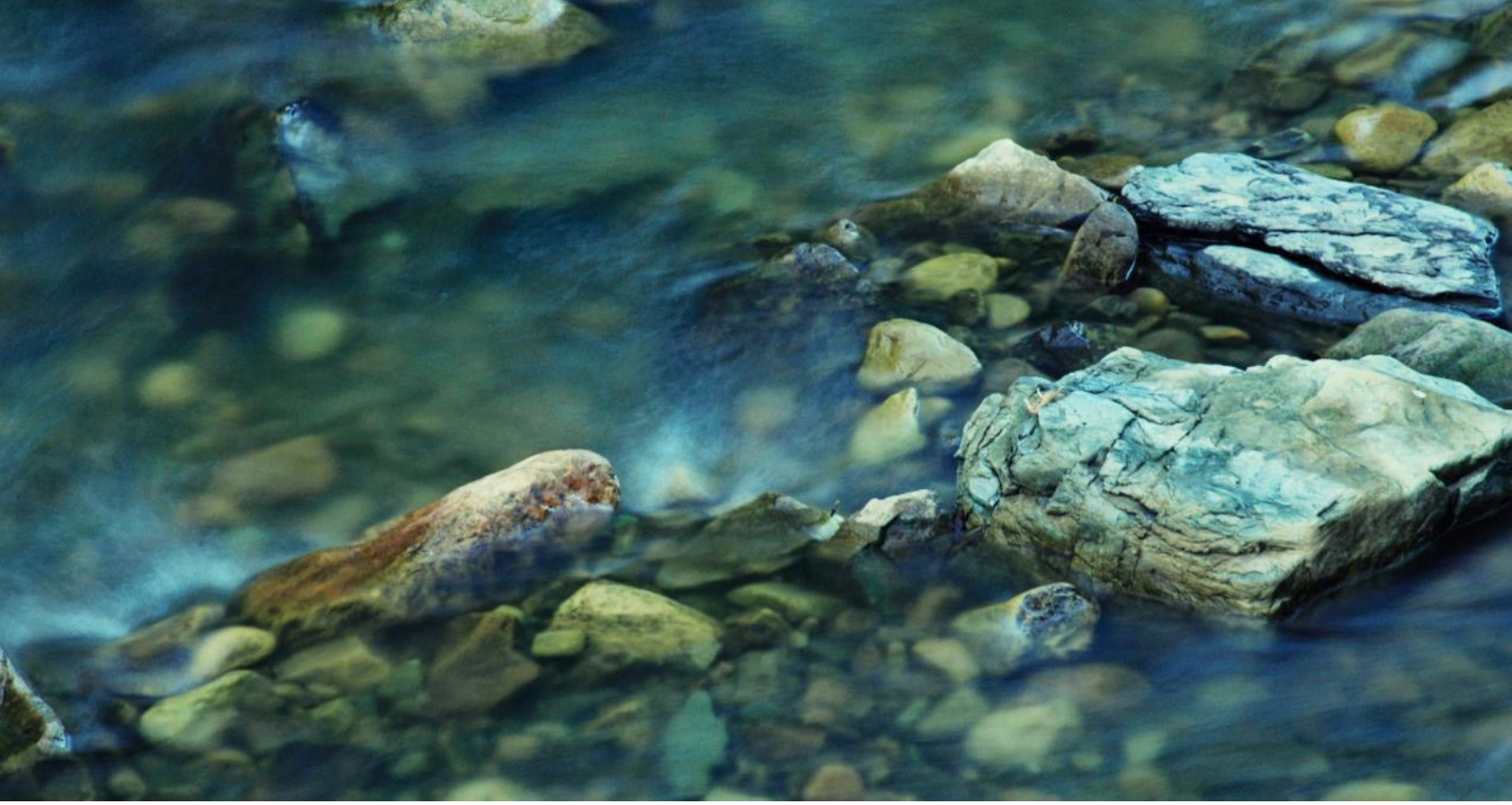
Attachment D
Air Quality and Greenhouse Gas Emissions Technical Study



July 2023
Port of Grays Harbor Terminal 4 Expansion and Redevelopment Project

ANCHOR QEA

Air Quality and Greenhouse Gas Emissions Technical Study

Prepared for Port of Grays Harbor and Ag Processing, Inc.

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Port of Grays Harbor
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Prepared by
Anchor QEA, LLC

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ABBREVIATIONS

--	not applicable
µg/m^3	micrograms per cubic meter
AGP	Ag Processing, Inc.
BNSF	Burlington Northern Santa Fe
CAA	Clean Air Act
CAP	criteria air pollutant
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
GHG	greenhouse gas
kg	kilograms
lb	pound
MT	metric tons
NAAQS	National Ambient Air Quality Standards
NO_X	oxides of nitrogen
ORCAA	Olympic Region Clean Air Agency
PM	particulate matter
$PM_{2.5}$	particulate matter less than or equal to 2.5 micrometers in diameter
PM_{10}	particulate matter less than or equal to 10 micrometers in diameter
Port	Port of Grays Harbor
ppb	parts per billion
ppm	parts per million
PSAP	Puget Sound and Pacific Railroad
PSD	Prevention of Significant Deterioration
RCW	Revised Code of Washington
ROG	reactive organic gases
SO_2	sulfur dioxide
tpy	tons per year
USC	United States Code
USEPA	U.S. Environmental Protection Agency
WAC	Washington Administrative Code

1 Introduction

The Port of Grays Harbor (Port) is proposing the Terminal 4 Expansion and Redevelopment Project to increase rail and shipping capacity at Terminal 4 at the Port located in the cities of Hoquiam and Aberdeen, Washington, to accommodate growth of dry bulk, breakbulk, and roll-on/roll-off cargos. This includes the rail upgrades and site improvements, the Terminal 4A cargo yard relocation and expansion, and the Terminal 4 dock fender and stormwater upgrades. These project elements would be constructed by the Port and are referred to as the Port Project. It also includes a new export terminal by Ag Processing, Inc. (AGP), at Terminal 4. This project element is referred to as the AGP Project. Together, the Port and AGP projects are referred to as the Proposed Project.

The purpose of this technical study is to describe the affected environment and potential impacts of the Proposed Project and its alternatives on the air quality of the study area as well as the contribution to climate change via greenhouse gases (GHGs) emitted by the Proposed Project. This includes quantifying emissions from construction and operation of the project to determine the net increase in criteria pollutants and GHG emissions, as well as off-site emissions generated by new rail, marine vessel, and truck traffic resulting from the Proposed Project. This technical study will be used to support environmental review of the project by the state and federal agencies with a funding, jurisdictional, or permitting authority over the project. This includes compliance with the Washington State Environmental Policy Act and the National Environmental Policy Act. This technical study will be used as supporting documentation for permitting efforts.

1.1 Location and Regional Setting

Figure 1 shows the location and regional setting of the Port. The Port was founded in 1911 and is located on the Pacific coast of Washington state in Grays Harbor County. The Port is located near where the Chehalis River enters Grays Harbor, approximately 15 miles east from the Pacific Ocean. The Pacific Ocean is accessed from the Port via the Grays Harbor deep-draft federal navigation channel within Grays Harbor. The Proposed Project does not include expansion or deepening of the Grays Harbor federal navigation channel. Rennie Island is just south of the Port and is within Grays Harbor. Bowerman Airport is approximately 4 miles west-northwest of the Port.

1.2 Project Area

The Project Area consists of the area where the proposed facilities would be located, called the On-Site Project Area, and the existing off-site transportation corridors, called the Off-Site Project Area. The On-Site Project Area includes the area that will be directly affected by construction and operation of the Proposed Project. The Off-Site Project Area includes off-site transportation corridors used for rail and vessel transportation and is shown in Figure 2. This includes the Puget Sound and Pacific Railroad (PSAP) line from the Port property to the connection with the Burlington Northern Santa Fe (BNSF) Railway and Union Pacific Railroad mainlines in Centralia, Washington, and the

Chehalis River and Grays Harbor federal navigation channel from the Port property, through Grays Harbor, to the Pacific Ocean, up to 3 nautical miles offshore from the southern mouth of Grays Harbor. The Proposed Project will likely include rail construction on property owned by others (PSAP or other private owners) along the PSAP rail corridor east of West Heron Street. It has not yet been established whether the additional segment of rail needed to serve the site will be built and owned by the PSAP, built and owned by the Port, or some other combination of ownership and leasing. Specific study areas for the analysis of potential impacts of the Proposed Project is defined in Section 5.1 based on the potential for effects to air quality and greenhouse gas.

