Company's (BNSF) Custer Spur Industrial rail line (Custer Spur), which connects to BNSF main line at Custer, Washington, approximately 6 miles from the project area. The Custer Spur/mainline connection is called the Custer Wye. The Custer Spur would provide access to the nationwide rail network.

The terminal would be developed to have the capacity to export and import up to 54 million metric tons per year (mmtpy) of dry bulk commodities. The type and quantity of dry bulk commodities that would be handled at the terminal will likely change over time and would depend on international market conditions and customer demands. Products to be exported to the international market would include coal, grain products, potash, calcined petroleum coke, and other bulk commodities. The main features of the proposed terminal are shown in **Figure 2**.

As a deep-water, multimodal marine terminal for the export and import of dry bulk commodities, the terminal has been designed to meet the operational needs of Pacific International Terminals and to serve dynamic international bulk commodity markets successfully over the long term. The terminal design provides maximum flexibility to handle a wide range of commodities as market needs and customer demands change over time. The deep-draft wharf and storage and handling areas allow the terminal to load large, ocean-going vessels efficiently for shipment of commodities to Asian and other international markets.

Because the terminal would handle a broad range of dry bulk commodities during its functional life, it would be designed so that only minor changes in infrastructure would be required to accommodate different commodities, or to change from export to import. For successful operation, a large land area is needed to provide sufficient space to store cargo temporarily at the terminal and to support the required rail infrastructure. In addition, a deep-draft wharf is

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[2] **Panamax** vessels are the largest vessels that can currently transit the Panama Canal, with capacities of 65,000 to 85,000 dead weight tons (dwt); the dwt measure was historically based on long tons (2,240 pounds), but is now typically based on metric tons (tonnes). **Capesize** vessels are a class of bulk carrier with beams (widths) greater than 105.6 feet that are too wide to transit the Panama Canal, and therefore travel around the Cape of Good Hope or Cape Horn. The majority of existing Capesize fleet has capacities between 160,000 and 180,000 dwt.

[3] Certain dry commodities, such as grain and potash, are ruined by moisture and thus would be stored in covered structures or silos.

necessary to accommodate the large Panamax and Capesize vessels that currently service the import/export commodity trade.

The GPT facility would require extensive infrastructure and utilities as part of the development of the following project components:

- Two independently operational, industrial service rail loops (the "East Loop" and "West Loop") with sufficient trackage to handle projected bulk volumes by rail; both loops would be connected to the BNSF Railway Custer Spur, and each loop would house associated commodity storage capacity, material-handling and conveyance equipment, and other required bulk handling infrastructure
- A Shared Services Area providing access from the East and West Loops to the trestle and wharf
- A three-berth, deep-draft wharf with ship-loading equipment and an access trestle extending from the shoreline to the wharf
- Stormwater management systems and other utilities
- Specific design features to avoid, minimize, or compensate for the environmental effects of the terminal
- Improvements to the existing BNSF Railway Custer Spur, including rail receiving/ departing infrastructure and, eventually, a double track from the Custer Wye to the proposed terminal

3.2 Expected Terminal Construction Staging and Throughput Phasing

3.2.1 Construction Stages

Pacific International Terminals expects to construct the terminal in two stages, with four phases of gradually increasing throughput up to the facility design maximum. The first stage of construction is planned to commence in early 2014 after completion of necessary environmental reviews and issuance of required federal, state, and Whatcom County permits and authorizations. The second stage of construction would commence during construction of Stage 1, and be completed in 2018. Additional materials-handling equipment would be added in subsequent years in response to operational needs.

Stage 1 construction would include installation of the following elements:

- Access trestle and wharf with one ship loader connected to one belt conveyor line
- The Shared Services Area, including the longshoreman's services building
- Compensatory mitigation for the fully developed facility (to address potential impacts of both Stage 1 and Stage 2 construction)
- Rail infrastructure required at full terminal capacity for the East Loop, including:
  - → All bulk earthwork required for full terminal capacity, including the earthworks required to support four inbound rail lines and four outbound rail lines
  - → Tracks for two inbound rail lines and two outbound rail lines (two tracks would be installed at a later date)
  - → One rail unloading station
- The entire East Loop stockpile patio area
- Two stacker/reclaimer lines

- Covered, elevated conveyor systems leading to and from the stacker/reclaimers and to the Shared Services Area
- Access roadways and parking areas for the East Loop and Shared Services Area
- Stormwater management facilities at the East Loop, Shared Services Area, wharf, and access trestle
- Administration and maintenance buildings for the East Loop
- All utilities that would be required at complete development, including water, electrical, wastewater management, and communications
- Up to three receiving and departure tracks on the Custer Spur near the Valley Yard
- Upgrade of the existing Custer Spur tracks to include structural hardening and continuous welded rail from the Valley Yard to the terminal.

Stage 2 construction would complete the West Loop infrastructure and would provide improvements to the wharf to increase the material handling capacity by an additional 6 mmtpy of commodities. This stage of construction would add operating capacity and flexibility to handle different types and quantities of commodities at the terminal.

Stage 2 construction would include installation of the following facilities:

- All of the West Loop's infrastructure, including:
  - → All bulk earthwork for the West Loop rail lines
  - → Construction of the West Loop rail lines
  - → One rail loading/unloading station
  - → Access roadways
  - → A-frame storage shed
  - → Bulk storage silos
  - → Conveyor lines
  - → Stormwater management system
- A second ship loader on the wharf connected to a new conveyor line on the access trestle
- A second conveyor line in the Shared Services Area

3.2.2 Operational Stages

The Gateway Pacific Terminal **East Loop** would handle a wide variety of dry bulk commodities in its lifetime. Initially, it is anticipated that the East Loop would predominantly handle low-sulfur, low-ash coal. The general layout of the East Loop is shown in **Figure 2**. The terminal East Loop would include the following facilities:

- Service rail loop and unloading station
- 80-acre stockyard and associated machinery, including coal stacking and reclaiming machines
- Approximately 8,000 square feet of new buildings
- Conveyors for out-loading and in-loading commodities
- Access roadways

The East Loop would also include development of utilities, such as stormwater treatment facilities, electrical power, lighting, water, communications, and wastewater facilities.

The GPT **West Loop** would be designed to handle multiple types of dry bulk commodities. Similar to the East Loop, the West Loop would be designed so that changes in types of commodities or a change from export to import operation would require only minor changes in infrastructure. The West Loop is initially planned to handle export of calcined petroleum coke and potash, and would have rail infrastructure and covered bulk commodity storage areas. The area would include stacking and reclaiming conveyors, an unloading station, and out-loading/in-loading conveyor lines.

The terminal West Loop would include the following facilities:

- Rail loop and unloading station
- 17-acre storage area and associated machinery
- Conveyors and conveyor lines
- Access roadways

Development of the West Loop would also include electrical power, water, stormwater, lighting, communications, and wastewater facilities.

Four operational phases dictated by the growth in capacity of the terminal (nominal maximal throughput) are anticipated (**Table 1**). The terminal would begin operations at completion of Stage 1 construction with an operational capacity of approximately 25 million metric tons per year (mmtpy). At the completion of Stage 2 construction, terminal capacity would reach 31 mmtpy. Two subsequent operational thresholds are envisioned (achieved approximately by 2021 and 2026), with the maximum capacity of the terminal (54 mmtpy) reached during Operational Phase 4.

Table 1. Terminal Commodity-Handling Capacity by Development Phase

Operational Phase	Approximate Year	Capacity at West Loop (mmtpy)	Capacity at East Loop (mmtpy)	Total Nominal Maximum Capacity (mmtpy)
1	2016	0	25	25
2	2018	6	25	31
3	2021	6	39	45
4	2026	6	48	54

mmtpy = million metric tons per year

Source: Pacific International Terminals 2012

Capacity would grow from 31 to 45 mmtpy during Phase 3 by addition of a third stacker/ reclaimer at the East Loop to manage an additional stockpile of 1 million metric tons within the existing East Loop patio area. Additional equipment upgrades needed to accomplish this level of capacity would likely include:

- Two additional rail lines adjacent to the two existing lines in the East Loop (no new embankment would be needed because all earthwork was completed during Stage 1 construction)
- An additional shipping conveyor with its own surge bin, running from the East Loop to the Shared Services Area
- An additional (third) conveyor in the Shared Services Area, access trestle, and wharf
- A third ship loader added to the wharf

To reach the full operational capacity of 54 mmtpy, one additional stacker/reclaimer would be installed at the East Loop.

3.3 Project Design Elements Intended To Minimize Emissions

The GPT facility as proposed includes a number of components either specifically designed to minimize emissions associated with on-site operations or whose use would have this effect. These emission control components are discussed in section **5.1.4** (page 29) of this report.

4 Affected Environment

4.1 Regulatory Overview

4.1.1 Ambient Air Quality Standards and Attainment Status

Air quality is generally assessed in terms of whether concentrations of air pollutants are higher or lower than ambient air quality standards set to protect human health and welfare. Ambient air quality standards are set for what are referred to as "criteria" pollutants (e.g., carbon monoxide - CO, particulate matter, nitrogen dioxide - NO_2, and sulfur dioxide - SO_2). Three agencies have jurisdiction over the ambient air quality in the proposed project area: the U.S. Environmental Protection Agency (EPA), the Washington State Department of Ecology (Ecology), and the Northwest Clean Air Agency (NWCAA). These agencies establish regulations that govern both the concentrations of pollutants in the outdoor air and rates of contaminant emissions from air pollution sources. Although their regulations are similar in stringency, each agency has established its own standards. Unless the state or local jurisdiction has adopted more stringent standards, the EPA standards apply. Applicable local, state, and federal ambient air quality standards are displayed in **Table 2**. These standards have been set at levels that EPA and Ecology have determined will protect human health with a margin of safety, including the health of sensitive individuals like the elderly, the chronically ill, and the very young.

Ecology and NWCAA maintain a network of air quality monitoring stations throughout the Puget Sound area. In general, these stations are located where there may be air quality problems, and so are usually in or near urban areas or close to specific large air pollution sources. Other stations located in more remote areas provide indications of regional or background air pollution levels. Based on monitoring information for criteria air pollutants collected over a period of years, Ecology and EPA designate regions as being "attainment" or "nonattainment" areas for particular pollutants. Attainment status is therefore a measure of whether air quality in an area complies with the federal health-based ambient air quality standards for criteria pollutants. Once a nonattainment area achieves compliance with the National Ambient Air Quality Standards (NAAQSs), the area is considered an air quality "maintenance" area. One aspect of the air quality study described here was to assess whether ambient air quality would continue to comply with the NAAQSs with the GPT project operating, and thus, whether the GPT project would result in any potential significant adverse air quality impacts.

Table 2. Applicable Ambient Air Quality Standards for Criteria Pollutants

Pollutant	Terms of Compliance [a]	Concentration
Total Suspended Particulate (TSP) Annual Average (µg/m^3) 24-Hour Average (µg/m^3) WA State only; no federal standard	Geometric mean not to exceed Not to be exceeded more than once per year	60 µg/m^3 150 µg/m^3
Inhalable Particulate Matter (PM10) Annual Average (µg/m^3) 24-Hour Average (µg/m^3)	Arithmetic mean; not to be exceeded The 3 year average of the 98th percentile of the daily concentrations must not exceed	50 µg/m^3 [b] 150 µg/m^3
Fine Particulate Matter (PM2.5) Annual Average (µg/m^3) 24-Hour Average (µg/m^3)	The 3-year annual average of daily concentrations must not exceed The 3-year average of the 98th percentile of daily concentrations must not exceed	12 µg/m^3 [c] 35 µg/m^3
Sulfur Dioxide (SO_2) [b] Annual Average (ppm) 24-Hour Average (ppm) 1-Hour Average (ppm) 1-Hour Average (ppm)	Annual arithmetic mean of 1-hour averages must not exceed 24-hour average must not exceed 1-hour average must not exceed No more than twice in 7 consecutive days may 1-hour average exceed	0.02 ppm [b] 0.10 ppm [b] 0.40 ppm [b] 0.25 ppm [b]
Carbon Monoxide (CO) 8-Hour Average (ppm) 1-Hour Average (ppm)	The 8-hour average must not exceed more than once per year The 1-hour average must not exceed more than once per year	9 ppm 35 ppm
Ozone (O_3) 8-Hour Average (ppm)	The 3-year average of the 4th highest daily maximum 8-hour average must not exceed	0.075 ppm
Nitrogen Dioxide (NO_2) Annual Average (ppm) 1-Hour Average (ppm)	The annual mean of 1-hour averages must not exceed 3-year avg. of 98th percentile of daily max 1-hour averages must not exceed	0.053 ppm 0.1 ppm
Lead (Pb) Rolling 3-month Average	Rolling 3-month average not to exceed	0.15 µg/m^3

Note: µg/m^3 = micrograms per cubic meter; ppm = parts per million

[a] All limits are federal *and* state air quality standards except as noted. All indicated limits represent "primary" air quality standards intended to protect human health.

[b] Washington State standards; Washington applies more stringent annual and 24-hour limits for SO_2 than in federal rules. There is also a federal 0.5 ppm 3-hour average "secondary" standard for SO_2 to protect welfare.

[c] EPA issued a new 12 µg/m^3 annual standard on 12/14/2012 that will become effective on March 18, 2013; the previous annual standard was 15 µg/m^3.

4.1.2 Acceptable Source Impact Levels for Air Toxics

In addition to the health-based ambient air quality standards described above there are screening-level regulations for air pollutants that are known or suspected to be toxic or carcinogenic to people. These screening levels, known as Acceptable Source Impact Levels or ASILs, are applied in permitting processes for industrial pollution sources (e.g., a power plant). But these screening limits will not apply to any on-site sources associated with the GPT project. [(4)] In addition, these limits do not apply to the mobile sources associated with facilities like the proposed GPT project. These screening levels are sometimes used as benchmarks for considering concentrations of toxic air contaminants, so they are discussed more completely in later sections of this report.

4.1.3 Air Quality Conformity Review

Special air quality "conformity" rules apply in areas that are designated as nonattainment or maintenance for one or more air pollutants. These rules do not apply in the project study area because the area is considered in attainment for all criteria air pollutants. Consequently, neither the "transportation" nor the "general" conformity rules apply to this project.

4.2 Existing Air Quality Conditions

Existing sources of air pollution in the project study area include several industrial sources (refineries and bulk fuel storage facilities), local traffic sources, and residential wood burning associated with low density residential development. Residential wood burning produces a variety of air contaminants, including large quantities of inhalable coarse and fine particulate matter (PM_{10} and $PM_{2.5}$). With typical vehicular traffic, the air pollutant of concern is carbon monoxide (CO). Other pollutants include ozone precursors (hydrocarbons and nitrogen oxides – NOx), coarse and fine particulate matter (PM_{10} and $PM_{2.5}$), and SO_2. The amounts of particulate matter generated by well-maintained individual vehicles are minimal compared with other sources (e.g., a wood-burning stove), and concentrations of SO_2 and NO_x are usually not high except near large industrial facilities. In Whatcom County, industrial sources likely comprise the largest contributors to ambient pollutant concentrations. Concentrations of air pollutants measured in the general vicinity of the project site are summarized in **Table 3**.

4.2.1 Carbon Monoxide

Carbon monoxide is the product of incomplete combustion. It is generated by transportation sources and other fuel-burning activities like residential space heating, especially heating with solid fuels like coal or wood. Carbon monoxide is often used as an indicator of possible air quality impacts related to roadway transportation sources because it is the pollutant emitted in the greatest quantity for which short-term health standards exist. CO impacts are usually highly

[(4)] NWCAA rule 300.4 i) exempts from new source review permitting requirements any stationary internal combustion engine whose operation is limited to emergency situations and required testing and maintenance that operates fewer than 500 hours a year. Because these generators are the only stationary combustion sources associated with the GPT facility, and because the ASILs only apply to stationary combustion sources, these screening levels do not apply to this project.

localized, and CO concentrations typically diminish within a short distance of roads. The highest ambient concentrations of CO usually occur near congested roadways and intersections during wintertime periods of air stagnation.

There have been no measured violations of the CO ambient air quality standard within Washington State for several years. The project site is located in an area considered in attainment for CO.

Table 3. Summary of Measured Ambient Pollutant Concentrations

Pollutant	Monitoring Location	Averaging Period/(Source)	Measured Concentration	Unit	Year	Ambient Standard
$PM_{2.5}$	Bellingham Yew St	Annual, NAAQS (1)	6.0	µg/m³	2010	12
		24-hr, NAAQS (1)	15.8	µg/m³	2010	35
NO_2	Langley, BC	Annual, NAAQS (3)	11.8	µg/m³	2011	100
		1-hr, NAAQS 3-Yr Avg. of 98th percentile (3)	51.7	µg/m³	2009-2011	188
	La Conner, WA	1-hr, NAAQS 3-Yr Avg. of 98th percentile (2)	52.3	µg/m³	2009-2011	
SO_2	Bellingham Chestnut St	Annual, NAAQS (1)	14.2	µg/m³	1999	79
		24-hr Max, NAAQS (1)	36.7	µg/m³	1998	367
		1-hr, NAAQS 99th pct.	89.0	µg/m³	1998	196
Ozone	Custer Loomis	8-hr, NAAQS (1)	0.047	ppm	2010	9
		1-hr, Max, WA (1)	0.065	ppm	2010	0.12

Source: (1) Puget Sound Clean Air Agency: http://www.pscleanair.org/airq/datarequest.aspx; (2) US EPA: http://www.epa.gov/airquality/airdata/ad_maps.html; (3) Metropolitan Planning, Environmental and Parks Department, Metro Vancouver, BC

4.2.2 Ozone

Ozone is a highly reactive form of oxygen created by sunlight-activated chemical transformations of nitrogen oxides and volatile organic compounds (hydrocarbons) in the atmosphere. Ozone problems tend to be regional in nature because the atmospheric chemical reactions that produce ozone occur over a period of time, during which ozone precursors can be transported far from their sources. Transportation sources including large marine vessels, locomotives, and trucks are some of the sources that produce ozone precursors. Because ozone is not emitted directly, only very sophisticated air quality models are capable of considering ozone formation in the atmosphere, and such models are typically used for regional assessments of air quality plans. Thus, ozone modeling is not typically performed for project-specific reviews, and ozone was not considered in the air quality impact analysis for the GPT project.

A large portion of the Puget Sound region was once designated as nonattainment for ozone based on violations of the 1-hour standard in effect at that time. In 1997, the EPA determined that the Puget Sound ozone nonattainment area had attained the public health-based NAAQS

for ozone. At that time, EPA redesignated the Puget Sound region as attainment for ozone and approved the associated air quality maintenance plan. In 2005, EPA revoked the old 1-hour ozone standard in most areas of the US including the Puget Sound region. This action ended the maintenance status of this region. At the same time, however, the EPA adopted a new more stringent 8-hour average ozone standard that has since been made even more stringent and currently applies. [5] Some ozone measurements over the last few years have exceeded the 8-hour average standard (**Table 2**). If this pattern persists, the Puget Sound region may again be designated nonattainment for ozone. The ozone precursors (volatile organic compounds – VOCs – and oxides of nitrogen – NOx) are therefore important air pollutants in this region that will be considered as future air pollution control strategies are developed.

Ozone concentrations measured in the upper Puget Sound at the Custer-Loomis monitoring station indicate 8-hour concentrations reaching only about 60% of the NAAQS (**Table 3**). Under current air quality plans and policies, the potential future nonattainment status for ozone has no direct implications for the proposed GPT project.

4.2.3 Inhalable Coarse and Fine Particulate Matter – PM_{10} and $PM_{2.5}$

Particulate matter air pollution is generated by industrial activities, fuel combustion sources like marine vessels, residential wood burning, locomotives, motor vehicle engines and tires, and other sources. Federal, state, and local regulations set limits for particulate concentrations in the air based on the size of the particles and the related potential threat to health. When first regulated, airborne particulate matter rules were based on concentrations of "total suspended particulate," which included all size fractions. As air sampling technology has improved and the importance of particle size and chemical composition have become more clear, ambient standards have been revised to focus on the size fractions thought to be most dangerous to human health. Based on the most recent studies, EPA has redefined the size fractions and set new, more stringent standards for particulate matter based on fine ($PM_{2.5}$) and coarse (PM_{10}) inhalable particulate matter to focus control efforts on the smaller size fractions.

There are currently health-based ambient air quality standards for PM_{10}, or particles less than or equal to about 10 micrometers (microns) in diameter, as well as for $PM_{2.5}$, or particulate matter less than or equal to 2.5 microns in diameter (**Table 2**). $PM_{2.5}$ and even smaller (ultra-fine) particles are now thought to be the most dangerous size fractions of airborne particulate matter.

With the revocation of the federal annual standard for PM_{10} in October 2006, the focus of ambient air monitoring and control efforts related to particle air pollution in the Puget Sound region has been almost entirely on $PM_{2.5}$. The measurement location closest to the project site is in Bellingham. Based on reported data at that location, measured $PM_{2.5}$ values are about one-half of the current 24-hour and annual NAAQS (**Table 3**).

[5] The current 8-hour ozone standard became effective May 27, 2008.

The GPT project study area has never been included in a particulate matter nonattainment area. Particulate matter concentrations associated with the proposed GPT project are analyzed in detail as part of the air quality review reported here.

4.2.4 Sulfur Dioxide (SO_2)

Sulfur dioxide is a colorless, corrosive gas produced by burning fuels containing sulfur like coal and oil, and by industrial facilities such as smelters, paper mills, power plants and steel manufacturing plants. Except near large emission sources, SO_2 levels are typically well below federal standards. Over the past decade the Puget Sound area has experienced a significant decrease in SO_2 from sources such as pulp mills, cement plants, and smelters. Additionally, levels of sulfur in diesel and gasoline fuels are decreasing due to federal regulations set by the US Environmental Protection Agency.

Existing SO_2 emission sources in the project area include large industry near the Cherry Point area, vessels in transit and generating electrical power while moored (hotelling), and diesel-fueled vehicles traveling area roadways that contribute to ambient background concentrations of SO_2. The nearest agency-operated SO_2 monitoring station was located in Bellingham up until 1999, but the BP Cherry Point Refinery has also measured SO_2 concentrations in more recent years. Measured concentrations at the BP monitoring station 2 km north of the GPT site indicate background SO_2 concentrations in the project vicinity are approximately 53% of the restrictive 1-hour standard (**Table 3**, above). SO_2 concentrations associated with the proposed GPT project are analyzed in detail as part of the air quality review reported here.

4.2.5 Nitrogen Oxides (NOx)

The sum of nitric oxide (NO) and nitrogen dioxide (NO_2) is commonly called oxides of nitrogen or NOx. Other oxides of nitrogen, including nitrous acid and nitric acid are part of the nitrogen oxide family. Of this family of gasses, NO_2 is the only component for which ambient air quality standards have been established, and this pollutant is used as the indicator for the larger group of nitrogen oxides. There is an annual average standard for NO_2 that has been in effect for many years.