Figure 1
On-Site Project Area

Figure 2
Off-Site Project Area

2 Proposed Project and Alternatives

Two alternatives are evaluated in this study: the Proposed Project and a No Action Alternative. Additional details about these alternatives are documented in the *Port of Grays Harbor Terminal 4 Expansion and Redevelopment Project Description Technical Report* (Anchor QEA 2023). The alternatives include the following:

- **Alternative 1 (Proposed Project).** As noted in Section 1 and as further described in the *Port of Grays Harbor Terminal 4 Expansion and Redevelopment Project Description Technical Report* (Anchor QEA 2023), the Proposed Project consists of the Port Project and the AGP Project. The Port Project includes the following: 1) rail upgrades and site improvements; 2) Terminal 4 dock, fender, and stormwater upgrades; and 3) cargo yard relocation and expansion. In addition to these proposed upgrades at Terminal 4, AGP, an existing tenant of the Port, intends to upgrade Terminal 4B to include improved rail receiving facilities, a new shiploader, and a soybean meal storage structure (referred to as a surge silo). The primary elements of the Proposed Project could be constructed in phases.
- **No Action Alternative.** The No Action Alternative represents the conditions anticipated without construction and operation of the Proposed Project over the course of the construction analysis period of 2024 to 2025 and the operations analysis period from 2025 to 2045. Although the Port would not complete the proposed infrastructure enhancements or redevelop the Terminal 4 cargo yard under the No Action Alternative, it is anticipated that the Port would pursue growth opportunities within the existing Port footprint. It is also assumed that AGP would not complete the proposed infrastructure enhancements at Terminal 4B, but AGP would maximize its operations at the existing Terminal 2 facility. However, under the No Action Alternative, the Port would continue to operate and maintain T4 as it exists under existing conditions and would continue to seek out new business. Because activity under the No Action Alternative would be limited to current port infrastructure and terminal capacity limits, the No Action Alternative is anticipated to result in operations similar to existing conditions.

3 Regulatory Context

3.1 Regulations

Table 1 presents the regulations, statutes, and guidelines that apply to air quality and GHG emissions.

Table 1
Regulations, Statutes, and Guidelines that Apply to Air Quality and Greenhouse Gas Emissions

Regulation, Statute, or Guideline	Description
Federal	
Clean Air Act of and amendments (42 USC 7401 et seq.)	Enacted in 1970, as amended in 1977 and 1990, regulates the nation's air emissions through the enforcement of the National Ambient Air Quality Standards for criteria air pollutants in the ambient (outside) air. In 2007, the U.S. Supreme Court ruled to regulate GHG emissions as air pollutants under the CAA.
State	
Clean Air Act (RCW 70.94)	Regulates stationary sources of emissions to protect air quality.
Controls for New Sources of Toxic Air Pollutants (WAC 173-460)	Establishes the systematic control of new or modified sources emitting toxic air pollution to prevent air pollution, reduce emissions, and maintain air quality that will protect human health and safety.
Washington State Operating Permit Regulation (WAC 173-401)	Establishes the elements for the state air operating permit program.
Reporting of Emissions of Greenhouse Gases (WAC 173-441)	Establishes mandatory GHG reporting requirements for owners and operators of certain facilities that directly emit GHGs at a rate of 10,000 MT CO_2e per year or greater.
Washington State Ambient Air Quality Standards (WAC 173-476)	Establishes maximum acceptable levels in the ambient air for particulate matter, lead, SO_2, NO_2, O_3, and CO. Washington State adopts current federal NAAQS in state regulations.
Limiting Greenhouse Gas Emissions (RCW 70.235)	Establishes statutory reductions of overall GHG emissions and report emissions to the governor biannually. The first target statutory reduction is to achieve 1990 level GHG emissions by 2020 and 50% below 1990 levels by 2050 (or 70% below the State's expected emissions that year).
Local	
Olympic Region Clean Air Agency	Regulates stationary sources of air pollution in Clallam, Grays Harbor, Jefferson, Mason, Pacific, and Thurston Counties.

3.2 Required Permits and Approvals

The Olympic Region Clean Air Agency (ORCAA) is responsible for monitoring air quality and enforcing federal, state, and local air pollution laws in the study area. These apply to stationary sources and fugitive dust during construction. ORCAA also manages odor complaints in the region, which are addressed on a case-by-case basis. The following permit that applies to air quality and GHG emissions would be required for the Proposed Project:

- **Notice of Construction—ORCAA:** Businesses and industries that cause, or have the potential to cause air pollution are required to receive approval from the local air agency prior to beginning construction. These are requirements of Washington's Clean Air Act (CAA) and apply statewide (Chapter 70.94 Revised Code of Washington [RCW]). Businesses located in Grays Harbor County are regulated by the ORCAA. The Proposed Project is subject to compliance with an air permit issued by the ORCAA, which would include enforceable requirements specifying emission limits, reporting, and recordkeeping requirements for on-site stationary sources. Air emissions would be controlled using best available control technology as required by the agency as part of the Proposed Project's Notice of Construction Air Permit. The following permit condition is expected to reduce impacts on air quality:
  - To reduce the potential for fugitive emissions associated with soybean meal unloading and loading, the applicant will ensure that the receiving pits and ship loader will be equipped with an aspiration system and baghouse for particulate matter control.

4 Information Sources

The following information sources were used to describe existing conditions and expected future conditions within the project area to support the impact analysis:

- Various sources of information regarding the design, construction, and operation of the Proposed Project provided by the Port of Grays Harbor and AGP
- Air Operating Permits, ORCAA Title V Permitting Program website
- *Air Quality Green Book* (USEPA 2022a)
- California Air Resources Board's (CARB's) *Emissions Estimation Methodology for Ocean-Going Vessels* (CARB 2011)
- Motor Vehicle Emission Simulator: MOVES3 (USEPA 2020)
- *AP-42 Fifth Edition Compilation of Air Pollutant Emissions Factors, Volume 1: Stationary Point and Area Sources* (USEPA 2022b)
- *Emission Factors for Locomotives* (USEPA 2009)
- *Westway Expansion Project Final Environmental Impact Statement* (Ecology 2016)
- *Millennium Bulk Terminals – Longview State Environmental Policy Act Final Environmental Impact Statement, Volume I: Final Environmental Impact Statement* (Ecology 2017)
- *Washington State Greenhouse Gas Emissions Inventory: 1990 – 2019* (Ecology 2022)
- NW-AIRWEST Criteria Pollutant Design Values Tool (WSU 2017)