EPA adopted a new 1-hour standard for NO_2 that became effective in April 2010. NO_2 has not been measured in the project vicinity, though measurements have been taken near La Conner, WA and Langley, BC. The reported 1-hour and annual average concentrations presented in **Table 3** indicate that background NO_2 concentrations are well below the current NAAQS. NO_2 concentrations attributable to sources associated with the proposed GPT project are considered in detail in the air quality review documented in this report.

4.2.6 Toxic Air Pollutants (TAPs)

In addition to the criteria air pollutants for which health-protective air quality standards have been set, fuel combustion sources emit a number of known or suspected toxic air pollutants that may be directly harmful due to their chemistry and/or cause cancer or other detrimental effects to human health with long-term exposure. Although there are not any specific health-related air quality *standards* for such pollutants, EPA, Ecology, and NWCAA have established *screening* levels for a variety of toxic air pollutants (TAPs) that can be used in assessing the relative potential of adverse impacts. One TAP, diesel engine exhaust particulate matter (DPM), was

considered in this analysis because information regarding GPT project-related emissions of this pollutant is expected to be of interest during the environmental review phase for this project.

A common method of assessing potential risk related to exposure to TAPs is to estimate the likelihood of increases in cancer due to a lifetime of exposure (usually assumed to be 70 years) to a given contaminant. Some screening levels for assessing such potential risk are based on an increased risk of one additional cancer among one million people. Ecology and NWCAA have adopted this sort of conservative screening approach for TAPs using screening levels called Acceptable Source Impact Levels (ASILs). ASILs are used during air quality permitting review of proposed new or modified stationary emission sources and ASILs are applied based on the incremental changes in pollutant concentrations expected to occur due to proposed projects. The Washington State ASILs are ***not*** intended for use in evaluating emissions from mobile sources such as those associated with the GPT project because such sources are not subject to air pollution permits. The ASILs nonetheless represent general benchmarks that can be used for assessing potential risk related to exposure to TAPs.

As screening levels, ASILs and guidelines used for reviewing potential impacts related to TAPs are based on estimated health impact thresholds derived through review of available scientific studies. Unlike the ambient air quality standards for criteria air pollutants which are adopted after rigorous review of the science involved, screening levels like ASILs are adopted based on much less thorough evaluations.

The ASIL referred to in this assessment is also fundamentally different than the ambient air quality standards (NAAQSs) adopted to protect human health and welfare with a margin of safety. The NAAQSs shown in **Table 2** are designed to protect against known or suspected short-term acute and long-term chronic health effects due to exposure over certain periods of time. The NAAQSs are based on protecting even the most sensitive populations from exposure over periods ranging from 1 hour to 1 year. For example, SO_2 standards are based on 1-hour, 3-hour, 24-hour, and annual average concentrations, and the ambient standards for other criteria pollutants are similarly based on time-weighted average exposure limits.

In contrast, the ASILs such as the one for DPM considered in this analysis are based on estimates of the possible risk of the additional incidence of cancer in a population with *continuous* (i.e., 24 hours per day) exposure over 70 years. So instead of standards based on relatively well-defined dose-responses, the long-term TAPs screening levels are based on the estimated potential risk associated with long-term, constant exposure. For this reason, the TAPs screening level are not given the same weight during emission source review processes, and do not have the same force of law as do the NAAQSs.

Although the ASILs for TAPs do ***not*** apply to mobile sources associated with the proposed project, the ASIL for DPM was considered in this assessment to provide a rough benchmark for assessing potential impacts of DPM emissions. The Washington TAP screening impact level for DPM is a 0.0033 $\mu g/m^3$ annual average concentration (**Table 4**). The US EPA has not adopted a similar cancer risk estimate for use at the federal level due to continuing uncertainties in the underlying data. EPA says, "[diesel exhaust] human exposure-response data are considered too uncertain to derive a confident quantitative estimate of cancer unit risk . . ." (EPA 2002). Instead, EPA uses a 5.0 $\mu g/m^3$ Reference Concentration (RfC) to represent the exposure

through inhalation to which humans may be exposed throughout their lifetime without being likely to experience adverse *non-cancer* respiratory effects (**Table 4**).

The Washington State Department of Ecology indicated they consider the ASIL concentration for DPM to represent a "negligible risk," and went on to note that "even the least exposed Washingtonians are likely to be exposed to higher diesel particulate concentrations [than the ASIL]" (2008). Ecology also reported that EPA estimated the median DPM exposure in Washington to be 0.249 µg/m^3 – a level 75 times greater than the ASIL (Ecology 2008).

Table 4. Air Toxic Impact Screening Levels

Toxic Air Pollutant	Washington ASIL Annual Average (µg/m^3)	US EPA RfC (µg/m^3)
Diesel Engine Exhaust Particulate Matter (DPM)	0.00330	5.0

Note:

Acceptable Source Impact Levels (ASILs) represent screening levels intended to be used during permitting processes for stationary air pollution emission sources. ASILs do *not* apply to mobile sources and are not required to be considered during environmental reviews. This screening level is considered for discussion purposes only. The DPM ASIL is used in Washington as an indicator of potential risk of an increase in cancer rates of 1 in 1 million people exposed for 70 years. EPA has not adopted a cancer risk factor for DPM due to uncertainties in the underlying data; the EPA RfC is a non-cancer risk factor representing an estimated safe level of exposure over a lifetime.

Sources: WAC 173-460-150; EPA 2002

4.3 Meteorological Conditions and Climate

Air quality is substantially influenced by climate and meteorological conditions, so prevalent weather patterns are a major factor in long-term air quality conditions. Climate in the project study area is affected by regional geography. The lowlands of Northwest Washington are surrounded by mountains and water bodies. Mountainous regions dominate to the south, east (Cascades), and north (Coast Mountains in Canada), while the Strait of Georgia borders the west. The combination of mountains and water create a regional meteorology unique to the Pacific Northwest. The climate is dominated by cooler summers that are comparatively dry, and winters that are mild, wet, and cloudy. Annual average precipitation measured at Bellingham, Washington reaches 35 inches, with the wettest months being November, December, and January, and with an average snowfall of 13.7 inches.

Wind direction and wind speed are complicated by geography so it is more difficult to represent predominant winds using more distant climatological data. However, the BP Cherry Point Refinery (BP Cherry Point) measures wind speed and wind direction near its facility. ENVIRON used a 5-year meteorological data set (2001–2005) assembled for a previous modeling analysis (for a different project) in the GPT analysis. A wind rose representing these data is presented and discussed in section **5.2.2**. This meteorological data set was used in the air quality modeling analysis documented in later sections of this report.

4.4 Greenhouse Gases and Global Climate Change

The phenomena of natural and human-caused effects on the atmosphere that cause changes in long-term meteorological patterns due to global warming and other factors is generally referred to as "climate change." Due to the importance of the "greenhouse effect" and related atmospheric warming to climate change, the gases that affect such warming are called greenhouse gases or GHGs. The GHGs of primary importance are carbon dioxide (CO_2), methane, ozone, and nitrous oxide. Because CO_2 is the most abundant of these gases, GHGs are usually quantified in terms of CO_2 equivalents, or CO_2e.

Transportation is a significant source of GHG emissions primarily through the burning of gasoline and diesel fuels. National estimates indicate the transportation sector (including on-road, construction, airplanes, and vessels) accounts for 25 percent or more of total domestic CO_2 emissions. In 2008, emissions estimates for Washington suggest transportation accounted for nearly half of GHG emissions because the state relies heavily on hydropower for electricity, unlike other states that rely more heavily on fossil fuels (e.g., coal, petroleum, and natural gas) to generate electricity. The next largest contributors to total gross GHG emissions in Washington were about 20 percent each in fossil fuel combustion in the residential, commercial, and industrial sectors and in electricity generation. Agricultural activities and specific industrial processes, such as aluminum or cement manufacturing, accounted for about 6% each, while solid waste management activities, including GHG emissions from landfills, contributed about 3 percent (Ecology 2010).

CO_2 is not considered an air "pollutant" that causes direct health-related impacts, so it is not subject to ambient standards used to gauge pollutant concentrations in the air. The GHG tabulation for this project was developed using accepted techniques for emission inventories, but this listing is intended only to provide a preliminary indication of potential project-related GHG emissions based on estimated direct and indirect emissions from project-related fuel combustion sources within the project study area.

There are no specific emission reduction requirements or targets applicable to the GPT project, nor are there any generally accepted emission level "impact" thresholds with which to assess potential localized or global impacts related to GHG emissions. The Washington Department of Ecology has issued internal guidance to assist its staff in determining which projects should be evaluated and how to evaluate GHG emissions under SEPA (Ecology 2011a). These guidelines suggest Ecology staff make SEPA decisions on a case-by-case basis. The suggested emission guidelines are discussed further in Mitigation Section **7.2**.

5 Analytical Methods

The air quality impact analysis included two basic steps: (1) emission inventory development to estimate emissions related to operation of the terminal facilities in 2016 with Phase 1 operations and in 2026, with Phase 4 operations, and (2) dispersion modeling to estimate resulting air contaminant concentrations in the ambient air associated with each of these phases of operation. The following sections discuss the methods employed and the critical assumptions involved in each portion of the analysis.

5.1 Emission Inventory Methods

The proposed facility would result in emissions from vessels and trains (i.e., fuel combustion sources) and "fugitive" (i.e., non-source specific) non-combustion emissions (i.e., dust) from coal and other commodity handling. There would also be two small (250 kW) on-site emergency generators that in the event of a power failure would allow the mechanical systems to shut down without being damaged. All of these emissions were considered in the emission inventory and the subsequent dispersion modeling analyses.

5.1.1 Emission Factor Tools and Sources

The emissions estimates for project-related sources employed several standard computer tools as well as emission rate calculations using formulas published by EPA. The application of these tools varied by the project phase being considered (i.e., construction or operation). Important assumptions employed in this portion of the assessment are summarized in **Table 5**.

Table 5. Emission Factors: Tools, Sources, and Critical Assumptions

Equipment Type	Tool/Method Source and Critical Assumptions
GPT Construction Phase – Regarding GHG Emissions Only	
Tugs	EPA Current Methodologies in Preparing Mobile Source Port-related Emission Inventories, April 2009 (EPA, 2009) • Assume tugs use ultralow sulfur diesel 15 ppm (0.0015% S) fuel → 2015 goal of the Northwest Ports Clean Air Strategy [NWPCAS] and vessels in IMO ECAs) is 1,000 ppm [(a), (b)] • Conservatively assume Tier 2 engines → Tier 3 applies beginning in 2009 → Tier 4 applies beginning in 2014
Barge Cranes and Pile Drivers	EPA NON-ROAD Model • Non-road parameters assume default settings for WA state population/age distribution & control technology ratings • All equipment uses ultra-low sulfur diesel (ULSD) fuel
Excavators, Graders, Haul Vehicles	EPA NON-ROAD Model • Non-road parameters assume default settings for WA state population/age distribution & control technology ratings • All equipment uses ultra-low sulfur diesel (ULSD) fuel
GPT Operational Phase – GHG and Criteria Pollutant Emissions	
Ocean-Going Vessels	EPA, 2009 • Emission factors based on 1,000 ppm (0.1%) S distillate fuel (the 2015 goal of the NWPCAS and vessels in IMO ECAs) [(a), (b)] • Bulk carrier average engine 11,000 kW, w/ 3 auxiliary engines at 612 kW each → 11,000 kW for mains; ENVIRON estimate based on review of available information • Load factors for engines and boilers from EPA as follows: → Main @ cruise - 0.27 → Main maneuvering - 0.2 → Aux @ cruise - 0.27 → Maneuvering - 0.45 → Hotelling - 0.1 • 2016 NOx emission factors (EFs) conservatively **not** adjusted for Tier 3 NOx • 2026 NOx EFs are conservatively **not** adjusted for Tier 3 • Transit speed assumed to be 5 knots
Tugs	EPA, 2009 • Tugs use ULSD • Auxiliary engines and load factors from EPA methods • Assumed Tier 2 engines • 2016 NOx emission factors (EFs) **not** adjusted for Tier 3 requirements • 2026 NOx EFs are **not** adjusted for Tier 3 requirements Ausenco Sandwell • Tug power ratings at 5,000 hp (per vessel; assume 2 engines) • Assume 4 tugs for Capesize, 3 tugs for all other vessel sizes

Table 5. Emission Factors: Tools, Sources, and Critical Assumptions

Equipment Type	Tool/Method Source and Critical Assumptions
Locomotives	EPA Emission Factors for Locomotives, 2009 • Assumed fleet average emission rates for line-haul engines (that reflect fuel quality requirements) • Locomotive fuel use and time in notch setting per segment on east and west loops provided by BNSF modeling under conditions without AESS (automatic engine stop during idling); worst-case assessment because locomotives will use AESS when temperatures exceed 40°F. • Estimated daily and annual emissions from 125-car (2016) and 150-car coal train (2026) (with 5 locomotives) operations on east loop • Estimated 2026 daily and annual emissions 170-car potash trains (with 7 locomotives) on west loop [(c)] • Terminal rail traffic on Custer Spur was analyzed. Other potential future traffic on Custer Spur was not included in the analysis of project effects
Emergency Generators	EPA emission factors based on Standards for Stationary Compression Ignition Internal Combustion Engines, FR 40 CFR Parts 60, 85 et al. July 2006, Table 2 • New Source Performance Standards (NSPS) required emission rates • 2, 250 kW diesel-powered generators
Coal Pile Stacking and Reclaim	• Emission factors from AP-42, Section 13.2.4 • Emission factors in pounds per ton of material loaded • Additional factors needed are moisture content of the material (coal) and annual average wind speed • Moisture content of coal is 26.7% • Average wind speed is 5.86 mph, calculated from BP wind data • Throughput has been assumed to be 7,000 metric tons per hour for stacking (load-in) and 10,000 metric tons per hour for reclaim (load-out) for each stacker/reclaimer. • Refer to photo of large stacker/reclaimer in **Appendix A**
Conveyor Runs	• Most conveyors are covered or completely enclosed and only considered a source of emissions at transfer points that are vented to the atmosphere • Conveyors in the stacker reclaimer area are open. Emissions from these are considered with the wind erosion calculations. • Refer to photos of enclosed conveyors in **Appendix A**
Conveyor Transfer Points	• Conveyor transfer points are emission points only when vented to the atmosphere. Most conveyor transfer points, and all those involving coal with the exception of those on the wharf would be completely enclosed and dust would be controlled through the use of passive emission controls and dry fog applications. These sources were assumed to have zero emissions. • Conveyor transfer points for non-coal materials and the coal transfer points on the wharf will be enclosed, but vented to a fabric filter control device. Four 4 exhaust points were identified in addition to the railcar unloading station and the ship loader as indicated **Figure 5**. • The exhaust from several transfer points is vented to a central baghouse located at the surge bin. This baghouse would have a 50,000 cfm air flow rate and 0.005 grains per cubic foot (gr/cf) loading • Three bin vent collectors, fabric filter systems similar to a baghouse, will be

Table 5. Emission Factors: Tools, Sources, and Critical Assumptions

Equipment Type	Tool/Method Source and Critical Assumptions
	located at the wharf. Each bin vent collector will have an air flow rate of 5,000 cfm and 0.005 grains per cubic foot (gr/cf) loading.
Train car dumpers/ Baghouses	• The railcar unloading facility for coal (east loop) will include two unloading buildings operating simultaneously on adjacent tracks; these buildings will enclose the dumping under negative air pressure to prevent dust escaping the open ends of the buildings, with the air drawn off to a baghouse. • The fan capacity for the east loop railcar unloading facility assumed to be 300,000 cfm combined for both tracks with grain loading of 0.005 gr/cf • For the west loop, assumed a single railcar unloading facility; enclosed with open ends, negative pressure, and vented to a baghouse • The baghouse fan size for the west loop assumed to be 100,000 cfm with grain loading of 0.005 gr/cf
On-site Loaders (vehicles)	• On-site vehicles potentially generating dust include dozers and graders working in the stockpile area. Emission factors for these sources have been taken from AP-42, Section 11.9, Table 11.9-1 (factor for dozers applied to front-end loader since no specific factor for front-end loaders) • Emission factor is rate of dust generated per hour of operation of the dozer/front-end loader • Additional factors needed for the emission computation are silt and moisture content of the material (coal) • Assumed a moisture content of the coal of 26.7% • Assumed a silt content of the coal of 2%
Ship Loading	• Emission factor for estimating ship loading emissions for coal taken from AP-42, Section 13.2.4 • Emission factor provides emissions in pounds per ton of material loaded • The maximum potential coal loading rate of 10,000 metric tons per hour was used in the calculation of emissions • Additional factors needed are moisture content of the material (coal) and annual average wind speed • Moisture content of coal is 26.7% • Average wind speed is 5.86 mph, calculated from BP wind data • Ship loading of materials from the west loop will use specialized equipment called a "Cascade Bulk Material Loading Chute." This technique will minimize or eliminate dust from the vessel loading operations for the ship loading in the west loop. See example here: http://www.clevelandcascades.co.uk/chute.php • For purposes of calculation of emissions, an uncontrolled emission rate was first calculated on the basis of 3,000 metric tons per hour maximum potential loading rate for non-coal materials. Then a 95% control was assumed for the Cascade Bulk Material Loading Chute. • A moisture content of 0.5% for the driest material, calcined coke, was assumed. • Refer to photo of ship hold coal loading in **Appendix A**
Wind Erosion	• The only area subject to wind erosion is the stacker/reclaimer stockpile area. • This entire area was assumed to be a source of fugitive coal dust including the open surface of the conveyor belts in the stockpile area.

Table 5. Emission Factors: Tools, Sources, and Critical Assumptions

Equipment Type	Tool/Method Source and Critical Assumptions
Wind Erosion (con't)	• Emission factors for this operation are based on AP-42 Section 13.2.5, which calculates a separate emission rate for every hour based on the wind speed for each hour. • For each hour: → The hourly average wind speed is used to estimate the fastest wind speed for that hour → From the fastest wind speed, a friction velocity is computed → The friction velocity is compared to a published "threshold" → Each hour with a friction velocity exceeding the threshold is considered a wind erosion event and emissions are calculated → Hours during which the friction velocity threshold is not exceeded are considered to be zero emission • The facility plans to water the surface of the exposed coal and apply surfactants or other dust palliative materials to the open surface of the coal to reduce emissions. It has been suggested by manufacturers and others that these dust control chemicals and water can produce as much as 90% control of emissions from the piles. **http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0204.pdf** • For purposes of this analysis, the effect of the watering and chemical application was conservatively estimated to control 50% of the emissions that would otherwise evolve from an uncontrolled stockpile.

(a) The Northwest Ports Clean Air Strategy is a cooperative agreement among the Ports of Seattle, Tacoma and Vancouver, BC developed to reduce emissions from these facilities in accord with progressively more stringent emissions controls that are consistent with the programs being implemented by the International Maritime Organization. These emission control strategies do not specifically apply to the proposed GPT facility at Cherry Point, but application of such controls would be consistent with the aims of other ports in the area, and the project proponents have committed to implementation of these same controls as a means to minimize potential air quality impacts from the facility.

(b) The International Maritime Organization (IMO) has established a program to create and administer Emission Control Areas (ECA) intended to result in lower emissions within specially designated areas.

(c) ENVIRON also used dispersion modeling to evaluate the potential effects of annual train traffic based on 123-car grain trains, which would total about 512 per year if grain were to be a major export commodity. This modeling indicated grain train traffic would have only a minor effect on the maximum off-site concentrations of criteria pollutants, so the final modeling considered only potash trains.

5.1.2 Facility Operational Emissions – Combustion Sources

ENVIRON estimated combustion source (i.e., vessels and trains) emissions associated with operation of the terminal in 2016 and 2026 based on the maximum expected commodity throughput at the operational facility in those years. The combustion source emissions assessment used detailed operational scenarios of both peak day and annual levels of activities developed in discussions with Pacific International Terminals. Emission estimates considered the following sources: ocean-going vessels (OGVs) in transit over about three nautical miles from the junction of the east-west and north-south routes from the Strait of Juan de Fuca to the docks of the GPT; OGVs hotelling at berth; harbor vessels (i.e., tugs) assisting OGVs during docking and undocking; incoming loaded and outgoing empty trains traveling along the Custer Spur; trains traveling through the terminal's east and west loops while waiting to unload, during

unloading, and waiting to leave. **Table 6** lists critical assumptions regarding facility operations and basic dispersion modeling characteristics associated with project-related combustion sources.

Table 6. Facility Operations and Dispersion Modeling Critical Assumptions – Combustion Sources

Equipment Type	Source and Critical Assumptions
Ocean-Going Vessels and Tugs	**Operations** • Transit speed at 5 knots • Emissions during transit to/from dock based on travel distance of about 3 nautical miles (nm) from dock to common route point • Maneuvering occurs with tugs assisting within ½ nm of dock and for ½ hour of activity to and from the dock • Assume 4 tugs for Capesize, 3 tugs for all other vessel sizes • Time at berth (i.e., hotelling emissions) based on average time required for loading Panamax (48 hours) and Capesize (71 hours) vessels, and based on expected numbers of each size vessel → This includes 1 hour before and 1 hour after unloading • Vessel numbers as follow: → 2016 – Capesize 77; Panamax 144 (Total 221) → 2026 – Capesize 169; Panamax 318 (Total 487) • Position of vessels as follows (from Ausenco Sandwell) → Berth 1 – used for Panamax vessels in 2016 and 2026; receiving coal from east loop → Berth 2 – used for Capesize vessels in 2016 and 2026; receiving coal from east loop → Berth 3 – not used for commodity loading in 2016, but used as location for hotelling vessels in both 2016 and 2026 and for receiving commodities from west loop in 2026 **Modeling** • Transiting vessels considered series of point sources along a 400-foot wide route • Annual modeling considered total annual emissions related to transiting, maneuvering, and hotelling vessels – distributed evenly in time and space along the 3-nm transiting route, maneuvering route, and at all three berth positions in 2016 and 2026 [(a)] • Short-term modeling included a single vessel transiting, maneuvering, and at each berth with hourly emissions distributed evenly in time and space along the transiting route, maneuvering route, and all three berth positions in 2016 and 2026 [(b)]
Locomotives	**Operations** East Loop • 125-car coal trains in 2016 for daily and annual emissions • 150-car coal trains in 2026 for daily and annual emissions West Loop • No activity in 2016 • Considered 170-car potash train movements for emissions estimates and modeling in 2026 **Modeling – East Loop: 2016**

Table 6. Facility Operations and Dispersion Modeling Critical Assumptions – Combustion Sources

Equipment Type	Source and Critical Assumptions
Locomotives (con't)	• Annual modeling based on total annual emissions from 5 trains/day evenly distributed in time and space across the entire year as emission sources located along the off and on-site rail as appropriate [(a)] • Annual modeling considered trains along all on-site rail routes and along the Custer Spur • Short-term modeling considered reasonable worst-case conditions during periods up to 24-hours long (because this is the longest "short-term" ambient standard) [(b)] • Short-term modeling assumed 5 trains on site during any (and every) 24-hour period as follows: → 2 trains idling in north portion of site waiting for connection to indexer for unloading → 2 trains being unloaded by indexing process → 2 trains idling in south portion of site waiting to leave • Short-term modeling did not consider trains along the Custer Spur because the facility was assumed to be operating at capacity with no room for additional trains **Modeling – East Loop: 2026** • Modeling for 2026 for annual conditions was the same as for 2016 except that it considered emissions from 8 trains per day • Short-term modeling assumed 6 trains on site during any (and every) 24-hour period as follows: → 2 trains idling in north portion of site waiting for connection to indexer for unloading → 2 trains being unloaded by indexing process → 2 trains idling in south portion of site waiting to leave • Short-term modeling did not consider trains along the Custer Spur because the facility was assumed to be operating at capacity **Modeling – West Loop - 2026** • Considered short-term and annual scenarios as described for east loop, using 170-car potash trains with 7 locomotives [(c)] **Train Modeling – All** • Train routes to/from and on the site were treated as a series of volume sources, as follows: → Volume sources placed along the center of the track alignments with their centers spaced every 100 to 110 feet, and with widths varying as needed to encompass the tracks → Used SCREEN3 modeling technique to define stack and release heights; see discussion **here** (page 35)

Table 6. Facility Operations and Dispersion Modeling Critical Assumptions – Combustion Sources

Equipment Type	Source and Critical Assumptions
Emergency Generators	• One generator located near the power substation near the east loop coal car unloading building • One generator located on the GPT wharf • Both units assumed to operate continually in the same 1-hour period • 1-hour emissions considered in every hour of the 5-year meteorological data set

(a) "Annual" modeling refers to the process of assessing pollutant emissions and concentrations based on expected emissions over an entire year. Calculated concentrations are compared with ambient standards based on annual statistics and/or with annual average health risk estimate criteria.