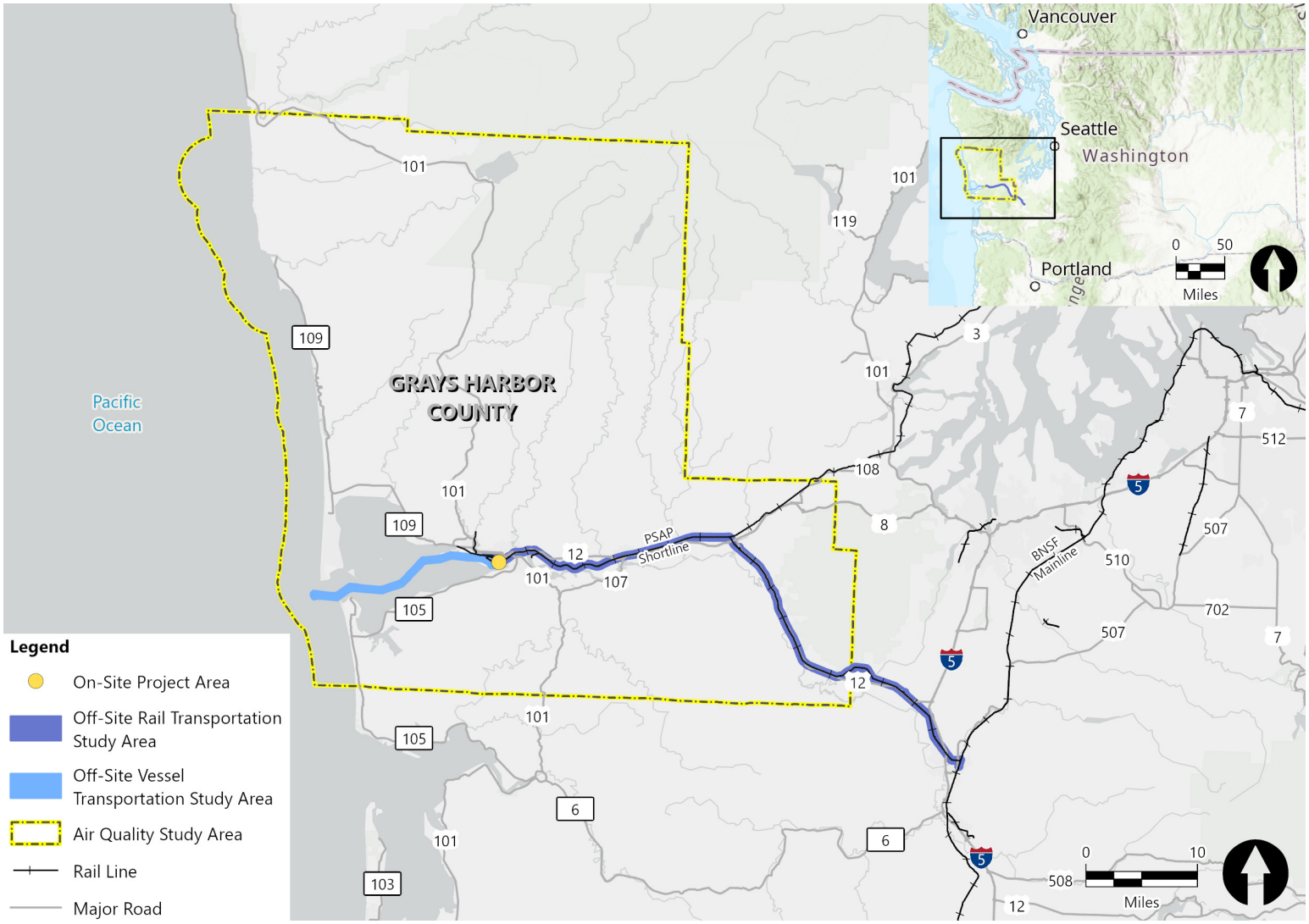
5 Affected Environment

5.1 Study Area

This section describes current air quality in the study area, which includes all of Grays Harbor County, Washington, as well as the PSAP line from the Port property to the connection with the BNSF Railway and Union Pacific Railroad mainline in Centralia, Washington, and the Grays Harbor federal navigation channel from the Port property, through Grays Harbor, to the Pacific Ocean and up to 3 nautical miles offshore from the southern mouth of Grays Harbor. The study area is larger than for other resources because air emissions move through the air and can be influenced by regional conditions such as weather. The study area for air quality is displayed in Figure 3.

The study area for GHG emissions includes the project site and emissions related to rail and vessel emissions in the State of Washington.

Figure 3
Air Quality Study Area



5.2 Background

Air quality in the study area is regulated by federal and state law. As required by the federal Clean Air Act (CAA), the U.S. Environmental Protection Agency (USEPA) establishes federal National Ambient Air Quality Standards (NAAQS) for six common pollutants known as criteria pollutants. These include ground-level ozone, particulate matter (PM, measured as PM_{10} and $PM_{2.5}$), carbon monoxide (CO), lead, sulfur dioxide (SO_2), and oxides of nitrogen (measured as NO_X). Criteria pollutants are found all over the country. They can harm human health and the environment and cause property damage. Ambient criteria pollutant concentrations are monitored because if levels in the air exceed the NAAQS, action must be taken to improve them. USEPA often delegates implementation and regulatory authority of the CAA to state, local, and tribal authorities. The Washington Clean Air Act further establishes the framework under which state and local authorities may regulate specific sources of pollution within the state.

Several large stationary sources of air pollution are present in Grays Harbor County, including a combined cycle natural gas-fired power plant, a wood-fired cogeneration facility, a resin manufacturing and paper coating facility, and two sawmills (ORCAA 2023). The power plant and one sawmill are in the southeast region of the county. The cogeneration plant and one of the sawmills are located just upriver of the Port, and the resin manufacturing and paper coating facility is directly adjacent to the Port on John Stevens Way.

Existing criteria pollutant and GHG emissions in the study area are also produced by vehicles, construction activities, and fugitive dust. Vehicle emissions occur along transportation corridors, including US-12 and US-101, and in surrounding communities. Emissions are also generated at the Bowerman Airport by aircraft and support vehicles, as well as by marine vessel traffic to, from, and within the Port of Grays Harbor. Likewise, rail traffic on the PSAP is a source of fugitive dust and diesel exhaust. Particulate emissions in this area are generated mainly from home heating, trucks, fishing vessels, and commercial cargo vessels (ICF 2016).

More generally, various small, disperse operations, including construction equipment and timber operations, are also responsible for generating emissions. Fugitive dust is generated by various sources, including forestry operations on dirt roads, such as those stretching north and south of Grays Harbor,[1] and soil-moving activities at construction sites. Similarly, odors may be generated from sources such as exhaust from heavy-duty commercial equipment.

[1] A map of timberland in Grays Harbor County is available on the Grays Harbor County website at: https://www.graysharbor.us/departments/Forestry/forestry_managed_timberlands.php.

5.3 Existing Air Quality

Background concentrations of other criteria pollutants at the project site were estimated using NW AIRQUEST (WSU 2017). Table 2 shows the criteria pollutant concentrations estimated for the project site and their percentage of the current national or state (whichever is more stringent) ambient air quality standard.

Table 2
Modeled Background Ambient Pollutant Concentrations at the Project Site

Pollutant and Averaging Time	Primary NAAQS, as of January 2023	Modeled Concentration	Percentage of Ambient Air Quality Standard
PM_{10}, 24 hours	150 µg/m^3	42.3 µg/m^3	28%
CO, 1 hour	35 ppm	1.04 ppm	3%
CO, 8 hours	9 ppm	0.7 ppm	8%
NO_2, 1 hour	100 ppb	20.2 ppb	20%
NO_2, annual	53 ppb	4 ppb	8%
O_3, 8 hours	0.070 ppm	51 ppb	73%
$PM_{2.5}$. 24 hours	35 µg/m^3	12.7 µg/m^3	36%
$PM_{2.5}$, annual	12.0 µg/m^3	5.2 µg/m^3	43%
SO_2, 1 hour	75 ppb	4.8 ppb	6%

5.4 Attainment Status

Local air quality is measured against the national and state air quality standards. Areas that do not meet the standards are designated as "nonattainment areas." If measured data or modeling show that an area meets the standards, it is called an attainment area and designated "attainment/unclassifiable." A third classification, referred to as "maintenance," is applied to areas that have recently begun attaining the NAAQS and where states must perform continued monitoring for several additional years. States must develop State Implementation Plans to lower ambient concentrations in nonattainment areas. Grays Harbor County and its neighboring counties are currently designated attainment/unclassifiable for all criteria pollutants (USEPA 2022).