(b) "Short-term" modeling refers to assessments considering emissions and concentrations to be compared with short-term ambient standards such as 1-hour and 24-hour averages.

(c) ENVIRON also used dispersion modeling to evaluate the potential effects of annual train traffic based on 123-car grain trains with 4 locomotives, which would total about 512 per year if grain were to be a major export commodity. This modeling indicated grain train traffic would have no effect on the maximum off-site concentrations of particulate matter (compared with potash trains), so grain trains were not considered further.

The combustion source emission factors applied in the analysis are listed in **Table 7**.

Table 7. GPT Project Combustion Source Emission Factors

Train Locomotive Emission Factors (g/gal)									
Year	**NOx**	**NO_2**	**PM10**	**PM2.5**	**HC**	**VOCs [a]**	**CO**	**SO_2**	**CO_2**
2016	121.00		3.10	3.01	5.10	5.37	26.6	0.09	10,217
2026	69.00		1.50	1.46	2.50	2.63	26.6	0.09	10,217
Vessel Emission Factors (g/kW-hr) [b]									
	NOx	**NO_2**	**PM10**	**PM2.5**	**HC**	**CH_4**	**CO**	**SO_2**	**CO_2**
Tug Main Engines	6.8	6.2	0.26	0.25	0.19	1.89	5	0.0065	690
Tug Aux Engines	6.1	6.2	0.13	0.13	0.21	1.89	0.9	0.0065	690
Vessel Main Engines	10.59	9.61	0.19	0.17	0.5	0.084	1.1	0.4	646
Vessel Main Engines (low load)	4.63	4.63	7.29	6.71	21.8	21.8	9.9	1.0	3.28
Vessel Aux Engines	10.59	9.61	0.18	0.17	0.4	0.084	1.1	0.42	691
Vessel Boiler	1.61	0.018	0.13	0.12	0.4	0.63	0.2	0.57	970
Emergency Generators (g/kW-hr) [c]									
Generators	9.2								

[a] Emission factors for VOCs calculated as %HC

[b] Emissions factors for vessel engines used in this assessment did not vary by year because no credit was taken for future improvements in vessel emission controls. Specific emission rates varied as a function of fuel quality.

[c] Two emergency 250 kW stationary generators; one near East Loop unloading building and one on the wharf; both to operate under normal conditions for testing and maintenance only, and expected to operate fewer than 100 hours per year. NWCAA rule 300.4 i) exempts from new source review permitting requirements any stationary internal combustion engine whose operation is limited to emergency situations and required testing and maintenance and that operates fewer than 500 hours a year. These two generators are therefore not subject to new source review, but were considered in separate air quality modeling.

Sources:
Locomotive Emission Rates from USEPA Emission Factors for Locomotives, April 2009
Vessel Emission Factors from USEPA Current Methodologies in Preparing Mobile Source Port-related Emission Inventories, April 2009
Vessel boiler emission factors from CARB Emissions Estimation Methodology for Ocean-Going Vessels, May 2008
Regulation of the Northwest Clean Air Agency, Effective December 18, 2011

5.1.3 Facility Operational Emissions – Fugitive Dust Sources

Dust source emissions, which are subject to an air quality permit review, were considered only in 2026 with full facility buildout and maximum throughput because facility dust is the primary focus of the air quality permit, and the permit only requires consideration of the facility at full capacity. Dust emission sources associated with the project included coal unloading on the terminal east loop within the two dumper buildings – controlled by two baghouses; coal moved via open and covered conveyors; coal pile formation and extraction from the pile using stacker/reclaimers; two on-site loaders used to keep the coal pile storage yard tidy; coal pile fugitive (i.e., wind-blown) emissions; potash and calcined coke dumping in a building on the west loop – controlled by a baghouse; and ship-loading of all commodities at the offshore wharf. **Table 8** provides additional information regarding the critical assumptions involved in the development of these emission scenarios.

Table 8. Facility Operations and Dispersion Modeling Critical Assumptions – Fugitive Sources

Equipment Type	Source and Critical Assumptions
Coal Pile Stacking and Reclaim	**Operations** • Four stacker/reclaimers operating in the storage area; each stacker/reclaimer has the capacity to load in 7,000 metric tons (tonne) per hour and load out 10,000 tonne/hr • Emissions calculations assumed two reclaimers would be loading in coal and two would be loading out coal **Modeling** • Emissions of dust from both fugitive and non-fugitive emissions sources at the facility were modeled using AERMOD, applying a combination of Point and Area sources.
Conveyor Runs	• Conveyors feeding the stacker/reclaimers will be open and were considered as part of emission sources within this area. • Conveyors feeding the commodity export systems will be covered, so they were not considered as emission sources.
Conveyor Transfer Points	• Conveyor transfer point emissions for coal were assumed to be zero since these are controlled by complete enclosure and dry fog with the exception of the bin vent collectors on the wharf. • Conveyor transfer points for the west loop were based on fan flow rate and grain loading, thus no operational parameters were assumed. • For modeling purposes, transfer points for the west loop were assumed routed to a single point source of emissions located at the surge bin using the following parameters: → Release height of 60 feet → Exhaust Volume of 50,000 cfm → Exhaust velocity 4,500 ft/min → Stack effective diameter calculated from above 0.725 m

Table 8. Facility Operations and Dispersion Modeling Critical Assumptions – Fugitive Sources

Equipment Type	Source and Critical Assumptions
Train car dumpers/ Baghouses Train car dumpers/ Baghouses (con't)	• Emissions for railcar unloading operations assumed negative pressure enclosures and baghouses, thus emissions calculations were based on fan flow rates and the assumed grain loading. No operations assumptions were necessary. • For modeling purposes, baghouses were considered point sources of emissions using the following parameters: → East loop one baghouse for both car dumpers → East loop release height of 70 feet → Exhaust volume of 300,000 cfm → Exhaust velocity 4,500 ft/min → Stack effective diameter calculated from above 2.81 m → West loop one baghouse → West loop release height of 70 feet → Exhaust volume of 50,000 cfm → Exhaust velocity 4,500 ft/min → Stack effective diameter calculated from above 1.14 m
Stockpile Area, including stackers/ reclaimers, open conveyors, and on-site loaders (vehicles)	• Four Stacker/reclaimers operating, two loading in coal, two loading out coal • Two on-site loaders or dozers units were assumed, operating 2 hours per day • For modeling purposes these were combined in a single area source of 296,361 square meters (73 acres)
Ship Loading	• For coal, the assumption was made that two ships would be loaded simultaneously, each at a rate of 10,000 tonne/hr • For modeling purposes the ship loading operations were considered an area source of total area 31,304 square meters • For the west loop, emissions from vessel loading were calculated based on a control of 95% over uncontrolled rates due to the use of the specialized loading chutes
Wind Erosion	• Wind erosion emissions were modeled as part of the same area source used for the other stockpile area emissions, an area source of 296,361 square meters (73 acres).

(a) "Annual" modeling refers to the process of assessing pollutant emissions and concentrations based on expected emissions over an entire year. Calculated concentrations are compared with ambient standards based on annual statistics and/or with annual average health risk estimate criteria.

(b) "Short-term" modeling refers to assessments considering emissions and concentrations to be compared with short-term ambient standards such as 1-hour and 24-hour averages.

Fugitive dust source emission factors are listed in **Table 9**.

Table 9. GPT Project Dust Source Emission Factors

Emissions Source	Emission Factors
Baghouses and Bin Vent Collectors	Emissions based on the volumetric flow rate of air through the fabric filter multiplied by an assumed grain loading of 0.005 grains per cubic foot of air flow
Dozers and Front End Loaders	PM_{10} Emissions = $(0.75)(18.6)(s)^{1.5}/(M)^{1.4}$ lb/hr $PM_{2.5}$ Emissions = $(0.022)(78.4)((s)^{1.2}/(M)^{1.3}$ Where: s is silt content in % and M is moisture content in %
Stacker/Reclaimer Ship Loading	PM_{10} Emissions = $0.35)(0.0032)(U/5)^{1.5}/(M/2)^{1.4}$ lb/ton $PM_{2.5}$ Emissions = $(0.053)(0.0032)(U/5)^{1.5}/(M/2)^{1.4}$ lb/ton Where: U in annual average wind speed in mph and M is moisture content in %
Wind Erosion	EPA document AP-42, Section 13.2.5, Industrial wind Erosion

5.1.4 Dust Emission Controls included in GPT Project Design

Air quality permitting rules that govern fugitive dust emissions from the proposed project require the use of Best Available Control Technology (BACT) for those sources subject to an air quality permit. [6] A BACT review includes consideration of all reasonably available means to reduce or control emissions, and the evaluation of both feasibility (i.e., whether such controls can be physically implemented and their potential effectiveness) and cost (i.e., based on expenditures per ton of emissions avoided). A BACT submittal is prepared as part of a permit application, and ENVIRON will be preparing a BACT report as part of the "Notice to Construct" permit application to the NWCAA. A brief review of the dust control mechanisms included in the GPT project follows. These emission controls are believed to represent BACT for the proposed facility.

As shown in **Table 5** (page 19) and **Table 6** (page 23), the GPT facility as proposed includes a number of components either specifically designed to minimize emissions associated with on-site operations or whose use would have this effect. These emission control components include the following.

- Commodity dumping inside buildings – all commodity hauling railcars would dump their loads inside negative pressure buildings that would collect dust and port it through baghouses. This would virtually eliminate emissions from the dumping buildings, while the baghouses would provide more that 99% control of emissions of fine particulate matter.
- The multiple large stacker/reclaimers used to create the coal piles within the East Loop and to load coal from these piles onto conveyors would be electrically powered. Thus operation of this equipment would result in zero emissions on the project site from either the motors or the hydraulic systems.
- Coal pile forming via coal stackers will use state-of-the-art technology to minimize the distance of the drop from the stackers to the piles.

[6] Northwest Clean Air Agency Regulations, Section 300,7

- All conveyors would be run using electrical conveyor drive motors.
- All conveyor transfer points will be controlled using a combination of passive emission control (PEC) systems and/or dry fog emitters. PECs limit dust production at transfer chutes by "sliding" the coal from one belt to another instead of dropping it. PEC chutes are fully enclosed, and these chute enclosures are inside a building. In areas with insufficient space to allow the use of PEC chutes, particulate matter emissions will be controlled using dry fog technology. In these locations, dry fog, a sonic-induced mixture of 10-15% water and 85-90% air, is sprayed over the belt both before and after the transfer points, which are also completely enclosed to allow retention time for the fog to work. A transfer building provides secondary enclosure around the entire process. Within the transfer point, the particles in the fog are so tiny in size that they attract the dust in the transfer hoods, allowing the dust to agglomerate to the water fog. The combination of PECs and dry fog are expected to provide 100% control of emissions at all conveyor transfer points, so all controlled transfer points are considered zero emissions.
- The surface of the open storage pile for coal will be treated with dust palliative chemicals. These chemicals, typically surfactants, decrease the surface tension of the water in which they are mixed, allowing the water to penetrate more effectively into the irregular surfaces of the coal particles. The net effect is to bind the coal particles together, making them effectively larger and less subject to the erosive forces of the wind. This technique is widely used for open storage piles of coal and is effective at reducing emissions.
- In addition to, and in combination with the dust control chemicals, the open storage piles of coal will be equipped with water cannons. These are high pressure water spray systems that allow complete coverage of the coal piles with water. Water works with the dust control chemicals to agglomerate the smaller dust particles, making them less subject to the forces of the wind. ENVIRON assumed the combination of water spray and surfactants would provide 50% control of fugitive emissions from the stockpile area.
- Ship loaders will be controlled via complete enclosure where possible and by the use of directional discharge mechanisms and shaped flow controls for coal ships to place the coal as gently as possible into open areas of the hold. Non-coal commodities will be loaded using Cascade Chute technology (see example). All vessel loading will minimize particulate matter emissions by ensuring the drops from conveyors occur below the combing of the hold (i.e., within the hold).
- On-site locomotive emissions will be minimized when possible because locomotives will be fitted with an Automatic Engine Shutoff System (AESS) that would sometimes shut off unneeded locomotives. When trains are on-site waiting to unload and while the trains are moving through the indexer as coal cars are being unloaded, and when temperature are greater than 40°F, the AESS would shut down three of the five locomotives associated with each coal train, and the other two locomotives would be running only in a low-power idling mode sufficient to keep the onboard systems running. Note that, in order to be conservative, the use of the AESS was *not* considered in the air quality impact analysis even though temperatures in the project area are less than 40°F only about 15% of the time, so factoring in AESS operations would result in emission reductions.

5.1.5 Greenhouse Gas (GHG) Emissions

ENVIRON estimated short-term GHG emissions associated with construction and long-term emissions related to operation of the proposed GPT facility at Phase 1 (2016) and at full buildout (2026). The emissions estimates considered combustion source emissions directly related to the operation of the facility (Scope 1), indirect emissions from purchased energy (Scope 2), and indirect emissions due to combustion sources associated with the operational activities of the facility (Scope 3). The estimates also included indirect emissions associated with product delivery by rail to the facility from the Custer Wye, along with emissions associated with exporting product via vessel (from the wharf out 3 nautical miles).

ENVIRON calculated GHG emissions using standard protocols and inventory methods published by the EPA, California Air Resources Board, the Intergovernmental Panel on Climate Change, and the Washington Department of Ecology. The emissions are estimated using the base equation:

$$CO_2e \text{ emissions} = \text{activity rate-duration X intensity X emission factor}$$

The emission factors used in this analysis and the critical assumptions employed in both the development of emissions and in estimating levels of construction equipment activities for the emission inventory tabulation are presented in **Appendix B**.

A later section (**7.2**) also considers measures included in the project as proposed that would reduce GHG emissions compared with alternative approaches to operating the proposed facility.

5.2 Dispersion Modeling

ENVIRON used air quality dispersion modeling simulations to estimate ambient concentrations due to ships, trains, and on-site emission sources associated with the operations at the GPT. This section discusses the methods used to develop these simulations to assess potential future pollutant concentrations in the area surrounding the facility.

5.2.1 Model Used

ENVIRON reviewed regulatory modeling techniques to select the most appropriate air quality model to simulate dispersion of air pollutants emitted by sources associated with the proposed project to estimate air pollutant concentrations.

ENVIRON selected AERMOD for this modeling analysis because it is the most up-to-date dispersion model currently available for handling the potential for exhaust plume downwash and plume impacts on intermediate and complex terrain. The terrain within close proximity on all sides of the GPT facility site is relatively flat, while hillsides rise 100 to 500 feet in elevation to the north. The modeling considered emissions downwash related to the permanent physical structures on the site (i.e., not the vessels).

The U.S. EPA has designated AERMOD as the preferred guideline air dispersion model for air dispersion modeling (EPA "Guideline on Air Quality Models," codified as Appendix W to 40 CFR Part 51) for complex source configurations and for sources subject to exhaust plume down-wash. AERMOD incorporates numerical plume rise algorithms (the PRIME algorithms) that

implicitly include the downwash effects a structure may have on an exhaust plume rather than using the wind tunnel based empirical algorithms of ISCST3. The PRIME algorithm also treats the geometry of upwind and downwind structures and their relationship to the emission point.

5.2.2 Modeling Procedures and Parameters

ENVIRON applied AERMOD to consider criteria pollutants using the regulatory defaults in addition to the options and data discussed in this section.

Model Setup and Application

ENVIRON employed the most recent version of AERMOD (Version 12060) with the default options for dispersion that depend on local meteorological data, regional upper air data, and the local physical characteristics of land use surrounding the facility. The GPT site is located in an industrial area with sparse rural developments in the vicinity. The effects of increased surface roughness and other physical characteristics associated with urban land uses were not included in the modeling analysis during the preparation of the meteorological database based on wind direction as described below.

Elevation Data and Receptor Network

Terrain elevations for receptors and emission sources were prepared using digital elevation models developed by the United States Geological Survey (USGS) and available on the USGS Seamless Server system. These data have a horizontal spatial resolution of approximately 7 meters (m). The base elevation and hill height scale for each receptor were determined using the EPA terrain processor AERMAP (Version 11103). AERMAP generates a receptor output file that is read by AERMOD.

The dispersion modeling analyses used modeling receptors spaced 500 meters apart covering the 12 kilometer (km) by 12 km simulation domain, with a 5-km by 5-km nested receptor grid at 200-m spacing, a 3.1-km by 3.1-km nested receptor grid at 50-m spacing, and a 2-km by 2-km nested receptor grid at 25-m spacing. All four receptor grids were centered on the Gateway Pacific Terminal site. Model receptors were located at 10-m intervals along the boundary of the facility. The modeling receptor locations are depicted in **Figure 3**.

ENVIRON used a separate set of modeling receptors covering an 8.3 km by 9.5 km simulation domain to examine short-term concentrations from off-site trains transiting on the Custer Spur from the Custer Wye to the GPT terminal. Within this area a series of receptor subareas were created at approximately 150 m, 450 m, 1,300 m, 3,000 m, and 4,750 m from the edge of the BNSF right-of-way. Within these subareas receptors were with 25-m, 50-m, 100-m, 200-m, and 500-m spacing, respectively. Thus the highest density receptor grids were closest to and along the entire length of the rail line so AERMOD could properly calculate maximum pollutant concentrations related to off-site trains. The modeling receptor grids used for the transiting trains modeling are depicted in **Figure 4**.

Meteorological Data

ENVIRON constructed a 5-year meteorological data set for use in the AERMOD dispersion model using surface and upper air data. Wind speed and wind direction data were from the

long-term meteorological monitoring station established and operated by BP. [7] Data from this monitoring station, which is about 2 kilometers due north of the northwest corner of the GPT site provide a reasonable representation of meteorological conditions in the project vicinity. The BP station data were processed through the AERMOD meteorological processor AERMET (Version 11059) as on-site data. Regional meteorological data parameters not available from the BP station (i.e., cloud cover and ceiling height) were derived from surface observations from the National Weather Service (NWS) station at Bellingham Airport, Washington, approximately 16 kilometers to the southeast.

A wind rose presenting wind speed and wind direction data for the five year period is shown in **Figure 6**. The wind rose indicates that the winds are predominantly light and are from the east-northeast and south-southwest directions. The average wind speed during the 5-year meteorological period was 2.6 meters per second (m/s), and calm conditions occurred less than 10 percent of the time.

Upper air data from Quillayute, Washington were also used for the 5-year meteorology data set. The Quillayute upper air data were compiled from the National Oceanic and Atmospheric Administration (NOAA) Forecast Systems Laboratory Radiosonde Database. [8]

EPA guidance indicates that surface parameters (albedo, Bowen ratio, and surface roughness) surrounding the primary meteorological site should be used in AERMET to construct the meteorological profiles used by AERMOD. Seasonal surface parameters were determined for the BP meteorological site using the AERMET preprocessor, AERSURFACE (Version 08009).

Daily versus Annual Operations

Operations of the proposed terminal are generally expected to occur over 24-hours per day, 365 days per year. The air quality modeling scenarios used to simulate daily and annual levels of operations are described further below.

ENVIRON developed modeling scenarios for the facility to reflect both maximum daily throughput and maximum annual throughput in 2016 with partial facility development, and 2026 with complete buildout and full operation. The short-term (24-hour) scenario was used to estimate 1-hour, 3-hour, and 24-hour concentrations, and this profile was considered with modeling simulation using every day in the 5-year meteorological database.

The annual operations scenarios for combustion sources used a profile of hourly emissions throughout the year, reflecting realistic operational schedules in both future years. For fugitive dust sources, maximum potential emissions were calculated based on the capacity of the equipment. These sources and the resulting emissions were assumed to occur continuously for all conditions and all times.

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[7] The BP met station is operated in accord with Prevention of Significant Deterioration (PSD) guidelines and other EPA guidance, including semi-annual independent audits.

[8] http://esrl.noaa.gov/raobs/

Averaging Periods

Pollutant concentrations predicted by the model were averaged over annual and short-term (1, 3, 8, and 24-hour) periods, as appropriate for a given pollutant's ambient standards or screening level. The modeling assessments for the CO standards and the short-term SO_2 and NO_2 standards were based on the peak-day modeling described above. The assessments for comparison with the ambient standards for PM10, PM2.5, and the annual SO_2 and NO_2 concentrations were all based on the annual operations modeling scenarios due to the statistical techniques required for assessing compliance. [9]

NO_2 Modeling - PVMRM

In accord with EPA guidance, ENVIRON applied the Plume Volume Molar Ratio Method (PVMRM) within AERMOD to allow the model to consider factors that affect both NO_2 emission rates and resulting concentrations in the ambient air. The PVMRM method accounts for both direct NO_2 emissions from stacks (e.g., locomotive exhausts) as well as atmospheric transformations that create NO_2 in the presence of estimated concentrations of ozone. Atmospheric formation of NO_2 from NOx sources in the project study area is almost certainly limited due to the lack of ozone. For this portion of the analysis ENVIRON assumed 10% of exhaust emissions were NO_2 and up to 80% of NOx could be converted to NO_2 in the atmosphere. [10] The background ozone concentration was estimated using data from the Bellingham ozone monitor, with substitutions for missing hours from the Custer-Loomis monitor. ENVIRON used these data to estimate hourly ozone concentrations for each day of the week in each of the four seasons, and applied the results in the PVMRM analysis.

Emission Source Locations, Characterization, and Release Parameters

Ship stack emissions from vessels in transit and hotelling at the dock were represented in the model as a series of **point sources**. Emissions from trains transiting to and from the site and traveling on the site were represented by series of **volume sources**. Dust emissions from fixed facilities (i.e., the bag houses) were treated as point sources, while dust emissions from the storage pile stockyard were considered as **area sources**. Finally, dust emissions associated with ship loading were considered as **areapoly sources**. Additional discussion of these sources follows.

Vessels hotelling at the wharf during loading were considered as point sources in the AERMOD analysis. Refer to **Table 10** for specific information regarding the modeling parameters for these sources. See also Table 6 (page 23) and **Table 8** (page 27) for additional information regarding the assumptions and methods employed in the dispersion modeling.

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[9] For example, the PM2.5 24-hour standard is based on the 3-year average of the 98th percentile of daily concentrations, which eliminates one or more of the highest concentrations each year and requires averaging the results. These calculations can be completed with the AERMOD model based on the realistic annual operations scenario, and cannot be based on the worst-case day modeling process used to evaluate not-to-exceed short-term standards. Thus, the annual operations modeling scenario was used to consider PM2.5 and PM10 which are subject to statistical ambient standards.

[10] In-stack NO_2 to NOx emission ratio from P G Boulter, I S McCrae, and J Green, Transportation Research Laboratory, *Primary NO_2 Emissions From Road Vehicles in the Hatfield and Bell Commons Tunnels*, July 2007 as reported in the San Joaquin Valley Air Pollution Control District Air Modeling Guidance for NO_2.

Vessels in transit, harbor assist vessels (i.e., tugs), and vessels hotelling at the wharf during loading were considered as point sources in the AERMOD analysis. For point sources, AERMOD calculates thermal buoyancy and downwash effects on source emissions. Thermal buoyancy causes warmer plumes to rise and downwash effects push plumes downward as wind travels over buildings. **Table 10** (above) provides specific information regarding the modeling parameters for these sources. See also **Table 6** (page 23) and **Table 8** (page 27) for additional information regarding the assumptions and methods employed in the dispersion modeling.

Trains traveling to and from the site and traveling on the site were considered as a series of equally spaced volume sources that represented the variable emission conditions along these curvilinear paths of travel. In AERMOD, volume sources are represented as a 3-dimensional Gaussian distribution of emissions. The model disperses the starting distribution of pollutant according to the meteorological conditions occurring in a given hour. Parameters describing the location and initial horizontal distribution of each volume source were determined using a series of equally spaced volumes per operational segment that followed the expanded alignment along the Custer Spur and onto and around the GPT site. Unlike point sources, AERMOD does not consider the effects of thermal buoyancy or downwash on volume source emissions, and this approach is not entirely appropriate for representing the heated emissions from a locomotive stack. ENVIRON therefore employed an additional adjustment to compensate for this limitation in the AERMOD model.

In 2004, as part of the Roseville Rail Yard Study, the California Air Resources Board (CARB) developed a method to estimate initial locomotive plume rise adjustments from buoyancy and downwash effects using the EPA SCREEN3 model. [(11)] Consistent with the ARB's adjustment calculations, ENVIRON estimated initial plume height using SCREEN3 based on typical in-stack temperature and flow rates based on average notch settings and approximate speed of the trains during transit. [(12)] Thus, the release height and vertical dimension of emissions from transiting trains take into account not only the height of the vehicle emission sources, but the buoyancy of the emission gasses and downwash effects generated by the train's movement. ENVIRON used the resulting estimated stack and release heights (**Table 10**) in the AERMOD assessment.

[(11)] State of California Air Resources Board, 2004, *Roseville Rail Yard Study*; this method does not consider variability in ambient meteorological conditions and wind speeds because as a screening-level model, SCREEN3 assumes fairly basic, static conditions in estimating dispersion. This technique represents a reasonable and previously applied method for representing plume rise associated with locomotive emissions.

[(12)] ENVIRON received notch-specific temperature and flow rates from Steve Fritz of the Southwest Research Institute's Locomotive Technology Center.

Table 10. Combustion Source Modeling Parameters

POINT Sources				
Source	**Stack Height (m)**	**Stack Temp. (K)**	**Exit Velocity (m/s)**	**Exit Diam. (m)**
Transiting Vessels	40	673.15	20	0.5
Hotelling Vessels	40	673.15	20	0.5
Harbor Vessels	10	673.15	20	0.3
Emergency Generators [(a)]	1.8	729.75	46.62	0.17

VOLUME Sources			
Source	**Release Height (m)**	**Initial Lateral Dimension (m)**	**Initial Vertical Dimension (m)**
On-Site Trains	5.5	14.1 -15.6	2.1
Transiting Trains	10.7	4	2.5

(a) Spec from Caterpillar gen set for Standby 250 kW 313 kVA 60 Hz 1800 rpm 480 Volts

The non-combustion (i.e., fugitive dust) emissions sources associated with the project were considered as a point, area, and areapoly sources within the AERMOD analysis. **Table 11** lists the source types and the emission parameters used in this portion of the analysis.

Table 11. Fugitive Dust Source Emission Parameters

POINT Sources				
Source	**Stack Height (m)**	**Stack Temp. (K)**	**Exit Velocity (m/s)**	**Exit Diam. (m)**
Rail Car Dump 1 (coal)	25.91	293	25.83	1.321
Rail Car Dump 2 (coal)	25.91	293	25.83	1.321
Rail Car Dump 3 (coal)	25.91	293	25.83	1.321
Rail Car Dump 4 (coal)	25.91	293	25.83	1.321
Rail Car Dump (other)	21.34	293	22.86	1.146
Surge Bin Baghouse	18.29	293	22.86	1.146
Bin Vent Collector 1	18.29	293	22.86	0.363
Bin Vent Collector 2	18.29	293	22.86	0.363
Bin Vent Collector 3	18.29	293	22.86	0.363
AREAPOLY Sources				
Source	**Release Height (m)**	**No. of Vertices**	**Initial Sigma-z (m)**	
Ship Loader (coal)	10.00	4	4.65	
Ship Loader (other)	10.00	4	4.65	
AREA Sources				
Source	**Release Height (m)**	**X-dimension (m)**	**Y- dimension (m)**	**Initial Sigma-z (m)**
Storage Pile Equipment	0	447	663	4.65
Storage Pile Wind Erosion	0	447	663	4.65

5.3 Modeling Post-Processing: Transiting Trains Monte Carlo Simulations

The AERMOD assessment of 1-hour NO_2 concentrations from trains traveling on the Custer Spur was based on one loaded train traveling inbound and one empty outbound train. To consider meteorological conditions across the entire 5-year data set, emissions associated with this train traffic were considered in *every hour* of the data set. But because such a level of train traffic is not possible (i.e., 2x24=48 train passbys per day; even at maximum capacity the facility would not handle this many trains), simply using the model-calculated maximum concentrations across every day considered would unreasonably skew the results towards high values and greatly overstate the potential for air quality impacts. To make this analysis of train traffic along the Custer Spur more realistic, ENVIRON employed a Monte Carlo probability analysis to make the total number of train passbys each day the maximum number associated with both future scenarios (i.e., 10 passbys in 2016 and 18 passbys in 2026) and to distribute these passbys across each day.

The Monte Carlo simulations involved post-processing the hourly modeling results for each day of the 5 years analyzed to randomly select hours during which the train passbys would occur. Data from the hours selected for each day were considered for each modeling receptor. This process was repeated 1,000 times for each year. Results of this selection process were then used to compute the median hourly NO_2 concentrations for comparison with the 1-hour ambient air quality standard. This analysis process was consistent with the approach developed by Clint Bowman of the Washington State Department of Ecology for addressing compliance assessments of intermittent (or randomly occurring) emission sources (Ecology 2011b).

5.4 On-Site Emergency Generators

ENVIRON conducted AERMOD modeling to consider NO_2 emissions from two on-site emergency generators. These units would be run only for periodic testing and in the event of power failures to allow critical systems to shut down in an orderly way without damaging equipment. Both 250 kW units were evaluated in standalone modeling that assumed both were running continually for 1 hour, and these emissions were considered across the entire 5-year meteorological data set using the same modeling receptors described previously. This worst-case modeling analysis for the emergency generators was conducted separately from the more complex modeling of the rest of the facility operations so as not to overly complicate the modeling and because for the generators, only the maximum possible impact scenario was considered.

5.5 Coal Dust Deposition onto the Water

Deposition of coal dust onto the waters near the GPT wharf was considered qualitatively based on model-calculated particulate matter concentrations in the ambient air at over-water receptors. Deposition modeling using the AERMOD model as configured for the rest of this analysis would not result in accurate projections because such modeling would not adequately represent conditions influencing deposition over water. In addition, because there are no applicable standards for particulate matter deposition onto water, there are no objective criteria by which to interpret modeling results to assess the relative impact of any such deposition. For these reasons, the potential for adverse effects from coal dust deposited onto water were considered qualitatively.

5.6 Off-Site Traffic Impact Assessment

The analysis of potential air quality impacts of off-site project traffic was conducted in accord with EPA guidance (EPA 1992b). The analysis was based on a qualitative review of information compiled in the traffic impact assessment report for the project (AMEC 2012).

EPA guidance regarding traffic related air quality impacts suggests consideration of the most congested signalized intersection that would be affected by project traffic, and further suggests possibly conducting dispersion modeling for adversely affected intersections. In this context, "adversely affected" refers to deterioration in an intersection's level of service (LOS) to a degree that might adversely affect air quality nearby. [13]

EPA suggests modeling the most congested intersections that would be directly affected by a project to the degree that LOS would be degraded to a LOS "D" or worse due to a project. [13] Consistent with EPA guidance, signalized intersections that would be affected by the proposed project were screened for possible analysis by reviewing the intersection LOS analyses provided by AMEC (2012). Based on these traffic data, none of the signalized intersections in the project study area would be adversely affected by project-related vehicle traffic to the extent that the LOS would degrade to LOS D or worse. These data are summarized in **Table 12**. As a result, because no intersections fall to an LOS of D or worse due to the project, no additional analysis is required to conclude project-related operational vehicle traffic would not result in air quality impacts due to increased congestion near off-site intersections. Note that this analysis does not reflect possible increases in vehicle delays on roadways affected by railroads crossing that would be obstructed by more project-related trains.

Table 12. GPT Project Study Area LOS Summary - 2026

Signalized Intersection	Without Project		With Project	
	Volume	LOS/Delay	Volume	LOS/Delay
Grandview Rd. and Portal Way	1,947	C	1.965	C
Slater Rd. and Sunset Ave./Rural Ave.	2,155	C	2,163	C
Main St./W. Axton Rd and Riverside Dr./Labounty Dr.	2,976	C	2,976	C
Slater Rd. and Haxton Way	1,591	C	1,604	C
Source: AMEC 2012				

[13] Level of service (LOS) is a measure of the relative efficiency of the operation of an intersection based on the amount of congestion that occurs, usually during a peak commute hour. The LOS for signalized intersections is the weighted average vehicle delay represented by a scale from A to F, with "A" representing little if any delay, and "F" representing congestion due to an intersection being over capacity. LOS "D," which is used as a threshold of *potential* for air quality impacts, results in delays of between 35 and 55 seconds per vehicle.

6 Potential Impacts of the Proposed Project

6.1 Construction-Related Air Quality: Potential Impacts

Development of the GPT project would include construction of new on-site buildings and other infrastructure improvements. There would also be substantial, multi-year efforts to re-grade, compact, and pave some of the site. Such activities could result in temporary, localized increases in particulate concentrations due to emissions from construction-related sources. For example, dust from construction activities such as excavation, grading, sloping and filling would contribute to ambient concentrations of suspended particulate matter. Construction contractor(s) would be required to comply with NWCAA regulations requiring that reasonable precautions be taken to minimize dust emissions.

If demolition of any existing structures is required it *might* require the removal and disposal of building materials that could possibly contain asbestos. If this proves to be the case, demolition contractors would be required to comply with EPA and NWCAA regulations related to the safe removal and disposal of any asbestos-containing materials.

Construction would require the use of heavy trucks, excavators, graders, work vessels, pile drivers, and a range of smaller equipment such as generators, pumps, and compressors. Emissions from existing industrial and transportation sources around the project area would very likely outweigh any emissions resulting from construction equipment. Pollution control agencies are nonetheless now urging that emissions from diesel equipment be minimized to the extent practicable to reduce potential health risks. The GPT will minimize emissions from diesel-powered construction equipment to the extent practicable by taking steps such as those specified in section **7.1**. With appropriate controls, construction-related diesel emissions would not be likely to substantially affect air quality in the project vicinity.

Although some construction phases would cause odors, particularly during paving operations using tar and asphalt, any odors related to construction would be short-term and located within commercial/industrial land uses where such odors would likely go unnoticed. Construction contractor(s) would be required to comply with NWCAA regulations that prohibit the emission of any air contaminant in sufficient quantities and of such characteristics and duration as is, or is likely to be, injurious to human health, plant or animal life, or property, or which unreasonably interferes with enjoyment of life and property.

Construction equipment and material hauling can affect traffic flow in a project area if construction vehicles travel during peak periods or other heavy-traffic hours of the day and pass through congested areas.

With implementation of the controls required for the various aspects of construction activities and consistent use of best management practices to minimize on-site emissions, construction of the proposed project would not be expected to significantly affect air quality.

6.2 Operational Air Quality: Potential Impacts

6.2.1 Projected Annual Emissions

The estimated annual emissions of criteria air pollutants from operation of the GPT facility in 2016 are presented in **Table 13**. The estimated annual emissions of criteria air pollutants from operation of the GPT facility in 2026 are presented in **Table 14**. Note that the emissions listed in both tables were distributed both spatially across the facility and temporally across each day of an entire year to provide the basis of the air quality dispersion modeling. Because the emissions and modeling analyses of fugitive dust sources were conducted only to represent full buildout and maximum capacity (worst-case emissions) throughput of the facility in 2026, fugitive dust is not considered in 2016 nor represented in the summary shown in **Table 13**.

Table 13. Projected Annual 2016 Operational Emissions (Combustion Sources)

Criteria Air Pollutant	Operational Sources	Operational Emissions (tons per year)
Inhalable Coarse Particulate Matter (PM_{10})	Vessels in Transit	0.64
	Vessels Hotelling	0.92
	On-Site Trains	0.72
	Off-Site Trains	1.10
Inhalable Fine Particulate Matter ($PM_{2.5}$)	Vessels in Transit	0.60
	Vessels Hotelling	0.87
	On-Site Trains	0.70
	Off-Site Trains	1.07
Sulfur Dioxide (SO_2)	Vessels in Transit	0.69
	Vessels Hotelling	2.55
	On-Site Trains	0.02
	Off-Site Trains	0.03
Carbon Monoxide (CO)	Vessels in Transit	7.22
	Vessels Hotelling	4.74
	On-Site Trains	6.18
	Off-Site Trains	9.44
Nitrogen Dioxide (NO_2)	Vessels in Transit	26.87
	Vessels Hotelling	45.15
	On-Site Trains	28.10
	Off-Site Trains	42.89
Total Annual Emissions		
Inhalable Coarse Particulate Matter (PM_{10})		3.38
Inhalable Fine Particulate Matter ($PM_{2.5}$)		3.23
Sulfur Dioxide (SO_2)		3.29
Carbon Monoxide (CO)		27.58
Nitrogen Dioxide (NO_2)		143.01

Assumes 100% of NOx emissions are NO_2
Vessels in Transit include tug assists during maneuvering
Train emissions without AESS; produces conservative results; including AESS would reduce emissions – see **Table 5**

Does not include fugitive dust sources which are only considered in the full buildout/maximum capacity operations scenario because dust sources are the focus of the air quality permitting, and permits are only concerned with full capacity operations and not with any interim years.

Table 14. Projected Annual Operational Emissions in 2026 (All Sources)

Criteria Air Pollutant	Operational Sources	Operational Emissions (tons per year)
Inhalable Coarse Particulate Matter (PM_{10})	Vessels in Transit	1.41
	Vessels Hotelling	2.03
	On-Site Trains	0.86
	Off-Site Trains	1.07
	Fugitive Dust	113
Inhalable Fine Particulate Matter ($PM_{2.5}$)	Vessels in Transit	1.32
	Vessels Hotelling	1.91
	On-Site Trains	0.83
	Off-Site Trains	1.03
	Fugitive Dust	83
Sulfur Dioxide (SO_2)	Vessels in Transit	1.52
	Vessels Hotelling	5.61
	On-Site Trains	0.05
	Off-Site Trains	0.07
Carbon Monoxide (CO)	Vessels in Transit	15.90
	Vessels Hotelling	10.44
	On-Site Trains	15.27
	Off-Site Trains	18.90
Nitrogen Dioxide (NO_2)	Vessels in Transit	59.21
	Vessels Hotelling	99.44
	On-Site Trains	39.57
	Off-Site Trains	48.99
Total Annual Emissions		
Inhalable Coarse Particulate Matter (PM_{10})		118.81
Inhalable Fine Particulate Matter ($PM_{2.5}$)		88.34
Sulfur Dioxide (SO_2)		7.25
Carbon Monoxide (CO)		60.5
Nitrogen Dioxide (NO_2)		247.2
Assumes 100% of NOx emissions are NO_2 Vessels in Transit include tug assists during maneuvering Train emissions without AESS; including AESS would reduce emissions Includes all combustion and fugitive sources of emissions.		

6.2.2 Projected Off-Site Air Pollutant Concentrations

The results of the air quality dispersion modeling analysis of GPT sources are summarized in the next three tables. **Table 15** presents the model-calculated future concentrations for criteria pollutants at the maximum impact locations affected by facility emissions in 2016 with partial operation (as delineated in **Table 1**, page 8).

Table 16 presents the model-calculated future concentrations for criteria pollutants at the maximum impact locations affected by facility emissions in 2026 with full buildout and maximum capacity operation. **Table 17** lists the modeling results for 1-hour NO_2 concentrations near the Custer Spur in 2016 and in 2026.

The dispersion modeling analysis considered facility operations in 2016 and 2026 with vessels using distillate fuel containing 0.1% (1,000 ppm) sulfur. At the present time, vessel operations in Puget Sound use standard marine fuels containing an average of about 2.7% (27,000 ppm) sulfur (Starcrest 2012). Use of the cleaner, lower-sulfur fuel is a 2015 goal established by the International Maritime Organization adopted by the Northwest Ports Clean Air Strategy (2007). [14] The modeling analysis was based on vessels using the cleaner vessel fuel.

In addition to vessels, the modeling included on-site train movements with all time periods (i.e., averaging times), and included off-site trains in the annual operating scenarios. Off-site train movements related to short-term (i.e., non-annual) averaging periods are considered in the modeling results presented in **Table 17**. In addition to the project-related combustion sources considered in 2016, the modeling for 2026 included project-related fugitive dust emissions. The modeling results are discussed further below.

2016 On-Site Activities, Vessel Hotelling and Transiting, On and Off-Site Trains

As shown in **Table 15**, model-predicted project-related criteria air pollutant concentrations at the maximum impact locations in 2016 are far less than the levels allowed by all the short and long-term ambient air quality standards. Although none of the pollutant concentrations shown in this table include background concentrations from other sources in the area, all the concentrations are so much less than the levels allowed by the respective air quality standards that the addition of background concentrations would not result in the total concentrations exceeding the air quality standards. [15]

2026 On-Site Activities, Vessel Hotelling and Transiting, On and Off-Site Trains

Table 16 lists the model-calculated criteria air pollutant concentrations associated with operation of the proposed GPT facility in 2026. As shown, all projected future concentrations are well below the levels allowed by the ambient air quality standards. Although none of the pollutant concentrations shown in this table include background concentrations from other sources in the area, all the concentrations are so much less than the levels allowed by the

[14] This is a non-binding agreement among the Ports of Seattle and Tacoma, and the Port Authority of Vancouver, BC.

[15] Because air quality permitting requirements will focus primarily on dust-related emissions from the GPT facility, and because the permitting will only consider full capacity operation and no interim year, the fugitive dust modeling was conducted only for the full buildout/full capacity operation in 2026.

Table 15. Modeling Results: 2016 Criteria Pollutant Maximum Concentrations (µg/m^3)

Criteria Air Pollutant	Avg. Time	B/G Conc.[a]	Project Related Concentration [b], [c]	Project Plus B/G	Ambient Standard [d]
PM10	24-Hour	29.0	0.95 [e]	[e]	150
PM2.5	Annual	6.0	0.14 [e]	[e]	12
	24-Hour	15.8	1.5 [e]	[e]	35
SO_2	Annual	14.2	0.03	14.2	52
	24-Hour	36.7	1.1	37.8	262
	3-Hour	14.1	6.3	20.4	1,310
	1-Hour	89.0	6.6	95.6	1,050
NO_2	Annual	11.8	3.5	15.3	100
	1-Hour	52.3	74.5	126.8	188

[a] Background concentrations based on measured levels. See Table 3 (page 12).
[b] Reported pollutant concentrations are those occurring at the maximum impact location for each pollutant. Concentrations at all other locations are less than those reported here.
[c] Note that all of the short-term concentrations are based on modeling that considered maximum hourly activity during every hour of the 5-year meteorological data set, which is not a possible actual level of activity. These results are therefore intentionally skewed to represent very conservative conditions. Note that consistent with EPA guidance, the annual modeling results are based on 5-year averages from the 5-year meteorological data set instead of 3-year as per the NAAQSs.
[d] All ambient concentrations are expressed in terms of micrograms per cubic meter (µg/m^3); Table 2 (page 10) which presents only the ambient air quality standards, includes some concentrations reported in parts per million (ppm).
[e] The air quality modeling for 2016 considered fuel combustion sources only because the fugitive dust component was not considered in 2016 because the permitting review focuses on full buildout. Total PM concentrations are, therefore, not projected in this table, but would clearly be far below the respective NAAQSs.

Table 16. Modeling Results: 2026 Criteria Pollutant Maximum Concentrations (µg/m^3)

Criteria Air Pollutant	Avg. Time	B/G Conc.[a]	Project Related Concentration [b], [c], [d] [Combustion Sources Only/ Combustion + Fugitives]	Project Plus B/G	Ambient Standard [e]
PM10	24-Hour	29.0	0.9 / 72.2	101.2	150
PM2.5	Annual	6.0	0.3 / 2.8 [f]	8.8	12
	24-Hour	15.8	0.7 / 17.7	33.5	35
SO_2	Annual	14.2	0.06 [f]	14.3	52
	24-Hour	36.7	1.1	37.8	262
	3-Hour	14.1	6.3	20.4	1,310
	1-Hour	89.0	6.6	95.6	1,050
NO_2	Annual	11.8	11.6 [f]	23.4	100
	1-Hour	52.3	106.5	158.8	188

[a] Background concentrations based on measured levels. See Table 3 (page 12).
[b] The air quality modeling for 2026 considered both fuel combustion sources and fugitive dust sources.
[c] Reported pollutant concentrations are those occurring at the maximum impact location for each pollutant. Concentrations at all other locations are less than those reported here.
[d] Note that all of the short-term concentrations are based on modeling that considered maximum hourly activity during every hour of the 5-year meteorological data set, which is not a possible actual level of activity. These results are therefore intentionally skewed to represent very conservative conditions.
[e] All ambient concentrations are expressed in terms of µg/m^3; Table 2 (page 10) which presents only the ambient air quality standards, includes some concentrations reported in parts per million (ppm).
[f] Note that consistent with EPA guidance, the annual modeling results are based on 5-year averages from the

5-year meteorological data set instead of 3-year as per the NAAQSs.

respective air quality standards that the addition of background concentrations would not result in the total concentrations exceeding the air quality standards.