5.5 Current Greenhouse Gas Emissions

GHG emissions trap solar heat in the atmosphere and increase surface temperatures on the Earth, contributing to global warming and climate change. GHGs are emitted from natural sources and removed from the atmosphere by natural processes. GHGs are also emitted by human activities (anthropogenic). Anthropogenic GHGs have increased substantially over the last 150 years. Anthropogenic greenhouse gas emissions are predominantly from the combustion of fossil fuels,

although industrial processes, land-use change, agriculture, and waste management are also contributors. GHGs are global, rather than local, air pollutants, with worldwide impacts. However, the global impacts of climate change, such as sea level rise, changes in precipitation patterns, ocean acidification, and surface temperatures, are also experienced locally and result from a global increase in GHG concentration in the atmosphere. GHG emissions calculations are characterized in terms of carbon dioxide equivalent (CO_2e) emissions based on the global warming potential factors for carbon dioxide (CO_2), methane, and nitrous oxide. In 2019, the Washington State Department of Ecology reported that Washington State was responsible for contributing 102.1 million metric tons (MT) of CO_2e, an increase of 4.9% since 2005 (Ecology 2022). In 2019, international bunker fuels used in marine and aviation transport sold within Washington resulted in emissions totaling 6.8 million MT CO_2e, which are reported separately and not included in the state inventory total (Ecology 2022).

5.6 2017 National Emissions Inventory

The 2017 National Emissions Inventory is a national compilation of air pollutant emission estimates (USEPA 2021). Emissions in the inventory are estimated by county for nonpoint, on-road, and nonroad sources. Estimated project emissions were compared to the Grays Harbor County emissions inventory to determine the overall project emission contribution.

5.7 People and Property Affected by Air Quality

Along with sources of pollutants, air quality analyses often consider the people and properties that may be the most affected by pollutants. These may be classified by use. For example, residents may be exposed to pollutants for longer periods of time, and recreationalists (such as a runner) may be exposed to pollutants while lung function is high. The nearest residence to the Proposed Project is approximately 90 feet to the northeast of the proposed rail improvements near the end of Hood Street in Aberdeen, Washington. There is also recreational use in the Chehalis River and Grays Harbor. Residences and recreational facilities are located across the PSAP Short line, which roughly follows the northern boundary of the Port. An athletic complex, Bishop Sports Park, is located across the Chehalis River from the Proposed Project.

6 Environmental Consequences

This section describes the environmental consequences of the No Action Alternative and the Proposed Project.

6.1 Assumptions

This analysis is based on the description of the design, construction, and operation of the Proposed Project as described in the *Port of Grays Harbor Terminal 4 Expansion and Redevelopment Project Description Technical Report* (Anchor QEA 2023). Additional assumptions relevant to this analysis include the following:

- Construction emissions were estimated assuming 30 workers working 14 hours per day, 5 days per week in the absence of specific information. The AGP Project was calculated based upon a total of 25 workers, per information provided for the *Port of Grays Harbor Terminal 4 Expansion and Redevelopment Project Description Technical Report* (Anchor QEA 2023).
- Construction worker commutes were assumed to average 20 miles each way. Off-site hauling trips were assumed to be 40 miles each way.
- Derrick barge emissions were estimated using dredge emission factors (SMAQMD 2017). Three total tug round trips were assumed for placement and removal of the derrick barge and two material barges.
- All increased operational vessel traffic to and from the AGP Project was modeled as bulk carriers.
- Slow speed marine diesel engines (<300 revolutions per minute) were assumed for all vessel transit to the mouth of Grays Harbor.
- The baseline marine cargo fleet was assumed to be evenly divided between auto and bulk carriers per historical Port data.
- Main vessel propulsion engines were assumed to burn heavy fuel oil (CARB 2011).
- Rail emissions were calculated assuming a fleet average of 20-year-old locomotives, equivalent to Tier 2.
- AGP facility operations were assumed to consist of PM emissions resulting from material unloading into pit and bulk loading via the shiploader.
- Operational daily vehicle emissions were calculated based on 80 additional round trip commutes per day, representing 186 employees following completion of the project, compared to 106 current employees, per the Port. Employee commutes were assumed to average 20 miles each way.
- An average of 1.5 hours round trip for on-site haul trucks circulating between on-site stockpile and casting basin, including filling and dumping, was assumed.

6.2 Approach

This section describes the approach to the impact analysis, including the types of impacts considered.

6.2.1 Approach to Analysis

This study evaluated the potential direct, indirect, and cumulative impacts of the alternatives that would be different from existing conditions. Existing conditions include those present at the time the analysis was completed in 2023. This study also includes a comparison of the operational impacts of the Proposed Project to the No Action Alternative. This was done to provide additional information about whether the project impacts may be different later in the analysis period.

Cumulative impacts are caused by the incremental impact of the alternatives when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor, but collectively significant actions, which take place over time (40 Code of Federal Regulations [CFR] 1508.7). The list of cumulative projects is presented in the *Port of Grays Harbor Terminal 4 Expansion and Redevelopment Project Description Technical Report* (Anchor QEA 2023). The following approach was developed based on guidance from the Council of Environmental Quality (CEQ 1997):

- Determine the cumulative impacts study area for each environmental resource. The study areas used to evaluate cumulative impacts for air quality and GHG are the same as those described in Section 5.1.
- Assess the existing condition of each resource as it has been affected by past actions. This is based on information provided in the corresponding Affected Environment section of this study (Section 5), which includes the effects of past actions.
- Evaluate the cumulative impacts of all past, present, and reasonably foreseeable future actions on each resource in the study area, which is described in Section 6.6.
- Assess how Alternative 1 would contribute to cumulative impacts, which is also described in Section 6.6.

6.2.2 Impact Terminology

Direct impacts are those that would occur as the result of and at the same time and place as the activities proposed by the Port and AGP. Direct impacts would only occur in the On-Site Project Area.[2] Indirect impacts would occur later in time or farther in distance from the immediate project location but would be attributable to the Proposed Project. Indirect impacts also include those that

[2] As defined in the *Port of Grays Harbor Terminal 4 Expansion and Redevelopment Project Description Technical Report* (Anchor QEA 2023), the On-Site Project Area consists of the area that will be directly affected by construction and operation of the Proposed Project and consists of on-site facilities at Port-owned properties.

would occur as the result of operating the project, such as traffic to and from the project area. These impacts could be temporary or permanent.

Impacts can be characterized by duration. Permanent impacts would affect the resource to such a degree that they would not return to their preconstruction state during the analysis period. Temporary impacts may be short-term or long-term. Short-term impacts were assumed to last for less than 2 years. Long-term temporary impacts would affect functions that will eventually be restored or recover over time, but not within 1 year or more after the impact ceases.

The magnitude of impacts is also described in terms of low, medium, and high impacts. Tables 3 and 4 provide guidance for how the impact levels were assessed. The level of impacts was assessed assuming that applicable regulations and permits and approvals listed in Section 3 would be adhered to and obtained. If needed, the impact analysis also identifies where mitigation would be required to reduce the impact to acceptable levels. Mitigation is described in Section 7.

Air quality impacts were determined based on emissions of individual criteria air pollutants (CAPs) relative to the Prevention of Significant Deterioration (PSD) thresholds. PSD applies to new major sources or major modifications at existing sources for pollutants where the area the source is located in is in attainment or is unclassifiable with the NAAQS. Although the study area is not a major stationary source subject to federal PSD rules (40 CFR 52.21), the emission threshold levels were used to evaluate potential impacts of construction and operation activity on the ambient air quality and continued NAAQS attainment within the study area.

GHG impacts were determined relative to the 10,000 MT CO_2e per year threshold for mandatory monitoring and reporting of GHGs in Washington State. This is an annual operations threshold applicable to direct GHG emitters, fuel suppliers, and electric power entities under the Climate Commitment Act. When applied to short-term construction emissions, it is a conservative threshold for significance.

Table 3
Impact Thresholds for Air Quality

Impact Indicator	Determining Degree of Impact
Degrade Existing Air Quality	**No/Negligible Impact:** An Alternative would result in net-zero or net-negative criteria air pollutant emissions within the study area. **Low Impact:** An Alternative would result in an increase in criteria air pollutant emissions below all significance thresholds within the study area. **Medium Impact:** An Alternative would result in an increase in criteria air pollutant emissions temporarily exceeding at least one significance threshold within the study area, but without permanent significant impact on air quality. **High Impact:** An Alternative would result in an increase in criteria air pollutant emissions above at least one significance threshold within the study area, resulting in permanent significant impacts on air quality.