Off-site concentrations of $PM_{2.5}$ are of particular interest because of public concerns regarding dust from the proposed facility. As shown in **Table 3** (page 12), the measured 24-hour average $PM_{2.5}$ concentration at a Bellingham monitoring station was 15.8 µg/m^3 at a location that is probably heavily influenced by nearby traffic and residential wood burning and probably overstates background conditions in the project area. Adding this background concentration to the worst-case, model-calculated 24-hour concentration due to project-related combustion sources results in a total concentration about 96% of the level allowed by the $PM_{2.5}$ NAAQS. On an annual average basis (consistent with the long-term NAAQS), and assuming a 6 µg/m^3 concentration from 2010 to represent background, the maximum total $PM_{2.5}$ concentration associated with the proposed GPT facility (plus background) represents only 59% of the level allowed by the health-based $PM_{2.5}$ annual-average NAAQS.

6.2.3 Short-Term Pollutant Concentrations due to Transiting Trains

In addition to the modeling of all combustion sources (i.e., trains and vessels) associated with the proposed GPT project, ENVIRON also performed an additional assessment of short-term emissions and concentrations associated with transiting train passbys along the Custer Spur. **Table 17** displays the modeling/post-processing results for 2016 and 2026. As shown, all projected short-term concentrations except 1-hour NO_2 are far less than the respective air quality standards. NO_2 is discussed further below, and a few illustrative graphs are attached to indicate the area where modeling projects the highest NO_2 concentrations due to transiting trains.

NO_2 Concentrations Related to Transiting Trains

EPA adopted a stringent 1-hour standard for NO_2 that became effective in 2010. Few monitoring data have been collected to ascertain whether compliance with this standard is possible near busy roads or at other locations with persistent emissions. But there have been many air quality modeling studies (typically based on conservative assumptions) that have suggested that this standard may be very difficult to meet. The initial modeling for transiting trains associated with the GPT project applied very conservative assumptions and led to the same conclusion. To avoid grossly overestimating short-term NO_2 concentrations by considering two trains in every hour of every day, ENVIRON conducted an **additional statistical analysis** to provide a more realistic assessment. The results of this analysis are shown in **Table 17**.

Modeling projected a 115.4-µg/m^3 1-hour NO_2 concentration in 2016 at the most affected location. Including an estimated background concentration of 52.3 µg/m^3 (**Table 3**, page 12) results in a projected total hourly concentration of about 168 µg/m^3, which is about 89% of the level allowed by the 1-hour NAAQS. As shown in **Figure 7**, the area potentially affected by NO_2 concentrations this high would be limited to a small area along the northern alignment of the Custer Spur. **Figure 8** shows a larger scale view of the area potentially affected by such maximum concentrations.

Modeling projected a 103.5-µg/m^3 1-hour NO_2 concentration in 2026 at the most affected location, without background. Adding a 52.3 µg/m^3 background concentration results in a total

hourly concentration of 155.8 µg/m^3, which is about 83% of the level allowed by the 1-hour NAAQS. This improvement in spite of increased train traffic is due to reduced emission rates from locomotives as newer equipment subject to increasingly stringent emission controls come into effect. As shown in **Figure 9**, the area potentially affected by NO_2 concentrations this high would again be limited to a very small area along the northern alignment of the Custer Spur. **Figure 10** shows a larger scale view of the potentially affected area.

Table 17. Modeling Results: Concentrations near Transiting Trains (µg/m^3)

Criteria Air Pollutant	Avg. Time	B/G Conc.[a]	Project Related Concentration [b], [c]	Project Plus B/G	Ambient Standard [d]
2016 with Phase 1 Development and Operation – 5 Trains					
$PM_{2.5}$	24-Hour	15.8	1.0	16.8	35
SO_2	24-Hour	36.7	0.07	36.8	262
	3-Hour	14.1	0.2	14.3	1,310
	1-Hour	89.0	0.3	89.3	1,050
NO_2	1-Hour	52.3	115.4 [e]	167.7	188
2026 Maximum Capacity Operation – 9 Trains					
$PM_{2.5}$	24-Hour	15.8	0.5	16.3	35
SO_2	24-Hour	36.7	0.07	36.8	262
	3-Hour	14.1	0.2	14.3	1,310
	1-Hour	89.0	0.3	89.3	1,050
NO_2	1-Hour	52.3	103.5 [e]	155.8	188

[a] Background concentrations based on measured levels. See **Table 3** (page 12).

[b] Reported pollutant concentrations are those occurring at the maximum impact location for each pollutant. Concentrations at all other locations are less than those reported here.

[c] Note that with the exception of NO_2, all the term concentrations reported here are based on modeling that considered maximum hourly activity during every hour of the 5-year meteorological data set, which is not a possible actual level of activity. These results therefore represent unrealistically conservative (or even possible) conditions.

[d] All ambient concentrations are expressed in terms of micrograms per cubic meter (µg/m^3); **Table 2** (page 10) which presents only the ambient air quality standards, includes some concentrations reported in parts per million (ppm).

[e] The results for NO_2 are based on AERMOD modeling with additional Monte Carlo simulation post-processing to avoid over-predicting NO_2 concentrations. See additional discussion here (page 38).

6.3 On-Site Emergency Generators

The AERMOD assessment of emissions from two 250 kW on-site emergency generators indicated the maximum 1-hour concentration of NO_2 would be less than 24 µg/m^3, or only about 13% of the 188 µg/m^3 1-hour NAAQS. The model-projected highest 1-hour concentrations related to operation of each generator (assuming worst-case conditions) occur near these respective sources, i.e., near the wharf and near the southern boundary of the central portion of the project site near the east loop. Although the projected 1-hour concentrations did not consider background concentrations and were not added to concentrations from other project-related sources (because this modeling was conducted separately), adding these very low periodic concentrations to those stemming from other project sources would not result in 1-hour levels exceeding the NAAQS.

6.4 Coal Dust Deposition onto Water

Using the AERMOD-calculated concentrations of coarse particulate matter (PM_{10}) in the ambient air at over-water modeling receptors it is possible to hypothesize regarding the potential effects of such deposition. The *maximum* (i.e., at a single receptor) model-predicted annual average PM_{10} concentration from all sources associated with the GPT facility in 2026 was 19.4 µg/m^3. This represents about 39% of the 50 µg/m^3 Washington ambient air quality standard. [16] The *average* model-predicted annual average PM_{10} concentration at all over-water receptors was 3.5 µg/m^3, or 7% of the state standard. Because the ambient air quality standards are intended to protect human health and welfare with a margin of safety, these data suggest that airborne particulate matter deposition into the water from emission sources at the GPT facility would not result in significant impacts. There are no applicable standards governing particulate matter deposition into the water.

Considering the potential impacts of deposition qualitatively, based on comparing air quality modeling results with concentrations allowed by the NAAQSs, is consistent with the approach US EPA has used in similar analyses. For example, in a letter regarding the level of analysis for deposition required as part of an assessment of potential impacts to endangered species, EPA said "Criteria pollutants were not evaluated [as part of the analysis] since the National Ambient Air Quality Standards (NAAQS) have been promulgated for most of the constituents that are protective of human health and the environment, including where appropriate, impacts to soil and vegetation. The demonstration of compliance with both the primary and secondary NAAQS, as indicated in the PSD permit application for the facility, precludes the need for additional analysis." [17] Based on this reasoning, the air quality analysis demonstrating compliance with the NAAQSs is sufficient to conclude with no additional review that other potential impacts related particle deposition are also adequately considered, and that the potential for significant environmental impacts from particle deposition is minimal.

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[16] Note that EPA has eliminated the annual average PM_{10} NAAQS.

[17] Letter from Pamela Blakley, Chief, Air Permits Section, US EPA Region 5 to Richard Nelson, Field Supervisor, Rock Island Illinois Field Office, United States Fish and Wildlife Service, April 5, 2007

6.5 GHG Emissions

The short term (construction) and long term (operational) GHG emissions were estimated to provide an indication of the potential for significant emissions as defined in SEPA. The sources and the extent of the area covered were the same as in the dispersion-modeling analysis described previously. The area considered included Custer Spur rail traffic, on-site rail, hotelling vessels, and ocean-going and harbor assist vessels in transit between the facility wharf and the anchorage buoy.

A summary of the emission inventory tabulation is presented in **Table 18**. During both Phase 1 and at full capacity, about half of the GHG emissions result from purchased electricity required to operate the commodity-handling systems and emission control devices. The facility's use of purchased electricity to operate conveyors, dust collectors, and product-unloading systems would minimize GHG emissions compared with either diesel-powered units or on-site electrical power generation that would otherwise be associated with running these systems. GHG emission reduction features included in the project as proposed are discussed further in mitigation section **7.2**.

Product import and export activities account for most of the remaining GHG emissions. GHG emissions during the facility's opening year of operation are about half of the total annual emissions at full design capacity.

The total estimated annual facility GHG emissions in both years considered exceed the 10,000 metric ton CO_2e value Ecology suggests as an indicator of the need to quantify project-related GHG emissions during SEPA review, including "new" direct and "proximate" direct and indirect emissions (Ecology 2011a). This guidance also indicates projects with annual emissions of more than 25,000 metric tons CO_2e should provide a quantitative assessment of GHG emissions and an evaluation of the potential for impacts of changing climate on the project's new infrastructure. Note that at this time, the extent to which transportation-related GHG emissions should be included in such an analysis is "an unsettled question under SEPA case law" (Ecology 2011a).

A tabulation of estimated total construction-related GHG emissions is also presented in **Table 18**. These estimates consider the total time to prepare and construct the facility, including the deep-water trestle and wharf. Because construction is expected to occur between 2013 and 2015, the total construction emissions in **Table 18** would be much less on an annual basis.

Table 18. Summary of GHG Emissions

Operational Emissions	Annual Emissions CO_2e - Metric Tons	
	2016 Phase 1	2026 Full Build Out
Direct Emissions		
On-Site Diesel Equipment	49	97
Indirect Emissions		
Purchased Energy [(a)]	9,939	24,847
Employee Commute	336	804
Rail Product Delivery [(b)]		
Transiting	3,317	6,644
On-Site	2,173	5,366
Vessel Product Export [(c)]		
Transiting	1,767	3,893
Hotelling	3,878	8,542
Annual Facility-Related GHG Emissions	**21,459**	**50,193**
Construction-Related Emissions	**Total Emissions CO_2e - Metric Tons**	
NonRoad Diesel Equipment - Landside [(d)]	6,659	
NonRoad Diesel Equipment - Over Water [(e)]	5,185	
In-Water Bubble Curtains	694	
Construction Employee Commute [(f)]	-	
Total Construction-related GHG Emissions	**12,537**	

(a) Based on emissions related to regional electrical generation, which may overstate GHG emissions in WA due to the heavy reliance on hydropower.

(b) "Rail Product Delivery" refers to locomotive operations to, from, and on the East and West Loops of the GPT site. Estimates of transiting-related emissions are based on locomotive engine emissions from trains traveling on the Custer Spur (only). On-site emissions are locomotive engine emissions while the trains are inside the property boundary, including all movements on the site, queuing before unloading, during unloading as the trains are advanced by the indexers, and during preparations to leave the site. Note that these projected emissions do not consider the GHG emission reductions that would result from the use of AESS to shut down unneeded locomotives because AESS is not used all the time (i.e., when temperature are less than about 40°F). Since temperatures exceed 40°F about 85% of the time, the locomotive AESS would reduce GHG to less than represented in this tabulation.

(c) "Vessel Product Export" Transiting emissions represent engine and boiler combustion emissions associated with transiting activities during the arrival and departure of vessels and assist tugs within about 3 nm of the wharf. Hotelling emissions are vessel-related combustion emissions from the auxiliary engines and boilers while the vessels are docked at the wharf.

(d) "NonRoad Diesel Equipment - Landside" are construction emissions that include engine combustion emissions from earthwork, soil stabilization, material and equipment delivery and landside construction. This does not include either importation of "fill" soils, if needed or construction of the Custer Spur improvements.

(e) "NonRoad Diesel Equipment – Over Water" are construction emissions from combustion sources used during trestle and wharf construction, but do not include delivery of construction materials, concrete, or equipment.

(f) Construction Employee data were not available at the time of this analysis.

6.6 Diesel Engine Exhaust Particulate Matter (DPM)

ENVIRON considered potential off-site concentrations of diesel engine exhaust particulate matter (DPM) associated with all on-site and transiting vessels and trains. The analysis used emissions of $PM_{2.5}$ from vessel and train sources associated with the project as a surrogate for DPM.

For this assessment ENVIRON used the AERMOD results for $PM_{2.5}$ across the entire modeling domain receptor grid to produce isopleths of estimated annual average DPM concentrations. These concentrations can be compared to the ASIL for DPM adopted by Washington State for use in screening for potential impacts during air quality permitting processes. Graphic results of the DPM analysis for 2016 with Phase 1 facility development and throughput are shown in **Figure 11**. Results for 2026 with complete project buildout and full capacity operation are shown in **Figure 12**.

These figures depict isopleths representing several multiples of the Washington State DPM ASIL (i.e., annual average concentration = 0.0033 $\mu g/m^3$). The ASIL is a screening-level concentration suggesting a "negligible" potential risk of increasing the incidence of cancer by one in a population of 1 million people with a constant 70-year exposure to the screening-level concentration (Ecology 2008). The ASIL does not include any consideration of the actual relative dose of inhaled particulate matter based on such things as lung capacity, rates of respiration (e.g., for an adult versus a child), or varying amounts of time of actual exposure. The ASIL is simply a screening tool, and should not be taken to represent a definitive indication of risk.

As shown in **Figure 11**, projected annual average concentrations of DPM associated with the proposed GPT facility operation in 2016 exceed the ASIL throughout most of the modeling domain. Most of the modeling area is in the range of 5 to 10 times higher than the ASIL, and some of the area north of the GPT site is up to about 15 times the ASIL. As shown in **Figure 12**, project operation in 2026 would increase the size of the areas near the GPT site with annual average concentrations in the range of 5 to 15 times the ASIL and create a small area very near the north side of the site where the annual average DPM concentration would reach up to about 45 times the ASIL.

It is worth noting that these projected DPM levels are high in comparison with the ASIL because the DPM ASIL is a very low number. As a result, almost any diesel combustion source can easily result in model-projected concentrations exceeding this level. So, for example, anywhere within a mile or more of the I-5 corridor through Washington would likely be projected by modeling to be exposed to DPM concentrations exceeding this screening level. In fact, Ecology reported that EPA estimated the median exposure in Washington to be 75 times higher than the level of the ASIL (Ecology 2008). As explained in section **4.2.6**, the US EPA has not adopted a cancer risk factor for DPM because of continuing uncertainties in the underlying health risk data (EPA 2002). Consequently, these projected DPM concentrations should not be taken to represent actual risk.

6.7 Additional Issues Related to Coal Dust from Storage Piles and Loading

Members of the public have expressed concerned about potential impacts from coal dust potentially emitted from the project site. Some comments have pointed to apparent problems at the Westshore coal export terminal near Tsawwassen, British Columbia. The Westshore terminal has operated for over 40 years, and there have been occasional complaints from residents living downwind of the facility. Long-term air quality sampling and several studies of particulate matter collected at sites in Tsawwassen have indicated coal dust from the Westshore terminal plays a minor role in measurable PM_{10} levels in the ambient air. Three of these studies are summarized below (in chronological order).

6.7.1 Westshore Terminals Coal Dust Complaint Investigation

In 1998 a study of accumulated dirt and particles was conducted to consider the composition of the materials that were soiling objects ranging from walkways to building siding to picnic tables about which complaints were made based on the assumption that the soiling was due to coal from the Westshore Terminal. [18] This analysis, based on microscopic inspection of 31 samples from 22 locations, found coal particles in one sample of material accumulated over a winter on a table top on the beach in Tsawwassen. All other stains and soiling that resulted in complaints were found to be organic in nature, and not related to the coal export facility. Although there have been persistent *assumptions* regarding soiling problems stemming from this facility, this study concluded that coal dust was generally not the source of the soiling that was identified and tested. In addition, the study concluded that "none of our investigations resulted in conclusive evidence that emissions were excessive or that Westshore Terminal was in violation of its permit conditions." [18] And as discussed further below, there would be an even lower probability of nuisance-related effects associated with the GPT facility.

6.7.2 Tsawwassen Particulate Air Quality Study

This 2002 study was based on particulate matter sampling at three locations near the Westshore terminal. [19] The study determined that measured levels of PM_{10} and $PM_{2.5}$ were well below the most stringent applicable Canadian air quality goals/standards, which are similar to the NAAQSs (**Table 2**, page 10). This study also concluded that measured concentrations of PM_{10} and $PM_{2.5}$ were similar in magnitude and pattern to concentrations measured elsewhere within the region, and that no site in the Tsawwassen area was unduly influenced by any one emission source, including the coal export terminal. Statistical analyses of collected data and microscopic examination of collection filters determined that coal dust from the Westshore terminal was not a major contributor to measured levels of PM_{10} or $PM_{2.5}$ at downwind locations. Although some larger particles of coal dust may have contributed to "soiling" of surfaces of boats at a marina or of table tops and cars near this old export terminal, this type of

[18] Greater Vancouver Regional District, 1998, *Westshore Terminals Coal Dust Complaint Investigation,* Air Quality Department, Greater Vancouver Regional District, October 1998

[19] Greater Vancouver Regional District, 2002, *Tsawwassen Particulate Air Quality Study, 2002*, Air Quality Monitoring and Assessment Division Policy and Planning Department Greater Vancouver Regional District. Full study report available **here**: (**http://www.metrovancouver.org/about/publications/Publications/TsawwassenAirQualityStudy.pdf**)

effect is not considered a human *health* impact due to particulate matter air pollution. In addition, due to both the physical setting (with greater distances and less unobstructed winds) and use of modern and more effective emission controls that will be employed at the GPT (as described throughout this report), even such minor impacts would be unlikely in the vicinity of the Cherry Point facility.

6.7.3 Delta Air Quality Monitoring Study

This study, conducted between June 2004 and March 2006 considered both fine particulate matter and other criteria air pollutants in the Tsawwassen area and reached conclusions similar to the 2002 study. [20] Specifically, the results of this analysis indicated all short-term (1-hour and 24-hour) and long-term (annual) air quality levels in the study area met the relevant Greater Vancouver Regional District (GVRD) objectives, and that fine particulate levels measured within the study area were the same as or less than other areas in the GVRD. [20]

6.7.4 Comparison of GPT and Westshore Locales and Environs

The findings discussed above that measured particulate matter concentrations near the Westshore coal terminal have not been found to reach levels that would endanger human health, would be expected to apply in the vicinity of the GPT site as well. The physical environment of the GPT site is, however, even *less* conducive to conditions that would result in wind-blown dust events than the area near the Westshore facility. For example, the Westshore terminal is surrounded by water and within ten to fifty feet of sea level, so the entire coal storage area and ship-loading wharfs are exposed to uncontrolled winds over the water. While the vessel-loading wharf of the GPT facility would be at the water, the on-site coal storage area would be more protected from winds because it would be upland about 3,000 feet from the water, about 110 feet above sea level, and partially surrounded by trees. These factors would reduce the potential for wind-blown dust events from the GPT compared with the Westshore terminal.

Furthermore, the GPT would employ new and improved emission control technologies compared with the older facilities at Westshore, which would greatly reduce the potential for fugitive emissions. See the listing of emission controls in section **7.2** (page 54). For these reasons, comparisons of the GPT with Westshore are not appropriate.

[20] Greater Vancouver Regional District, 2006, *Delta Air Quality Monitoring Study, June 2004 - March 2006*, Air Quality Policy and Management Division, Policy and Planning Department, Greater Vancouver Regional District, August, 2006. Full study report available **here**. (**http://www.metrovancouver.org/about/publications/Publications/DeltaAirQualityMonitoringStudy.pdf**)

7 Mitigation

7.1 Construction

Although significant air quality impacts are not anticipated due to construction of the proposed terminal, construction contractors will be required to comply with all relevant federal, state, and local air quality rules. In addition, implementation of best management practices will reduce emissions related to the construction phase of the project. Management practices for reducing the potential for air quality impacts during construction include measures for reducing both exhaust emissions and fugitive dust. The Washington Associated General Contractors brochure *Guide to Handling Fugitive Dust from Construction Projects* and the NWCAA suggest a number of methods for controlling dust and reducing the potential exposure of people to emissions from diesel equipment. A list of some of the control measures that could be implemented to reduce potential air quality impacts from construction activities follows:

- Use only equipment and trucks that are maintained in optimal operational condition.
- Require all off-road equipment to have emission reduction equipment (e.g., require participation in Puget Sound Region Diesel Solutions, a program designed to reduce air pollution from diesel, by project sponsors and contractors).
- Use car-pooling or other trip-reduction strategies for construction workers.
- Implement restrictions on construction truck and other vehicle idling (e.g., limit idling to a maximum of 5 minutes).
- Spray exposed soil with water or other suppressant to reduce emissions of PM and deposition of particulate matter.
- Pave or use gravel on staging areas and roads that would be exposed for long periods.
- Cover all trucks transporting materials, wetting materials in trucks, or providing adequate freeboard (space from the top of the material to the top of the truck bed), to reduce PM emissions and deposition during transport.
- Provide wheel washers to remove particulate matter that would otherwise be carried off site by vehicles to decrease deposition of particulate matter on area roadways.
- Cover dirt, gravel, and debris piles as needed to reduce dust and wind-blown debris.
- Stage construction to minimize overall transportation system congestion and delays to reduce regional emissions of pollutants during construction.

7.2 Operation

The proposed project includes measures that would serve to reduce emissions during operation of both the unloading and storage loops and the export conveyance systems of the facility as delineated below.

- Commodity dumping inside buildings – all commodity hauling railcars would dump their loads inside negative pressure buildings that would collect dust and port it through baghouses.
- The multiple large stacker/reclaimers used to create the coal piles within the East Loop and to load coal from these piles onto conveyors would be electrically powered.
- Coal pile forming via coal stackers would use state-of-the-art technology to minimize the distance of the drop from the stackers to the piles.