Table 4
Impact Thresholds for Greenhouse Gas Emissions

Impact Indicator	Determining Degree of Impact
Contribute Significantly to Global Climate Change Through Release of GHGs	**No/Negligible Impact:** An Alternative would result in net-zero or net-negative GHG emissions within the study area. **Low Impact:** An Alternative would result in an increase GHG emissions below the significance threshold within the study area. **Medium Impact:** An Alternative would result in an increase in temporary GHG emissions above the significance threshold within the study area, but insignificant long-term and permanent GHG emissions within the study area. **High Impact:** An Alternative would result in a long-term and permanent increase in GHG emissions above the significance threshold within the study area.

6.3 Methods

The environmental impacts of the Proposed Project on air quality and on GHGs were approached quantitatively, as these pollutants are invisible and best identified through the use of emissions inventories and modeling. This section describes the sources of information and methods used to evaluate the potential impacts on air quality and GHGs associated with the construction and operation of the Proposed Project and No Action Alternative. Sources from outside of Washington State were used when no applicable state or local methods or guidance were available. Information sources are provided in Section 4.

The impact analysis evaluated emissions from construction and operations of the Proposed Project. The analysis considers the effects of constructing the complete project; however, the Port and AGP may construct project elements in phases. Any major differences in the Proposed Project would be re-evaluated as appropriate. Air emissions were estimated for the CAPs: CO, NO_X, SO_2, particulate matter less than or equal to 2.5 micrometers in diameter ($PM_{2.5}$), and particulate matter less than or equal to 10 micrometers in diameter (PM_{10}). Also included were volatile organic compounds (also referred to as reactive organic gases [ROG]), an important precursor to ozone. GHG emissions CO_2 and methane (CH_4) were also calculated. GHGs are generally reported as CO_2e MT, to provide a normalized metric that accounts for the different global warming potentials of different GHGs.

Potential impacts to air quality and GHG emissions were analyzed by comparing modeled emissions against set thresholds of significance. Emissions from the construction and operation of the Proposed Project were determined using quantitative methods, as summarized in Table 5. The thresholds used to determine the level of impact are described in Section 6.2.2. Additional details are presented in Appendix A.

Table 5
Methods for Evaluating Impacts to Air Quality and Greenhouse Gas Emissions

Environmental Resource	Source of Impact	Type of Analysis	Model	Description
Air Quality	Construction Emissions	Quantitative	MOVES3	Inventory of CAP emissions related to offroad construction equipment, transportation, and hauling of materials
	Operational Emissions	Quantitative	MOVES3	Inventory of net mobile and stationary source CAP emissions resulting from operations (including on-site operations and vehicle/marine/rail activity) after construction compared to the baseline and the No Action Alternative
GHG Emissions	Construction Emissions	Quantitative	MOVES3	Inventory of GHG emissions related to offroad construction equipment, transportation, and hauling of materials
	Operational Emissions	Quantitative	MOVES3	Inventory of net mobile and stationary source GHG emissions resulting from operations (including on-site operations and vehicle/marine/rail activity) after construction compared to the baseline and the No Action Alternative

6.4 No Action Alternative

As described in detail the *Port of Grays Harbor Terminal 4 Expansion and Redevelopment Project Description Technical Report* (Anchor 2023), under the No Action Alternative, the infrastructure proposed by the Port and AGP would not be built and brought online, and potential beneficial or adverse environmental impacts of the Proposed Project would not occur. However, it is anticipated that AGP would maximize its operations at the existing Terminal 2 facility, although the Terminal 2 facility cannot accommodate the increased volume of export cargo intended to flow through Terminal 4 if redeveloped. Thus, Port operation would remain at existing conditions.

The Port will continue to market its facilities to new customers, but for the purposes of this analysis, it is assumed that no future development would occur at the Project Area. The Port will continue to maintain the existing infrastructure and operations and will invest in necessary maintenance, but it will not be investing in additional infrastructure improvements at this time. It will pursue growth opportunities within the existing terminal footprint, which may include expansion of industrial and commercial activities at facilities that are not at capacity.

The Port has included several upgrade and maintenance projects in their approved Capital Budget Plan for 2023 to 2028, including the fender system replacement, pile cap repairs, and repairs to the seawall approaches. Under the No Action Alternative, the Port would continue to pursue implementation of their approved Capital Budget Plan; however, because it is not presently funded

or permitted, fender system replacement under the No Action Alternative is not considered to be reasonably foreseeable, and Port operations over the next 20 years would largely continue similar to existing conditions, as described in the *Port of Grays Harbor Terminal 4 Expansion and Redevelopment Project Description Technical Report* (Anchor QEA 2023).

The No Action Alternative would result in no impact to low impact on air quality and GHG emissions. Marine vessel, rail, and vehicle traffic would maintain current levels of activity or experience slow growth. Over time, emissions from locomotives and motor vehicles are projected to decline as older engines and fuels are replaced with newer, cleaner, and more efficient engines and fuels. Marine vessels typically have a longer mean time to replacement, so improvement in these engines' emissions is not expected to keep pace with rail and on-road vehicle emissions reductions. Thus, the No Action Alternative would result in no impact to low impact on air quality or GHG emissions.

6.5 Proposed Project

This section describes the direct and indirect impacts that would occur as the result of construction and operations of the Proposed Project.

6.5.1 Construction

Construction-related activities associated with the Proposed Project could result in direct and indirect impacts described below. As described in the *Port of Grays Harbor Terminal 4 Expansion and Redevelopment Project Description Technical Report* (Anchor QEA 2023), construction-related activities include demolition of existing structures, earthwork and grading, construction of new sections of rail, removal and installation of upland and in-water piles to support the new fender and dock, and construction of buildings and facilities (e.g., shiploader and dumphouse).

The construction material delivery is assumed to occur via barge and truck. Haul truck emissions are included for the truck trips needed to make deliveries of construction material to the project area from off site. Material barge emissions are estimated to result from tug emissions into and out of the harbor. Maximum annual construction emission estimates for the peak construction year are shown in Table 6. Construction activities are explained in more detail in the *Port of Grays Harbor Terminal 4 Expansion and Redevelopment Project Description Technical Report* (Anchor QEA 2023).

Total CAP emissions were compared to PSD limits to assess significance of the air quality impact for construction of the Proposed Project. Total GHGs can be compared to the state GHG reporting threshold for industrial facilities of 10,000 MT CO_2e per year. Because the CAP emissions from construction would be below the PSD thresholds, construction of the Proposed Project would result in a low impact on air quality. Because GHG emissions during construction would not exceed the state GHG reporting threshold, construction of the Proposed Project would have a low impact on GHGs. Details on emissions calculations are provided in Appendix A.

Table 6
Maximum Annual Criteria Pollutant and Greenhouse Gas Emissions from Construction[1]

Project Element/ Emission Source	Criteria Air Pollutant Emissions (lbs)						GHG Emissions (kg)			
	ROG	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO	CO_2	CH_4	N_2O	CO_2e
Rail Upgrades and Site Improvements	1,751.5	19,644.9	28.1	1,379.3	1,337.9	9,157.6	*4,489,090.1*	*46.5*	*4.5*	*4,491,585.2*
Dock, Fender, and Stormwater Upgrades	217.6	2,211.1	2.8	149.9	145.2	1,237.3	*311,306.7*	*7.4*	*0.5*	*311,638.4*
Cargo Yard Relocation and Expansion	712.7	21,363.4	25.4	507.3	492.0	2,628.0	*4,279,604.1*	*22.7*	*1.5*	*4,280,605.3*
AGP Project	1,352.9	14,459.2	15.7	1,006.3	975.7	7,342.0	*2,169,248.1*	*39.3*	*3.2*	*2,171,172.6*
Fugitive Dust	--	--	--	9,436.7	1,492.5	--	--	--	--	--
Mobile (worker commute)	72.4	342.1	5.8	6.2	5.5	6,965.0	*395,653.5*	*10.6*	*2.1*	*396,541.2*
Hauling (truck)	134.8	4,910.0	7.3	73.4	67.5	3,214.8	*981,525.9*	*129.2*	*1.7*	*985,276.3*
Material Barge trips	26.1	310.8	0.2	17.9	15.9	91.3	*9,935.5*	*0.4*	*0.1*	*9,969.6*
Project Element/ Emission Source	**Criteria Air Pollutant Emissions (tons)**						**GHG Emissions (MT)**			
	ROG	**NO_X**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**CO**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**
Total	2.1	31.6	0.0	6.3	2.3	15.3	*12,636.4*	*0.3*	*0.0*	*12,646.8*
Year 1 Total[2]	1.9	25.0	0.0	1.4	1.3	13.3	*9,935.6*	*0.2*	*0.0*	*9,944.4*
Year 2 Total	0.3	6.6	0.0	0.2	0.2	2.0	*2,700.7*	*0.0*	*0.0*	*2,702.4*
Maximum Annual Emissions[3]	1.9	25.0	0.0	1.4	1.3	13.3	*9,935.6*	*0.2*	*0.0*	*9,944.4*
PSD Thresholds (tons)[4]	40.0	40.0	40.0	15.0	10.0	100.0	--	--	--	--
Mandatory Washington State GHG Reporting Threshold (MT CO_2e per year)										*10,000*

Notes:

1. Based on the continuous 12-month period with highest proposed construction activity. Project- and element-specific emissions estimates reflect the combined total for both years of construction.
2. Year 1 represents the first 12 months of construction, beginning on April 1, 2024, per the *Port of Grays Harbor Terminal 4 Expansion and Redevelopment Project Description Technical Report* (Anchor QEA 2023). Year 2 represents construction expected to occur after March 31, 2025.
3. Maximum annual CAP emissions reported in tons and maximum annual GHG emissions reported in metric tons.
4. Although the study area is not a major stationary source subject to federal PSD rules (40 CFR 52.21), the emission threshold levels were used to evaluate the severity of impact due to construction.

6.5.2 Operation

Sources of emissions during operations would include the shiploader; maintenance equipment, employee commute vehicles, and Proposed Project-related rail traffic along the PSAP and vessel operations in the federal navigation from the Port to 3 nautical miles into the Pacific Ocean.

Table 7 presents emissions from the Proposed Project operations and related rail and vessel operations in the study area. As shown in Table 7, rail and vessel transport would be the largest sources of emissions. The Proposed Project would produce small quantities of air pollutants from maintenance, operations, and emergency equipment.

Because the net CAP emission increases from operations would be below the PSD thresholds, operation of the Proposed Project would result in a low impact on air quality. Because GHG emission increases due to operation of the Proposed Project would not exceed the state GHG reporting threshold, operation of the Proposed Project would have a low impact on GHGs.

Table 7
Maximum Annual Criteria Pollutant and Greenhouse Gas Emissions from Project Operations

Source		Criteria Air Pollutant Emissions (tpy)						GHG Emissions (MT/year)			
		ROG	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO	CO_2	CH_4	N_2O	CO_2e
Mobile Sources	Rail	0.8	0.2	<0.05	0.6	0.6	8.5	2,582.1	<0.05	0.3	2,677.6
	Vessel	4.2	143.5	83.9	10.8	8.9	11.0	5,810.1	0.1	0.2	5,886.7
	Worker Vehicles and Crossing Delays	0.1	0.8	<0.05	<0.05	<0.05	7.7	1,121.0	<0.05	<0.05	1,123.7
Ship Loader and Surge Silo Vent		--	--	--	46.6	7.9	--	--	--	--	--
Project Total		5.1	144.5	84.0	58.1	17.4	27.9	9,513.2	0.9	0.5	9,688.0
No Action (2025) Total		4.0	118.1	62.8	21.5	9.3	18.5	6,748.0	0.5	0.3	6,865.2
Net Annual Increase		1.1	26.4	21.1	36.6	8.2	9.4	2,765.1	0.4	0.2	2,822.9
CAP PSD Thresholds (tpy)		40.0	40.0	40.0	40.0	40.0	100.0	--	--		--
Mandatory Washington State GHG Reporting Threshold (MT CO_2e/year)											10,000

6.6 Cumulative Impacts

Cumulative impacts are caused by the incremental impact of the alternatives when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor, but collectively significant actions, which take place over time (40 CFR 1508.7) and are evaluated as described in Section 6.2.1. Current conditions are a result of past and present actions. The current conditions in the study area that were used as the baseline existing environmental condition are described in Section 5. Therefore, the cumulative effect of past actions was assumed to be captured in the analysis of project impacts and was not separately called out in the analysis of cumulative impacts.

A number of other projects are currently in progress or are expected to occur in the foreseeable future, regardless of whether the Port Project or the AGP Project proceeds. The impacts of these projects may have the potential to contribute to a cumulative impact on resources when combined with the impacts of the Proposed Project. A complete list of projects with project descriptions is provided in Table 1 of the *Port of Grays Harbor Terminal 4 Expansion and Redevelopment Project Description Technical Report* (Anchor QEA 2023).

6.6.1 Cumulative Air Quality Impacts

Air pollutants resulting from construction and operation of the Proposed Project are not anticipated to approach levels defined by the NAAQS. Although increased NO_X emissions during on-site operations of the Proposed Project would not lead to exceedance of the NAAQS, the emissions were evaluated under a scenario where all cumulative projects perform activities at the same time. The cumulative projects are not anticipated to result in meaningful increases in ongoing emissions from increased vessel, vehicle, or rail activity and potential impacts on air quality are likely to be limited to temporary construction emissions. Of the cumulative projects identified in the project area, none are anticipated to contribute significant annual CAP emissions, including NO_X. Therefore, construction and operation of the Proposed Project would not contribute to cumulatively significant impacts on air quality.

6.6.2 Cumulative Climate Change Impacts

The largest contributions of GHG emissions from the Proposed Project would result from rail and marine transport, which represent an increase of approximately 0.35% and 0.016% in the statewide rail and commercial marine vessel emissions of GHGs, respectively. Overall GHG emissions related to operation of the Proposed Project represent an approximately 0.0026% increase in statewide GHG emissions. None of the cumulative projects identified would be expected to result in significant annual GHG emissions. Therefore, the cumulative GHG impact of the Proposed Project is anticipated to be low.

7 Mitigation

As described in the *Port of Grays Harbor Terminal 4 Expansion and Redevelopment Project Description Technical Report* (Anchor QEA 2023), the Proposed Project design includes measures, such as aspiration of soybean meal product during ship loading, to reduce unnecessary emissions. Due to such measures and low impact determination based on the modeled emissions, no significant air quality impacts from the Proposed Project are anticipated. No additional mitigation is proposed.

8 References

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Appendix A
Emissions Calculations

Appendix A
Emissions Calculations

Work Zone	Project Element	Construction Category	Days	Start	Stop	Calendar Weekdays/ WZ (note)	Year
WZ1	Rail	Grading	10	4/1/2024	6/17/2024	56	1
WZ1	Rail	Trackwork	20				1
WZ1	Rail	Trackwork	5				1
WZ1	Rail	Trackwork	10				1
WZ1	Rail	Trackwork	5				1
WZ1	Rail	Trackwork	5				1
WZ1	Rail	Paving	15				1
WZ2	Rail	Demolition	90	4/1/2024	5/13/2025	292	1
WZ2	Rail	Grading	20				1
WZ2	Rail	Grading	20				1
WZ2	Rail	Building Construction	90				1
WZ2	Rail	Trackwork	20				1
WZ2	Rail	Building Construction	10				2
WZ2	Rail	Building Construction	120				1
WZ2	Rail	Trackwork	10				2
WZ3	Rail	Building Construction	30	4/1/2024	6/21/2024	95	1
WZ3	Rail	Demolition	5				1
WZ3	Rail	Paving	20				1
WZ3	Rail	Trackwork	5	10/29/2024	12/16/2024		1
WZ3	Rail	Grading	10				1
WZ3	Rail	Trackwork	15				1
WZ3	Rail	Trackwork	5				1
WZ3	Rail	Grading	10				1
WZ3	Rail	Trackwork	20				1
WZ3	Rail	Grading	10				1
WZ3	Rail	Trackwork	1				1
WZ4	Rail	Grading	10	4/29/2024	7/5/2024	50	1
WZ4	Rail	Paving	3				1
WZ4	Rail	Grading	20				1
WZ4	Rail	Trackwork	20				1
WZ4	Rail	Grading	10				1
WZ4	Rail	Trackwork	20				1
WZ5A	Dock/Fender/WW	Demolition	30	4/1/2024	10/25/2024	180	1
WZ5A	Dock/Fender/WW	Pile Installation	60				1
WZ5A	Dock/Fender/WW	Building Construction	60	5/26/2025	7/4/2025		1
WZ5A	Dock/Fender/WW	Building Construction	30				2
WZ5B	AGP	Building Construction	120	4/1/2024	5/23/2025	300	1
WZ5B	AGP	Building Construction	60				1
WZ5B	AGP	Building Construction	30				1
WZ5B	AGP	Building Construction	60				1
WZ5B	AGP	Building Construction	30				1
WZ5B	AGP	Pile Installation	30				1
WZ5B	AGP	Pile Installation	60				1
WZ5B	AGP	Building Construction	60				1