- Vessel hold loaders for coal will use shaped flow controls to place the coal as gently as possible into open areas of the hold, while ensuring that all particulate matter emissions associated with the drop from the conveyor occur below the combing of the hold.
- Vessel loading of other commodities will use specialized chutes to contain commodities during loading and minimize drops into the holds.
- All conveyors would be run using electrical conveyor drive motors.
- All conveyor transfer points will be controlled using a combination of passive emission control (PEC) systems and/or dry fog emitters.
- The surface of the open storage pile for coal will be treated with dust palliative chemicals, effectively binding the coal particles together and making them less subject to the erosive forces of the wind. This technique is widely used for open storage piles of coal and is effective at reducing emissions.
- In combination with the dust control chemicals, the open storage piles of coal will be equipped with water cannons that allow complete coverage of the coal piles with water, making them less subject to the forces of the wind.
- On-site locomotive emissions will be minimized when possible because locomotives will be fitted with an Automatic Engine Shutoff System (AESS). The benefits of this emission control measure were not considered in the air quality impact assessment.
- GHG emissions associated with operation of the facility would be reduced by the following components included in the project as proposed:
  - → Conservation of natural areas on site by minimizing new clearing/grading and wetland impacts to the extent practicable
  - → Use of new, high-efficiency material-handling equipment
  - → Use of electrically-powered equipment rather than fuel-powered equipment where practicable
  - → Recycling/reuse of water
  - → Optimization of rail infrastructure to minimize unnecessary cargo movements
  - → Providing opportunities to terminal customers to increase the GHG efficiency of their cargo handling / transport operations
  - → Use of teleconference and video conferencing to reduce employee travel
  - → Encouragement of carpooling during design, construction and terminal operations
  - → Development of facility with an electrical power supplier that obtains >90% of their power from non-fossil fuel sources
  - → Recycling of used building materials where practicable

The use of purchased electrical power and the use of AESS for locomotives are estimated to avoid GHG emissions from direct operation of the facility by more than 65% compared with on-site electrical power generation and not using AESS (without consideration of long-distance transportation; see **Appendix B**, page 13). Together, these and other features included in the proposed project represent sufficient reduction (per Ecology 2011a guidance document) to obviate the need for further assessment of the implications of project-related GHG emissions.

Based on these control features and the findings of the air quality impact assessment, no additional mitigation measures are warranted or proposed.

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Note that figures are formatted for printing on the "front" side of double-sided pages, and the "back" sides of these pages are unnumbered, but nonetheless included in the page count.

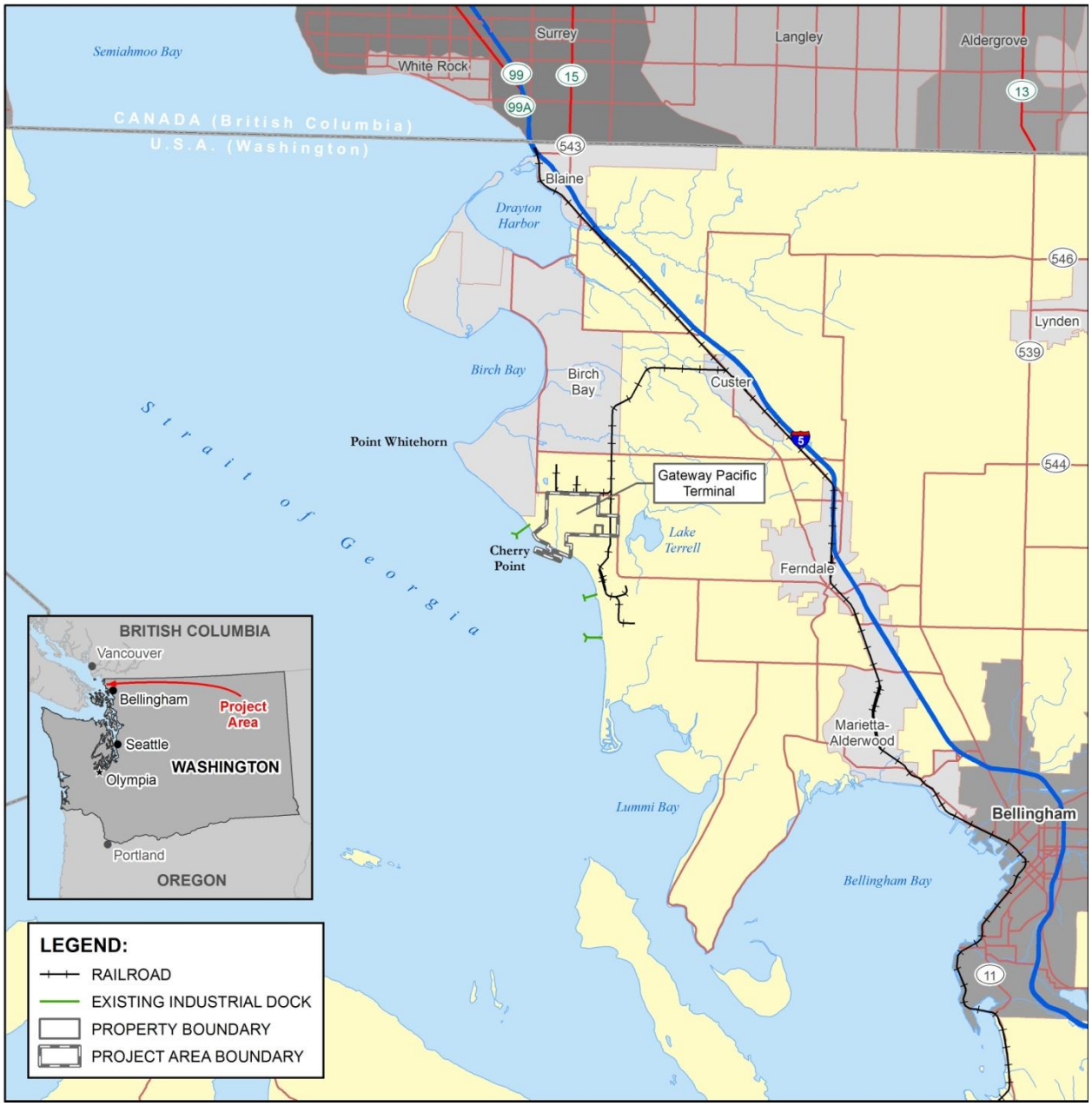


Figure 1. Project Vicinity Map

Figure 2. GPT Facility General Layout

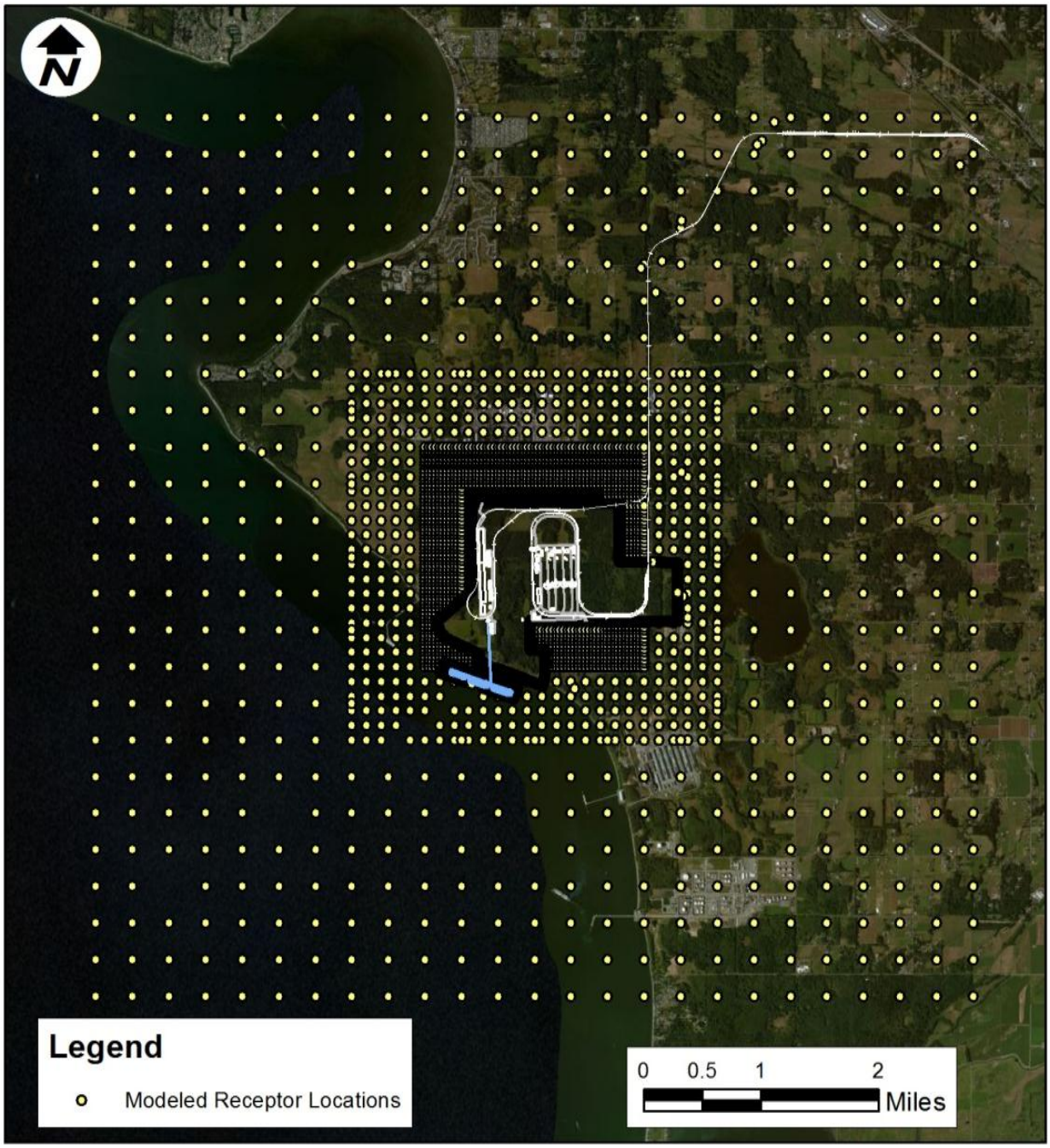


Figure 3. AERMOD Modeling Domain and Modeling Receptor Grids

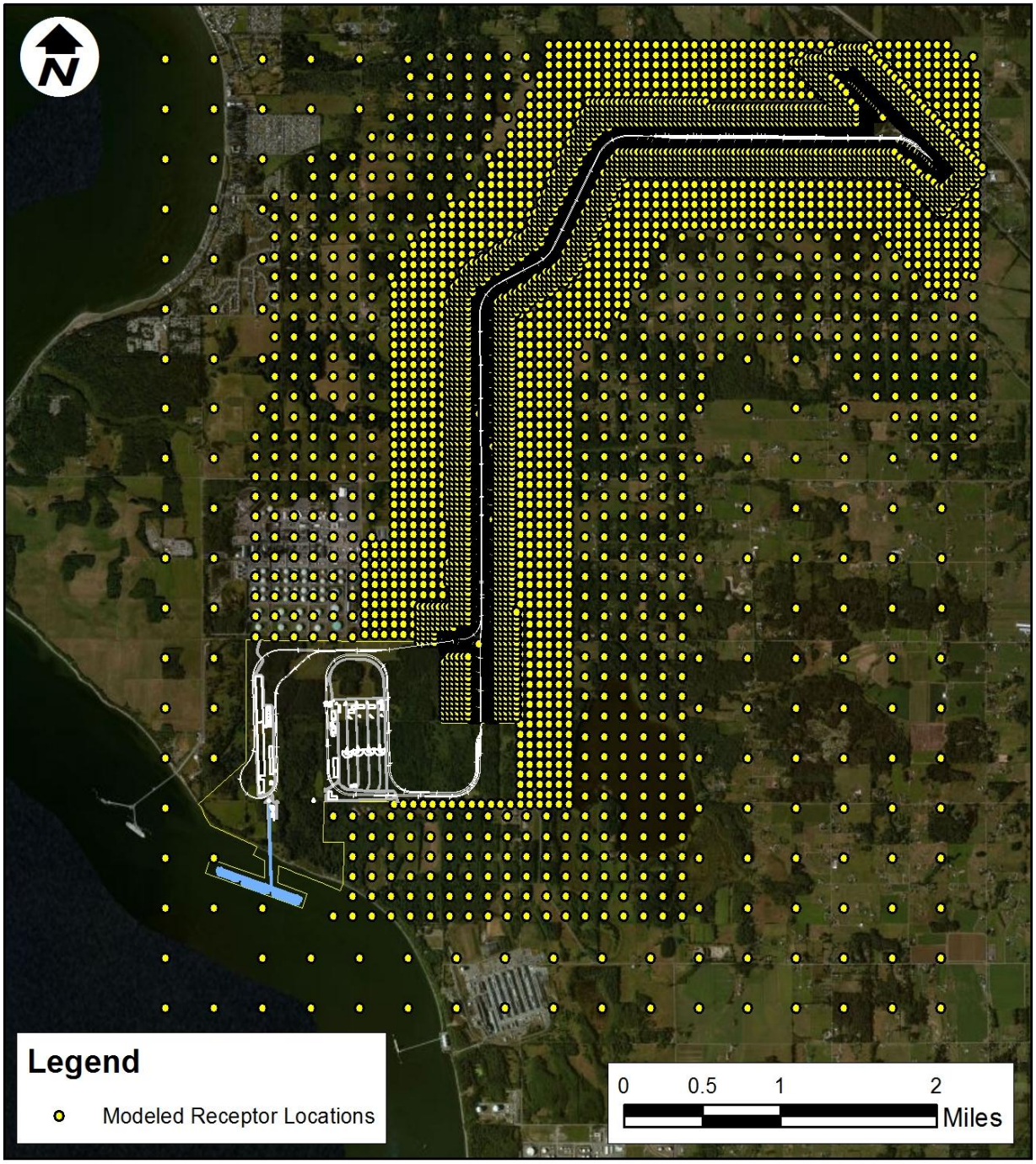


Figure 4. AERMOD Receptor Grids for Transiting Trains Modeling

Figure 5. On-Site Non-Combustion Emission Sources

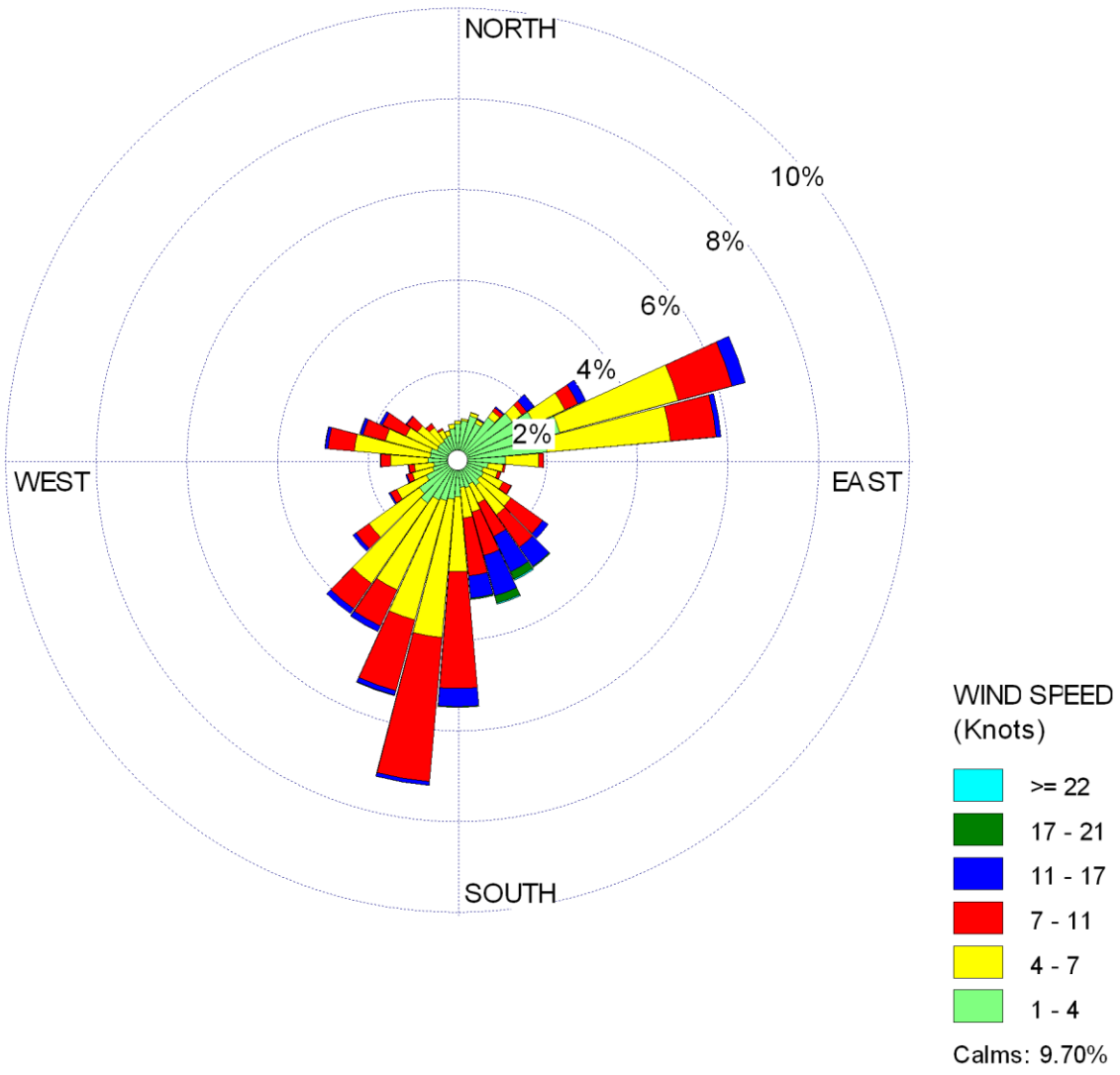


Figure 6. 5-Year Meteorological Data Set Wind Rose

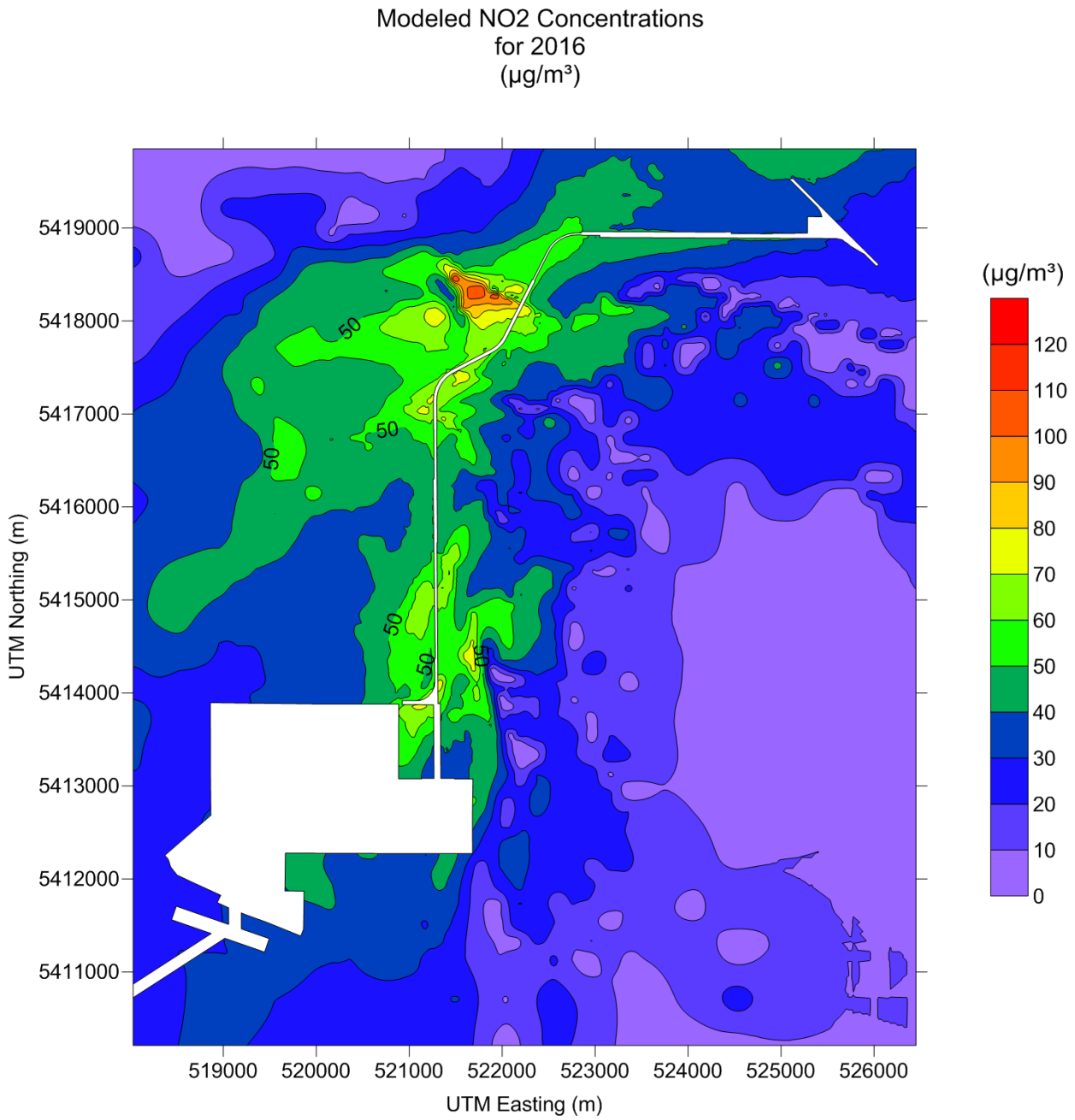


Figure 7. Modeling Results: 2016 1-Hour NO_2 Concentrations (Without Background) near Transiting Trains (µg/m^3)

Note that this figure does not depict model-calculated concentrations as high as or exceeding the 188 µg/m^3 1-hour standard, and even with the addition of background concentrations, project-related concentrations would not exceed this standard.

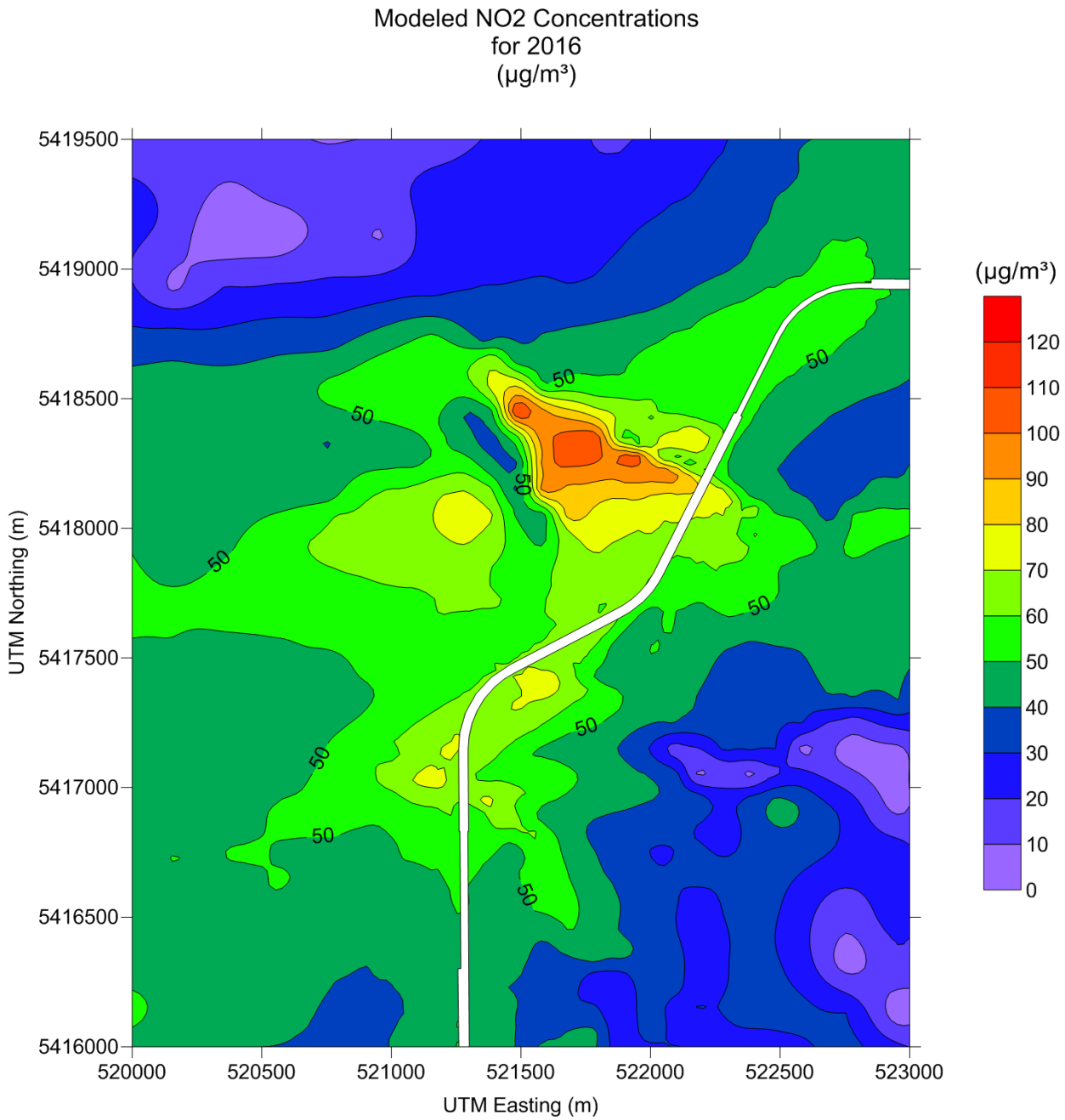


Figure 8. Modeling Results: 2016 1-Hour NO_2 Concentrations (Without Background) near Transiting Trains (µg/m^3) – Large Scale

Note that this figure does not depict model-calculated concentrations as high as or exceeding the 188 µg/m^3 1-hour standard, and even with the addition of background concentrations, project-related concentrations would not exceed this standard.

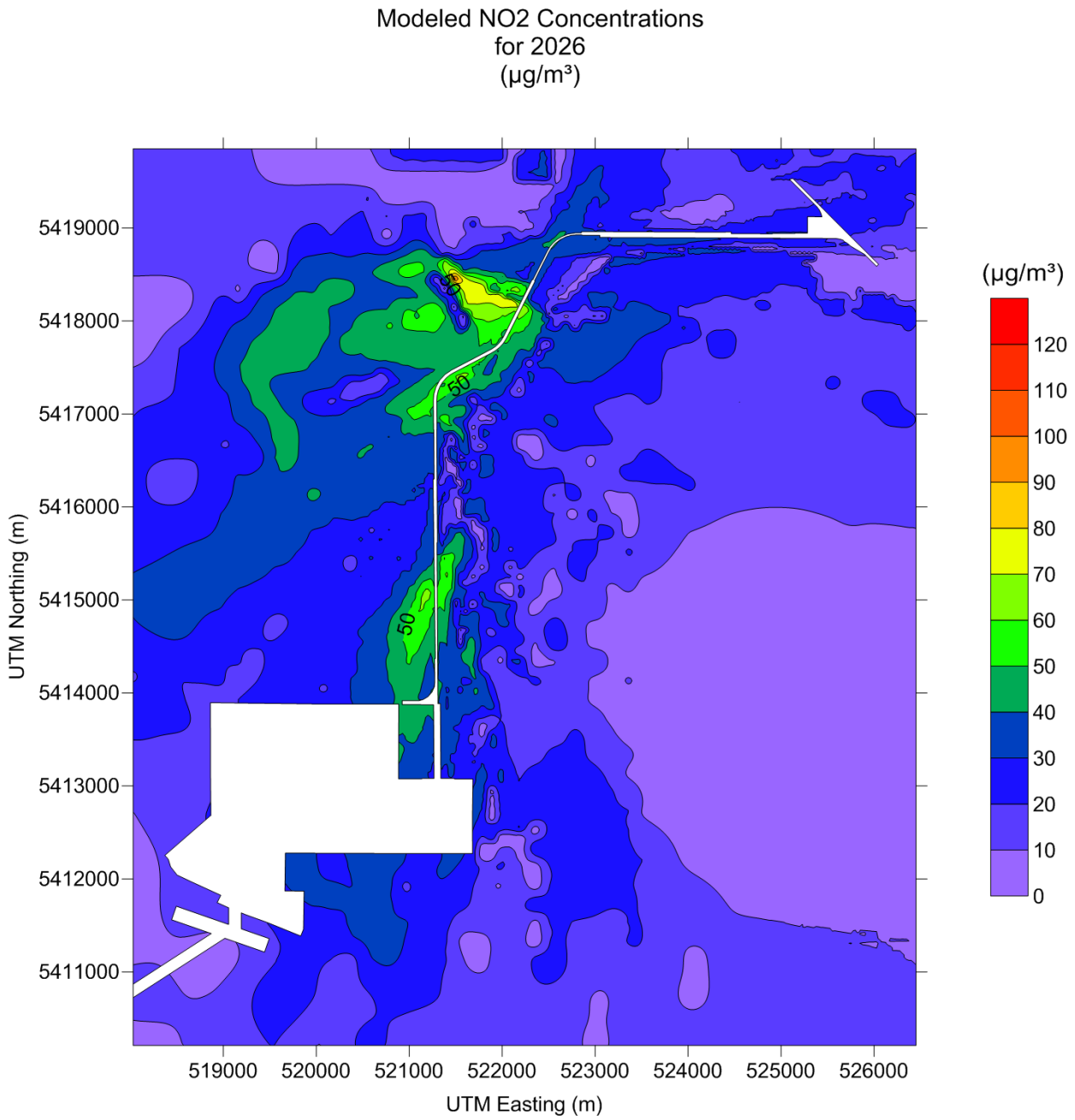


Figure 9. Modeling Results: 2026 1-Hour NO_2 Concentrations (Without Background) near Transiting Trains (µg/m^3)

Note that this figure does not depict model-calculated concentrations as high as or exceeding the 188 µg/m^3 1-hour standard, and even with the addition of background concentrations, project-related concentrations would not exceed this standard.

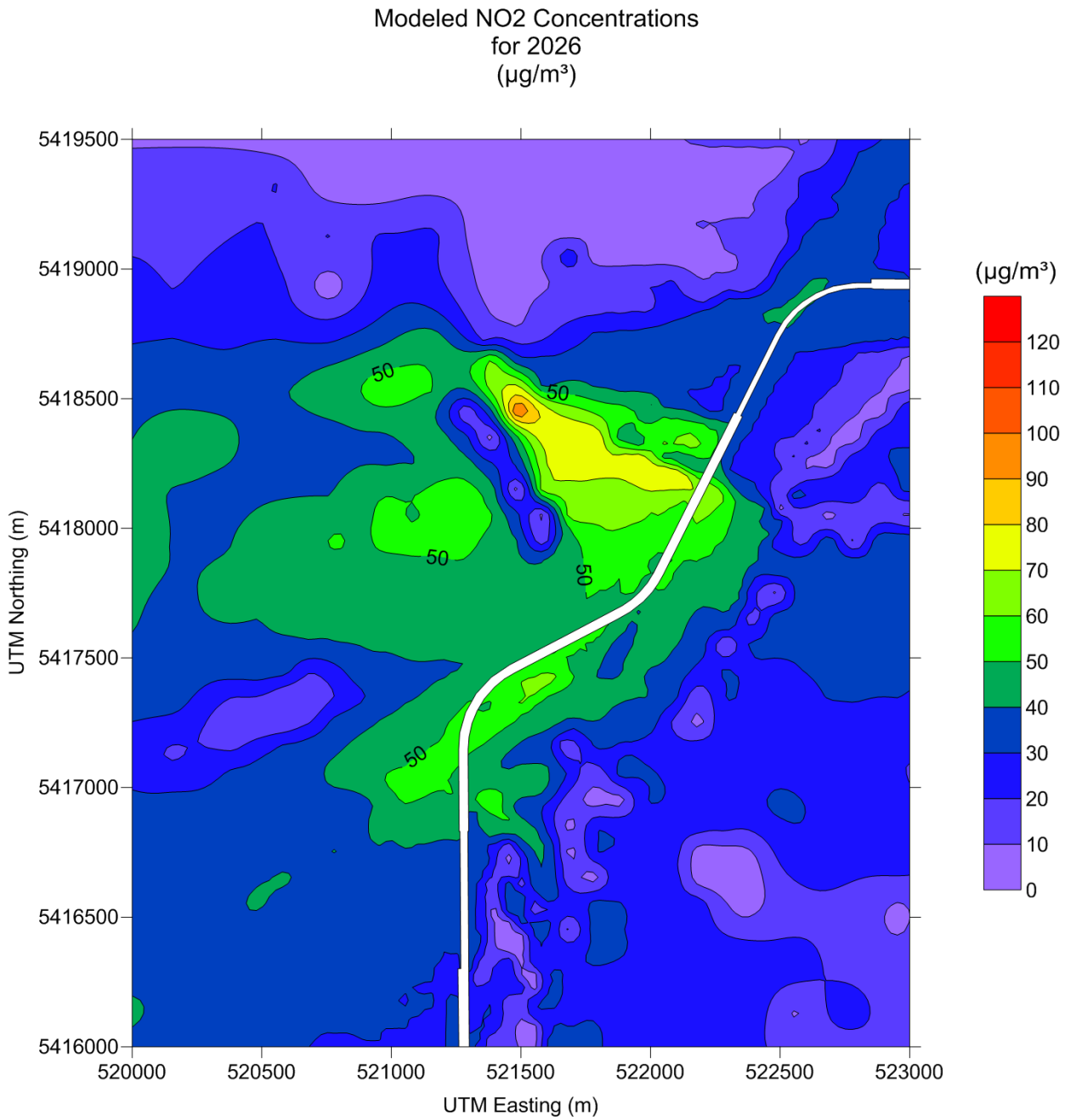


Figure 10. Modeling Results: 2026 1-Hour NO_2 Concentrations (Without Background) near Transiting Trains (µg/m^3) Large Scale

Note that this figure does not depict model-calculated concentrations as high as or exceeding the 188 µg/m^3 1-hour standard, and even with the addition of background concentrations, project-related concentrations would not exceed this standard.

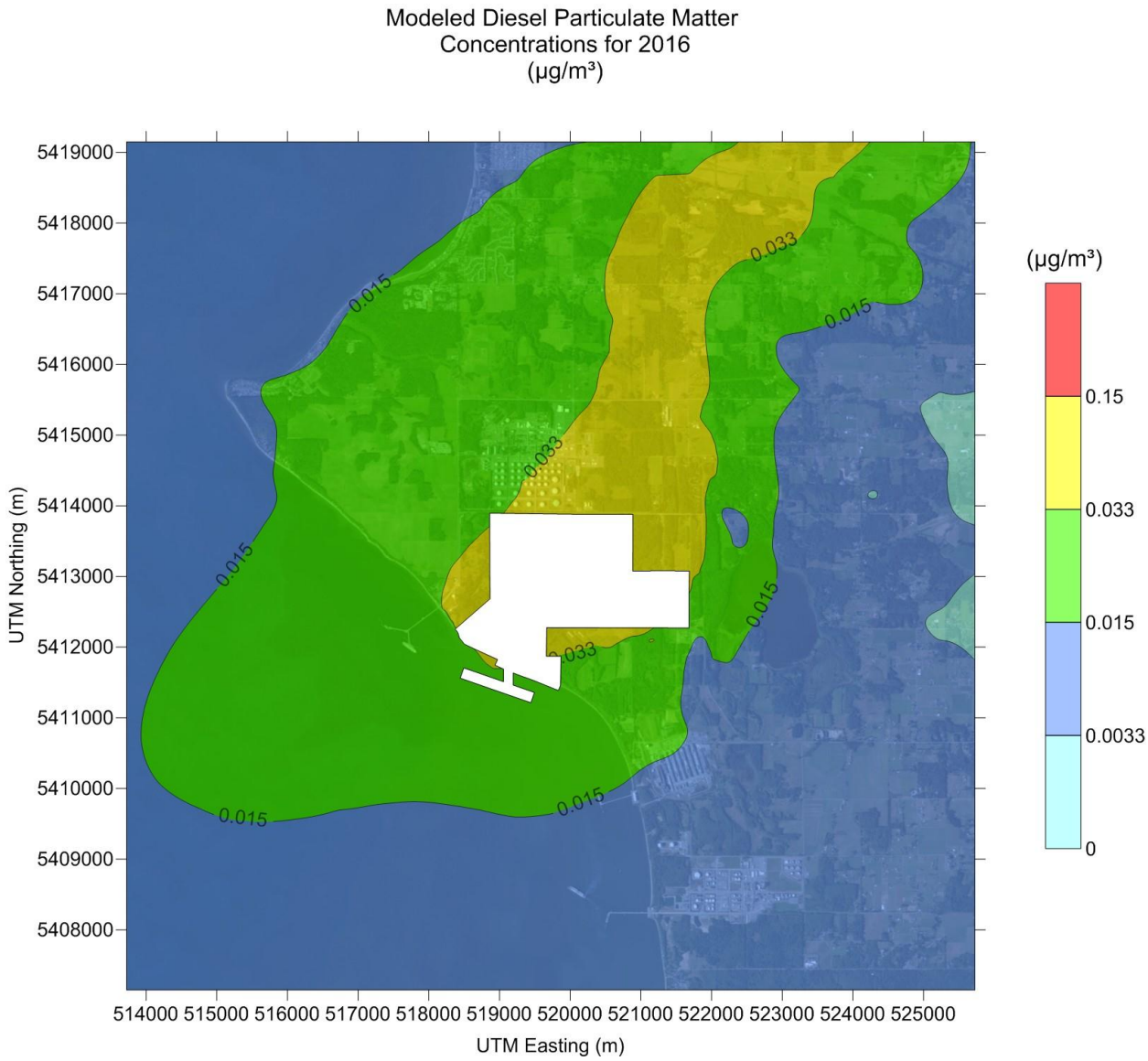


Figure 11. Modeling Results: 2016 Annual Average DPM Concentrations (µg/m^3)

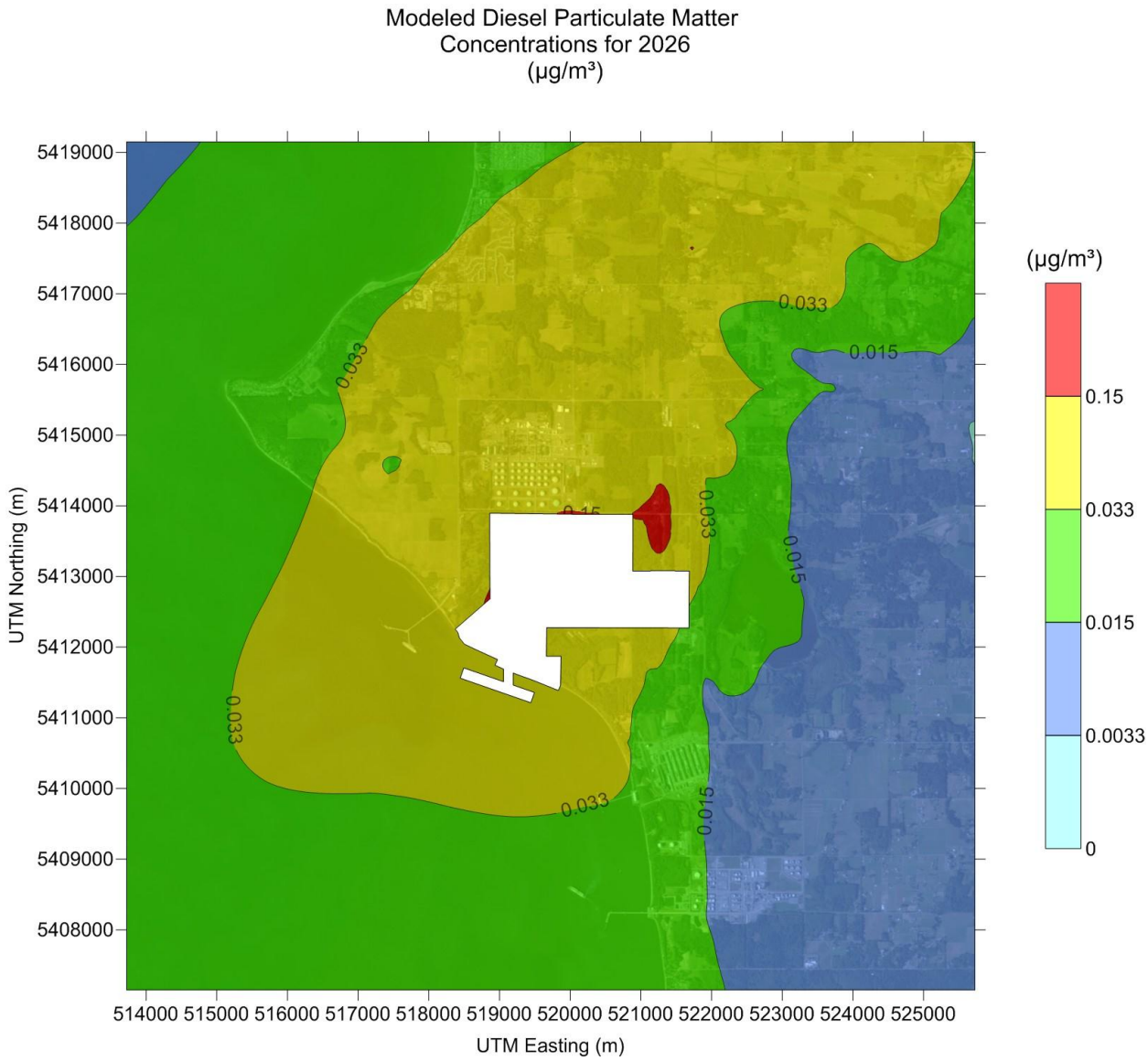


Figure 12. Modeling Results: 2026 Annual Average DPM Concentrations (µg/m^3)

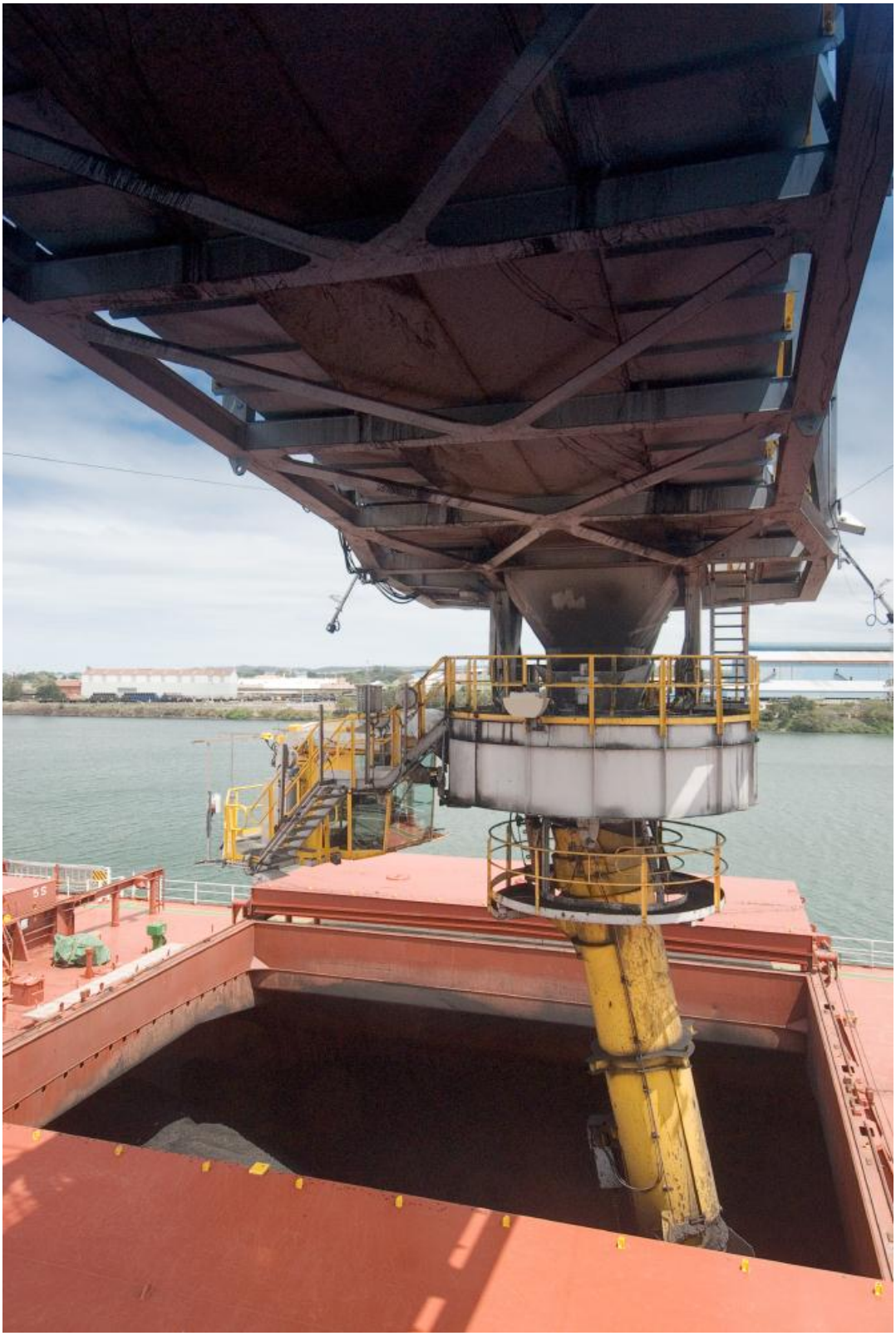
Appendix A: Coal-Handling Equipment Photos

Stacker/Reclaimer being fed by Open Conveyor – Adding to Pile

Enclosed Conveyor

Enclosed Conveyor with Close-Up of Returning Empty Belt Below

Enclosed Conveyor Viewed from Below



Vessel Loading Coal with Chute Well below Combing

Appendix B: GHG Emission Inventory

Summary of GHG Emissions

Operational Emissions	Annual Emissions CO_2e - Metric Tons	
	2016 Phase 1	2026 Full Build Out
Direct Emissions		
On-Site Diesel Equipment	49	97
Indirect Emissions		
Purchased Energy	9,939	24,847
Employee Commute	336	804
Rail Product Delivery		
Transit	3,317	6,644
On-Site	2,173	5,366
Vessel Product Export		
Transit	1,767	3,893
Hoteling	3,878	8,542
Annual Facility-Related GHG Emissions	**21,459**	**50,193**

Construction-Related Emissions	Total Emissions CO_2e - Metric Tons
NonRoad Diesel - Landside	6,659
NonRoad Diesel - Over Water	5,185
Bubble Curtains	694
Employee Commute	-
Total Construction-Related GHG Emissions	**12,537**

Key Assumptions

* Full Build out Purchased Electricity is based on Phase 1 Energy 67,000,000 kWh times 2.5 (per Ausenco-Sandwell)
* Rail Product Delivery transit includes roundtrip distance to/from the Custer Wye, based on fuel consumption. On-site considers fuel consumption during unloading of product while on-site.
* Vessel Transit GHG emissions based on travel 3 nautical miles offshore into Puget Sound , including tug assist. Hoteling includes all time while at wharf.
* Landside Construction based on GPT Construction Summary and includes earthwork, soil stabilization, material and equipment delivery, and land-side construction
* Bubble Curtains are listed separately; specifics regarding use of these curtains during pile driving is uncertain at this time

Note that emissions of both NO_2 and CH_4 reported in the following pages in terms of metric tons <u>include</u> consideration of their respective global warming potential multipliers to represent them as CO_2e.