Construction Category Days in First 12 Months, by Project Element

Project Element	Grading	Trackwork	Paving	Demolition	Building Construction	Pile Installation	Casting Basin Earthwork	Dewatering
Rail	275	437	108	95	285	0	0	0
Dock/Fender/WW	0	0	0	30	60	60	0	0
Cargo Yard	0	0	0	50	0	0	120	0
AGP	44	45	0	0	630	90	0	30

Construction Category Days After First 12 Months, by Project Element

Project Element	Grading	Trackwork	Paving	Demolition	Building Construction	Pile Installation	Casting Basin Earthwork	Dewatering
Rail	0	10	0	0	10	0	0	0
Dock/Fender/WW	0	0	0	0	30	0	0	0
Cargo Yard	30	0	30	30	30	0	120	0
AGP	0	0	0	0	30	0	0	0

Max Duration for Rail Project		Calendar Weekdays
4/1/2024	5/13/2025	292

Rail project construction activities at various work zones are planned for all workdays between April 29, 2024 and May 13, 2025.

Vibratory Hammer Hours

Piles/activity	Hours/Pile	Vib. Hrs/ Activity
50	0.5	25
15	0.5	7.5
18	1	18
76	1	76
324	1	324
12	1	12
60	1	60
22	1	22
49	1	49
6	0.5	3
27	0.5	13.5
16	1	16
6	0.5	3
8	1	8
24	0.5	12
24	0.5	12
	Total	661

On-Site Cargo Yard Fill Truck Activity/Day Calculation

Total onsite fill (cu yd)	200000
truck capacty (cu yd)	25
Trips from stockpile to site	8000
trips/day	33.3333
trips per truck per day	4.1667
Op hrs/day/unit (Assuming 1.5 hours/round trip)	6.2500

Impact Hammer Emissions

# of Piles	Impact Strikes per Pile	Strikes per Activity
76	300	22800
324	300	97200
12	300	3600
60	300	18000
22	300	6600
49	600	29400
6	0	0
27	0	0
16	500	8000
6	0	0
8	500	4000
24	0	0
24	0	0
654		189600

Work	200000	ft-lb/strike
	19151.496	hp-hrs
		gal
	0.018321864	ULSD/hp-hr
	350.8911034	gal ULSD
	negligible	

Appendix A
Emissions Calculations

Work Zone	Project Element	Construction Category	Days	Start	Stop	Calendar Weekdays/ WZ (note)	Year
WZ5B	AGP	Building Construction	30				2
WZ5B	AGP	Grading	30				1
WZ5C	AGP	Dewatering	30	4/1/2024	1/17/2025	210	1
WZ5C	AGP	Building Construction	60				1
WZ5C	AGP	Grading	7				1
WZ5C	AGP	Building Construction	60				1
WZ5C	AGP	Building Construction	60				1
WZ5C	AGP	Building Construction	30				1
WZ5C	AGP	Grading	7				1
WZ5C	AGP	Building Construction	30				1
WZ5C	AGP	Building Construction	30				1
WZ5C	AGP	Trackwork	15				1
WZ5C	AGP	Trackwork	15				1
WZ5C	AGP	Trackwork	15				1
WZ6A	Rail	Grading	15	8/14/2024	10/15/2024	45	1
WZ6A	Rail	Trackwork	20				1
WZ6A	Rail	Trackwork	5				1
WZ6A	Rail	Trackwork	5				1
WZ6B	Rail	Grading	20	5/14/2024	8/31/2024	79	1
WZ6B	Rail	Trackwork	20				1
WZ6B	Rail	paving	30				1
WZ6B	Rail	Building Construction	20				1
WZ7	Rail	Trackwork	3	4/3/2024	7/24/2024	81	1
WZ7	Rail	Grading	20				1
WZ7	Rail	Trackwork	60				1
WZ7	Rail	Trackwork	5				1
WZ7	Rail	Paving	30				1
WZ7	Rail	Trackwork	3				1
WZ8	Rail	Grading	30	4/1/2024	8/2/2024	90	1
WZ8	Rail	Building Construction	10				1
WZ8	Rail	Grading	30				1
WZ8	Rail	Grading	10				1
WZ8	Rail	Paving	10				1
WZ8	Rail	Trackwork	30				1
WZ8	Rail	Trackwork	30				1
WZ8	Rail	Trackwork	5				1
WZ8	Rail	Building Construction	15				1
WZ9	Rail	Grading	30	8/5/2024	1/24/2025	125	1
WZ9	Rail	Trackwork	60				1
WZ9	Rail	Trackwork	30				1
WZ9	Rail	Trackwork	5				1
WZ9	Rail	Trackwork	5				1
WZ10	Cargo Yard	Demolition	30	8/1/2024	2/28/2026	412	1
WZ10	Cargo Yard	Casting Basin Earthwork	60				1
WZ10	Cargo Yard	Demolition	20				1
WZ10	Cargo Yard	Casting Basin Earthwork	60				1
WZ10	Cargo Yard	Casting Basin Earthwork	120				2
WZ10	Cargo Yard	Grading	30				2
WZ10	Cargo Yard	Paving	30				2
WZ10	Cargo Yard	Building Construction	30				2
WZ10	Cargo Yard	Demolition	30				2

Note:
Calendar weekdays per workzone are calculated based on overall start and finish dates for each work zone. Since some activities occur simultaneously, this value does not necessarily match the sum of days assigned to each activity for the work zone. Calendar workdays are used for employee commute, for example, and the sum of days assigned to an activity is used for estimating the operating hours for specific pieces of construction equipment.