Direct Operation Emissions

At Full Build - 2026

On-Site Diesel	Total Equipment	Activity / equipment		Fuel Consumed		CO_2e Emissions		
		hr/day	Days/yr	gal/hr	gal/yr	CO_2 Mt/yr	N_20 Mt/yr	CH_4 Mt/yr
Dozers	2	2	365	3.5	5,110	51.87	0.40	0.07
Front end loaders	2	2	365	3	4,380	44.46	0.34	0.06

Total CO_2e Emissions per year - 2026: 97.20 Mt/yr

Total CO_2e Emissions per year - 2016: 48.60 Mt/yr

Assumptions:
Phase 1 2016, assumes 1 piece of equipment each for the same durations as above
Fuel consumption rate based on GPT Construction emissions assumptions for excavator, skid steer

CO2e GWP Multipliers		EF per gal fuel [1]	
N_20	298	0.26	g/gal
CH_4	25	0.58	g/gal
CO_2	1	10.15	kg/gal

[1] Table C.6 Methane and Nitrous Oxide Emission Factor for Non-Highway Vehicles, Construction/Diesel, CCAR, Carb.

Mt = metric tons

GPT Construction GHG Emissions Calculations

Site Work Summary Table

Earthworks	Equipment	Volume	Hours	Hal/Hr	Gallons	CO_2 Equivalent Emissions (Mt)		
						CO_2	CH_4	N_2O
Cut-Fill	637G	1,552,798	4,494	19.1	85,835	871.0	1.24	6.65
Excess Fill	637G	1,496,058	4,330	19.1	82,699	839.1	1.20	6.41
Compaction	815F2	2,215,386	2,398	9.5	22,777	231.1	0.33	1.76
Support	140M	-	749	5.6	4,194	42.6	0.06	0.32
Support	D9T	-	749	11.4	8,539	86.6	0.12	0.66
Support	Water Truck	-	524	8.7	4,561	46.3	0.07	0.35
Earthworks Total					208,605	2,116.7	3.0	16.2
Total CO_2e								**2,135.9**

Stabilization	Equipment	Volume	Hours	Hal/Hr	Gallons	CO_2 Equivalent Emissions (Mt)		
						CO_2	CH_4	N_2O
Rotary Mixer	RM500	833,470	750	23	17,253	175.1	0.25	1.34
Compaction	815F2	833,470	902	9.5	8,569	86.9	0.12	0.66
Compaction	CS74	833,470	621	2.5	1,552	15.7	0.02	0.12
Support	140M	-	375	3.6	1,350	13.7	0.02	0.10
Support	D9T	-	375	8	3,000	30.4	0.04	0.23
Support	Water Truck	-	263	8.7	3,263	33.1	0.05	0.25
Stabilization Total					34,988	355.0	0.5	2.7
Total CO_2e								**358.2**

Construction Table

Delivery	Total Loads	Haul Hours	Offload Hours	Return Hours	Total Hours	Consumption gal	CO_2 Equivalent Emissions (Mt)		
							CO_2	CH_4	N_2O
Steel	2,154.0	355.0	89.0	355.0	800.0	6,956.0	70.6	0.10	0.54
Concrete	6,593.0	1,088.0	272.0	1,088.0	2,447.0	21,293.0	216.1	0.31	1.65
Rail Materials	829.0	5.0	28.0	5.0	37.0	1,193.0	12.1	0.02	0.09
Equipment				0.0	0.0		0.0	0.00	0.00
Support Facilities	59.0	10.0	2.5	10.0	22.0	192.0	1.9	0.00	0.01
Mob/Demob	92.0	15.0	8.0	15.0	38.0	330.0	3.3	0.00	0.03
Total CO_2e									**312.63**

Construction	Quantity	Units	Prod (Tons/Hr)	Hours	Gal/Hour	Consumption	CO_2 Equivalent Emissions (Mt)		
							CO_2	CH_4	N_2O
Material Shake Out	36,614	Tons	20	1,831	17.6	32,220	326.9	0.47	2.5
Heavy Erection (25%)	9,154	Tons	10	915	23.8	21,785	221.1	0.32	1.7
Medium Erection (50%)	18,307	Tons	15	1,220	20.9	25,508	258.8	0.37	2.0
Light Erection (25%)	9,154	Tons	5	1,831	8.6	15,744	159.8	0.23	1.2
Excavation	59,333	CY	20	2,967	24.3	72,090	731.5	1.05	5.6
Foundations	59,333	CY	5	11,867	17.6	208,852	2119.2	3.03	16.2
Rail Materials Installation	3,251	Tons	5	650		0	-	0.00	0.0
Rail Sub-Grade	97,650	CY	20	4,883		0	-	0.00	0.0
Construction Total						376,199	3,817	5	29
Total CO_2e									**3,851.91**

Total CO_2e	Mass Earthwork	2,136	
	Soil Stabilization	358	
	Material & Equipment Delivery	313	
	Construction	3,852	
	Total CO_2e	**6,659**	**Mt CO_2e**

***Does not include construction employee commute or bubble curtain in-water**

Assumptions:

All Consumption and equipment data provided by GPT Construction emissions spreadsheets

CO_2E GWP Multipliers			EF per gal
	N_2O	298	0.26 g/gal
	CH_4	25	0.58 g/gal
	CO2	1	10.147 kg/gal
convert g to lb		0.0022	
convert lb to kg		0.4536	
convert g to Mt		0.000001	

Table C.6 Methane and Nitrous Oxide Emission Factor for Non-Highway Vehicles, Construction/Diesel

From ARB GHG Reporting Protocol

GPT - GHG Emissions from Bubble Curtain Genset/Compressor

CFM Rating	HP rating	Load Factor %	Fuel Rating g/hr	Activity Hrs Pile Driving	CO_2	N_2O	CH_4
750 CFM	300.00	1.00	11.60	5840.00	**687.60**	**5.25**	**0.98**
Total CO_2e Mt							**694**

Assumptions:

Assumes 750 CFM Compressor Set based on Sullair 750H AF specifications from a study of viable designs for bubble curtains
Total activity hrs is the same as the activity time 'Construction over water Pile Driving, Trestle, Phase 1 and Phase 2'
1 set of bubble curtains for each pile driving activity area
Impact drive and vibratory drive are assumed to incorporate bubble curtains at all times throughout the work day

Conversions Factors

10.15 kg CO_2 generated / gal diesel
0.26 g N_2O generated / gal diesel
0.58 g CH_4 generated / gal diesel
298 N2O CO2e GWP multiplier
25 CH_4 CO_2e GWP Multiplier

Table C.6 Methane and Nitrous Oxide Emission Factor for Non-Highway Vehicles, Construction/Diesel

From ARB GRP

GHG Emissions from Employee Commute

Indirect Emissions - On-road Sources - Employee Commute, Operational, Full Build 2016

CO_2e Emissions

CO_2	N_2O	CH_4		Mt CO2e
332.3	0.18	3.48		335.96

Indirect Emissions - On-road Sources - Employee Commute, Operational, Full Build 2026

CO_2e Emissions

CO_2	N_2O	CH_4		Mt CO2e
795.3	0.42	8.34		804.03

Assumptions 2016:

779,640 annual miles traveled based on 89 employee trips (178 roundtrip):PID Table 4-3 Phase 1; 365 days per year

Average commute distance - Whatcom County

min	miles	
		As calculated above using Whatcom County WA 2010 Census Statistics http://census-statistics.findthedata.org/1/3041/whatcom-county-wa
20	12.0	Transportation Energy Data Book #30, 2011, Table 8.8 Trip Statistics by Trip Purpose, 2009 To/From Work

Assumptions 2026:

1,865,880 annual miles traveled based on 213 employee trips (426 roundtrip):PID Table 4-3 at full capacity; 365 days per year

0.0485 gal/mi national average fuel economy as calculated by ENVIRON from

20.6 mpg weighted-average autos and light trucks, Transportation Energy Data Book, Chapter 4, 2008

8,788 g/gal CO2e emissions gas-powered vehicles, as derived using EPA calculation and Transportation Energy Data Book CO2 Emissions rate, Table 11-11

EPA calculation found at: http://www.epa.gov/otaq/climate/420f05004.htm

CO_2 Annual Emissions = annual miles * gal/mi * g/gal CO2 EF converted to Metric Tons

N_2O, CH_4 Annual Emissions = miles * g/mi EF*GWP converted to Metric Tons

	g/mile EF	GWP
N_2O	0.009	25
CH_4	0.015	298

GHG Emissions - Rail Product Transport

Transiting Train Activity

Transit - Annual Emissions at Phase 1 (2016)

	CO_2 Mt	CH_4 Mt	N_2O Mt	Total GHG Emissions Mt CO_2e
Trains, Coal, roundtrip	3,286	6.4	24.9	3,317
Trains, Grain, roundtrip	0	0.00	0.00	0
Total GHG Emissions from Rail Product Delivery				**3,317**

Transit - Annual Emissions at Build out (2026)

	CO_2 Mt	CH_4 Mt	N_2O Mt	Total GHG Emissions Mt CO_2e
Trains, Coal, roundtrip	5,728	11.2	43.4	5,783
Trains, Potash, roundtrip	853	1.7	6.5	861
Total GHG Emissions from Rail Product Delivery				**6,644**

ON-SITE ACTIVITIES

On Site -Annual Emissions at Phase 1 (2016)

	CO_2 Mt	CH_4 Mt	N_2O Mt	Total GHG Emissions Mt CO_2e
Trains, Coal, roundtrip	2,153	4.2	16.3	2,173
Trains, Potash, roundtrip	0	0.00	0.00	0
Total GHG Emissions from Rail Product Delivery				**2,173**

On Site - Annual Emissions at Build out (2026)

	CO_2 Mt	CH_4 Mt	N_2O Mt	Total GHG Emissions Mt CO_2e
Trains, Coal, roundtrip	4,093	8.0	31.0	4,132
Trains, Potash, roundtrip	1,222	2.4	9.3	1,234
Total GHG Emissions from Rail Product Delivery				**5,366**

Assumptions:

Number of Trips at Phase 1 2016:

Trains, Coal, roundtrip 1,825 (5 trains per day, 365 days of the year)

Number of Trips at Full Build 2026:

Trains, Grain, roundtrip 513 (1.4 train per day, 365 days of the year)

Trains, Potash, roundtrip 365 (1 train per day, 365 days of the year)

CO_2 Emissions based on fuel consumed

g/gal CO_2 derived using Fuel density (7.08 lb/gal or 3200 g/gal) and the carbon content of 87% - Emission Factors for Locomotives, p5, EPA

Rail Emissions - Transiting Custer Spur between GPT Site and Custer Wye			**Mt CO_2 / train**
w/o AESS	125 car coal train 2016		
	1,800,275	g/train	1.80
	150 car coal train 2026 w/o AESS		
	1,961,707	g/train	1.96
	123 car grain train 2026 (not used)		
	1,815,611	g/train	1.82
	170 car potash train 2026 (worst case annual)		
	2,337,701	g/train	2.34

Rail Emissions - On Site at Facility During Unload			**Mt CO_2 / train**
w/o AESS	125 car coal train 2016		
	1179578.73	g/train	1.18
	150 car coal train 2026 w/o AESS		
	1,401,803	g/train	1.40
	123 car grain train 2026 (not used)		
	1,878,958	g/train	1.88
	170 car potash train 2026 (worst case annual)		
	3,348,696	g/train	3.35

CO_2e Emission Factors and Multipliers

Table C.6 Methane and Nitrous Oxide Emission Factor for Non-Highway Vehicles, Locomotive/Diesel, ARB GHG Reporting Protocol

CO_2e GWP Multipliers		**EFs**
N_2O	298	0.26 g/gal
CH_4	25	0.80 g/gal
CO_2	1	22.53 lbs/gal

Fuel consumption per train provided by BNSF (gal while in specified activity)

Activity	**2016**	**2026**
On-site	115.5	137.2
Transiting	176.2	192.0
Total	291.7	329.2

GHG Emissions from Vessels and Tugs

Annual Green House Gas Emission Inventory - Mt CO_2e (At Phase 1 buildout 2016)

Emission Source	CO_2	N_2O	CH_4	Total Emissions Metric tons CO_2e
Vessels Hoteling	3,842.1	35.2	1.2	3,878
Vessels Transiting/Maneuvering	1,095.3	16.4	0.2	1,112
Tugs Transiting/Maneuvering	647.3	5.8	1.8	655
Total Vessel-related GHG Emissions - 2016				**5,645**

Annual Green House Gas Emission Inventory - Mt CO_2e (At full buildout 2026)

Emission Source	CO_2	N_2O	CH_4	Total Emissions Metric tons CO_2e
Vessels Hoteling	8,461.7	77.6	2.6	8,542
Vessels Transiting/Maneuvering	2,413.7	36.0	0.5	2,450
Tugs Transiting/Maneuvering	1,425.8	12.8	3.9	1,442
Total Vessel-related GHG Emissions -2026				**12,435**

Assumptions:

Emission values provided from AERMOD modeling inventory calculation using the same assumptions as modeling effort

Hourly Emission Factor derivation by activity (used with AERMOD to generate total emissions -see other spreadsheet for assumptions)

Hourly Emissions (g/hr /vessel)

Vessels *by source*	CO_2	N_2O	CH_4	**Activity**
AUX	330,314.10	4,595.73	40.17	transit
	458,769.58	6,382.96	55.79	maneuver
	203,897.59	2,836.87	24.80	hotel
BOILER	52,865.00	0.98	34.34	maneuver
	105,730.00	1.96	68.67	hotel
MAINS	1,360,644.48	20,238.66	176.90	transit
	275,488.51	5,784.26	238.06	maneuver
by activity				
MANUEVER	787,123.09	12,168.20	328.18	
Tugs *by source*	CO_2	N_2O	CH_4	**Activity**
AUX	-	-	-	cruise
	38,640.00	347.20	105.84	maneuvering
MAINS	-	-	-	cruise
	398,709.60	3,582.61	1,092.12	maneuvering
TUG Maneuvering	437,349.60	3,929.81	1,197.96	

Assume no transit modeling of tugs to and from vessel meeting point

Simplified Emissions Inventory Tool (SEIT)

Purchased Energy

INDIRECT EMISSIONS: Purchased Electricity

This tool uses GWPs from the IPCC's Fourth Assessment Report (AR4).

Phase 1 2016

Region (States)	Enter Activity Data	Unit of Measure	Emission Factors		Emissions (MT CO_2e)
11. (OR, WA, ID)	**67,000.0**	MWh	0.147	MT CO_2 per MWh	9,849.0
			0.01345	kg CH_4 per MWh	22.5
			0.00337	kg N_2O per MWh	67.3
				Total	9,938.8

Full Build Out 2026

11. (OR, WA, ID)	**167,500.0**	MWh	0.147	MT CO_2 per MWh	24,622.5
			0.01345	kg CH_4 per MWh	56.3
			0.00337	kg N_2O per MWh	168.2
				Total	24,847.0

Assumptions:

67,000 MWh = Phase 1 estimated energy consumption (7.6 MW) provided by Ausenco-Sandwell

167,500 MWh = Phase 2, estimated as 2.5 x Phase 1 (19.1 MW) per Ausenco-Sandwell

MW = MWh / 8760 hr annual consumption

SEIT Reference Sources

Intergovernmental Panel on Climate Change, Errata to Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

GWP Multipliers	AR4*
Methane	25
Nitrous Oxide	298

*Second Assessment Report, Third Assessment Report, Assessment Report 4

Construction - Over Water Work

Trestle

	SCC Code	HP Rating	Load Factor	Production	Activity Hrs	GHG Emissions - CO_2e (metric tons, MT) CO_2	CH_4	N_2O	
Pile Driver/Hammer	2270006005	200	0.43	Pile Driving	300	13.68	0.02	0.11	
Crane - 150T Ringer	2270002045	300	0.43	All	860	58.80	0.05	0.27	
Compressor	2270006015	100	0.43	All	860	19.61	0.02	0.13	
									Subtotal MT
									99.02

Dock - Phase 1 Center

	SCC Code	HP Rating	Load Factor	Production	Activity Hrs	GHG Emissions - CO_2e (metric tons, MT) CO_2	CH_4	N_2O	
Concrete Pump	2270006010	50	0.59	Concrete Work	450	7.03	0.01	0.07	
Pile Driver/Hammer	2270006005	200	0.43	Pile Driving	300	13.68	0.02	0.11	
Barge Diesel Generator	2270006005	200	0.43	All	1,350	61.54	0.10	0.52	
Crane -250T Crawler	2270002045	450	0.43	All	1,350	138.45	0.17	0.90	
Compressor	2270006015	100	0.43	All	1,350	30.78	0.04	0.21	
									Subtotal MT
									253.62

Dock - Phase 2 - Dock Built in 2 directions, from Center, Simultaneously

	SCC Code	HP Rating	Load Factor	Production	Activity Hrs/Side	Total Activity (Hrs/Side x2)	GHG Emissions - CO_2e (metric tons, MT) CO_2	CH_4	N_2O	
Concrete Pump	2270006010	50	0.59	Concrete Work	3,930	7,860	208.21	0.23	1.22	
Pile Driver/Hammer	2270006005	200	0.43	Pile Driving	2,620	5,240	555.49	0.38	2.01	
Barge Diesel Generator	2270006005	200	0.43	All	11,790	23,580	1074.87	1.69	9.03	
Crane -250T Crawler	2270002045	450	0.43	All	11,790	23,580	2418.19	2.94	15.71	
Compressor	2270006015	100	0.43	All	11,790	23,580	537.66	0.68	3.65	
										Subtotal MT
										4,831.95
								Total Mt CO_2e Over Water		**5,184.60**

Sources

Construction Timing Data from *143166 Gateway Construction Methodology, dated March 2012*

Load Factors from *Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling* , EPA, July 2010

Assumptions:

Inventory does not include emissions associated with delivery of materials, concrete or fuel by barge/rail or heavy-duty haul truck

Inventory does not include tug assist for barge delivery

Co2 Emissions calculated using g/hr rate from USEPA NONROAD model for CY2014

CH4/N20 Emissions calculated using gal/hr assumptions

Assume Pile Driver uses a power engine to supply hydraulic power, 200 hp

Assume barge has on-barge generator/compressor to provide electricity, 100 hp

Construction Equipment Fuel Consumption Data Gallons per Hour		**Assigned Equipment**
200 Ton Crane	4 gph	150 T Crane, not adjusted for load factor (because assumption is 'medium' use)
Generator	2 gph	Concrete Pump & Compressor, not adjusted for load factor (because assumption is 'medium' use)
Sullair 300 hp generator/air compressor @ 100% load	11.5 gph	Pile Driver & Barge Generator, adjusted to load factor
250 ton Linkbelt Crawler Crane @ 100% Load	20 gph	250 T Crane, adjusted for load factor

Fuel Consumption Data from GPT Construction Emissions_20120111.xlsx from client: (medium usage) except Sullair Compressor

Construction Timing

Trestle Activity

Per Bent (T1-T20)	**"days"**	**Total Days**	**Activity Hours**
Pile Driving	1.5	30	300
Concrete Work	2	40	400
Girders	0.5	10	100
Deck Panels	6	6	60

Notes:

Assume crane is used for all activities associated with concrete, piles, placing girders and deck panels

Assume x-hr days: 10

Assume x-# of bents 20

Assume 150-ton Ringer crane is used in lieu of floating crane or jack-up barge-crane

Total Days = 'days' * # Bents Activity Hours = Total Days * # Hours

	Dock Phase 1			**Dock Phase 2**		
Dock Construction	**"days"**	**Total Days**	**Activity Hours**	**"days"**	**Total Days**	**Activity Hours**
Falsework installation	1	15	150	1	131	1310
Pile Driving	2	30	300	2	262	2620
Concrete Work	3	45	450	3	393	3930
Girders/Deck Panel	2	30	300	2	262	2620
Remove Falsework	1	15	150	1	131	1310

	g/gal	**CO_2e GWP Multiplier**
CH_4, g/gal =	0.58	25
N_20 g/gal =	0.26	298

Table C.6 Methane and Nitrous Oxide Emission Factor for Non-Highway Vehicles, Construction/Diesel

Assume x-hr days:	10	
Assume x-# of bents	15	Phase 1
	131	Phase 2

AESS v Non-AESS Days

1301 hours average # of days below 40 F
8760 hrs / yr
14.9% of all hours in 5-year period were less than 40°F where AESS would not allow engine shutdown

Natural Gas 16.3 MW Rated Generator (19 MW Est. Need in 2026)

22931 bhp
148.9 MMBtu/hr
53.1 kg CO2/MMBtu Specifications for Wartsila NG Fired Engine
5 g CH4 /MMBtu
0.1 g N20 /MMBtu
8760 hr operation /yr

GHG	EF	MMBtu/hr	hr/yr	GWP	Emissions CO_2e MT
CO_2	53.1	148.9	8760	1	69,261.73
CH_4	5	148.9	8760	25	163.05
N_20	0.1	148.9	8760	298	38.87
TOTAL GHG EMISSIONS					**69,463.64**

IF Elec. Purchased
TOTAL GHG EMISSIONS 24,847.04

GHG Emissions Avoided **(44,616.61)**
-64.2%