Appendix A
Emissions Calculations

		Construction Schedule Assumptions		Total Hours of Operation										Total Project Emissions (g), Year 1							
Construction Category	Estimated Equipment Used, by MOVES category (Notes)	Units Operating	Hrs/day	Rail Upgrades and Site Improvements, Year 1	Rail Upgrades and Site Improvements, Year 2	Dock, Fender, and Stormwater Upgrades, Year 1	Dock, Fender, and Stormwater Upgrades, Year 2	Cargo Yard Relocation and Expansion, Year 1	Cargo Yard Relocation and Expansion, Year 2	AGP Project, Year 1	AGP Project, Year 2	Year 1 Total	Year 2 Total	ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4
Demolition	Crawler Tractor/Dozers	1	14	1330	0	420	0	700	420	0	0	2450	420	12262.31913	265004.58	551.695964	11532.37	11186.39146	65427.2	202726690.2	763.6255
Demolition	Concrete/Industrial Saws	1	14	1330	0	420	0	700	420	0	0	2450	420	8559.339709	149488.36	113.6229375	5118.67	4965.111918	41744.87	40695232.33	729.3021
Demolition	Tractors/Loaders/Backhoes	2	14	2660	0	840	0	1400	840	0	0	4900	840	68820.14686	350788.61	209.1118384	46572.73	45175.54312	311016.8	63865898.26	3616.545
Casting Basin Earthwork	Excavators	6	6.25	0	0	0	0	4500	4500	0	0	4500	4500	9787.460539	189119.57	657.942231	8575.66	8318.391745	42984.35	246313467.6	699.8978
Casting Basin Earthwork	Off-highway Trucks	8	6.25	0	0	0	0	6000	6000	0	0	6000	6000	93057.84797	3970174.2	3967.178176	62142.16	60277.92598	267781.4	1487766685	7096.249
Casting Basin Earthwork	Crawler Tractor/Dozers	2	6.25	0	0	0	0	1500	1500	0	0	1500	1500	7507.542326	162247.7	337.7730392	7060.633	6848.811095	40057.47	124118381.7	467.5258
Casting Basin Earthwork	Rollers	2	6.25	0	0	0	0	1500	1500	0	0	1500	1500	4221.615867	78929.715	124.9815456	3172.034	3076.873561	20819.41	45689016.92	355.5722
Grading	Crawler Tractor/Dozers	1	14	3850	0	0	0	0	420	616	0	4466	420	22352.45602	483065.49	1005.662929	21021.86	20391.19357	119264.4	369541795.2	1391.98
Grading	Tractors/Loaders/Backhoes	2	14	7700	0	0	0	0	840	1232	0	8932	840	125449.2963	639437.53	381.1810083	84895.44	82348.56145	566939.2	116418408.8	6592.444
Grading	Graders	1	14	3850	0	0	0	0	420	616	0	4466	420	10572.99421	144067.14	775.1543348	10567.71	10250.67734	47877.75	289538051.3	650.643
Grading	Excavators	2	14	7700	0	0	0	0	840	1232	0	8932	840	19427.02167	375381.33	1305.942224	17021.73	16511.08335	85319.16	488904865	1389.219
Grading	Scrapers	2	14	7700	0	0	0	0	840	1232	0	8932	840	74276.33901	1121881.6	3189.255445	69515.68	67430.19125	489381	1158041537	4772.484
Building Construction	Cranes	1	10	2850	100	600	300	0	300	6300	300	9750	1000	48831.1124	779862.97	1446.808667	34187.1	33161.48907	192456.6	516304188.4	3090.916
Building Construction	Rough Terrain Forklifts	1	10	2850	100	600	300	0	300	6300	300	9750	1000	34083.53348	627691.57	872.4486289	29128.98	28255.11698	198032	317161803.9	2422.733
Building Construction	Tractors/Loaders/Backhoes	1	10	2850	100	600	300	0	300	6300	300	9750	1000	136938.0473	697997.75	416.0898825	92670.23	89890.1113	618859.9	127080103.7	7196.186
Building Construction	Welders	3	14	11970	420	2520	1260	0	1260	26460	1260	40950	4200	202440.9088	1377173.1	838.1957018	132819.6	128835.2404	981639.4	262993402.3	12049.15
Building Construction	Generator Sets	1	14	3990	140	840	420	0	420	8820	420	13650	1400	76881.1361	846686.4	526.5423668	48173.97	46728.71159	312613	165422234.9	4917.219
Paving	Pavers	1	14	1512	0	0	0	0	420	0	0	1512	420	3742.435239	80597.091	164.7954101	3375.397	3274.134391	18855.47	61091345	331.8347
Paving	Cement & Mortar Mixers	1	14	1512	0	0	0	0	420	0	0	1512	420	11052.91639	103183.73	42.01675136	7445.038	7221.687601	46819.74	11481478.38	497.4224
Paving	Rollers	2	14	3024	0	0	0	0	840	0	0	3024	840	8510.777588	159122.31	251.9627959	6394.821	6202.977099	41971.93	92109058.12	716.8335
Paving	Tractors/Loaders/Backhoes	1	14	1512	0	0	0	0	420	0	0	1512	420	21235.93103	108243.34	64.52593871	14371.01	13939.88188	95970.89	19707191.46	1115.962
Paving	Paving Equipment	1	14	1512	0	0	0	0	420	0	0	1512	420	6105.587877	75734.629	97.13264259	3792.343	3678.573803	25339.14	34495207.25	465.7476
Trackwork	Rough Terrain Forklifts	2	14	12236	280	0	0	0	0	1260	0	13496	280	47178.60183	868853.89	1207.647866	40320.48	39110.87783	274117	439016995.5	3353.56
Trackwork	Railway Maintenance	1	14	6118	140	0	0	0	0	630	0	6748	140	89052.63808	568904.68	397.0696273	61094.81	59261.89314	346228.5	127485544.2	4126.543
Trackwork	Graders	1	14	6118	140	0	0	0	0	630	0	6748	140	15975.49596	217681.39	1171.23633	15967.5	15488.48426	72341.93	437483826.8	983.1033
Trackwork	Other Construction Equipment	1	14	6118	140	0	0	0	0	630	0	6748	140	184178.6117	2865312.4	2224.763071	178091.4	172748.6727	1276774	702857289.4	10622.57
Trackwork	Plate Compactors	1	14	6118	140	0	0	0	0	630	0	6748	140	16039.48763	89952.907	47.28231681	5317.132	5157.616597	49773.59	12859120.18	1261.083
Pile Installation	Derrick Crane	1	10	0	0	600	0	0	0	900	0	1500	0	19333.95641	343459.04	1228.324709	3132.553	2789.450122	253186.3	131407567.9	5330.466
Pile Installation	Tractors/Loaders/Backhoes	1	10	0	0	600	0	0	0	900	0	1500	0	21067.3919	107384.27	64.01382808	14256.96	13829.24789	95209.22	19550785.18	1107.106
Pile Installation	Other Construction Equipment	1	6	0	0	360	0	0	0	540	0	900	0	24564.42657	382154.89	296.7229941	23752.56	23039.98303	170287	93742080.69	1416.763
Pile Installation	Welders	1	14	0	0	840	0	0	0	1260	0	2100	0	10381.58507	70624.263	42.98439496	6811.259	6606.935403	50340.48	13486841.15	617.9053
Pile Installation	Other Construction Equipment			0	0	50.5	0	0	0	661	0	711.5	0	100206.9719	1558944.8	1210.437892	96895.07	93988.22821	694660.9	382407055.7	5779.476
Dewatering	Pumps	2	14	0	0	0	0	0	0	840	0	840	0	5157.178592	55275.775	34.43985347	3359.223	3258.44281	21486.23	10821542.3	322.3907
													Total Emissions (g)	1539253.111	19914427	25264.94334	1168554	1133248.512	7935576	8612584692	96250.47
													CAP Totals in lb, GHG Totals in kg	3393.47223	43903.796	55.69966563	2576.221	2498.385306	17494.95	8612584.692	96.25047
													CAP Totals in tons, GHG Totals in MT	1.696736115	21.951898	0.027849833	1.28811	1.249192653	8.747476	8612.584692	0.09625

Notes: Vibratory hammer modeled as "Other Construction Equipment" with 1,000 hp engine
Pile removal and installation operating hours based on specifics provided in the Project Description Report.
Derrick crane emission factors for construction operations are from SMAQMD Harborcraft, Dredge and Barge Emission Factor Calculator - Auxiliary Engine Emission Rates

Onroad Vehicle Construction Emissions		Total VMT/Element											
Trip Category	Vehicle Type	Rail Upgrades and Site Improvements	Dock, Fender, and Stormwater Upgrades	Cargo Yard Relocation and Expansion	AGP Project	ROG (lb)	Nox (lb)	SO2 (lb)	PM10 (lb)	PM2.5 (lb)	CO (lb)	CO2 (MT)	CH4 (MT)
Worker Trips	Onroad Passenger Vehicles	350400	216000	494400	300000	71.05053341	335.95977	5.6587141	6.1094113	5.4061343	6839.34968	388.5158428	0.0103886
Haul Trips	Onroad Heavy Duty Trucks			280000	360000	128.7598015	4690.14316	7.0040375	70.085655	64.473448	3070.81922	937.5769406	0.1233758
					CAP Totals in lb, GHG Totals in kg	199.8103349	5026.10293	12.662752	76.195066	69.879582	9910.1689	1326.092783	0.1337645
					CAP Totals in tons, GHG Totals in MT	0.099905167	2.51305147	0.0063314	0.0380975	0.0349398	4.95508445	1326.092783	0.1337645

Appendix A
Emissions Calculations

Construction Emissions Summary Table

	CAP Emissions are in lbs						GHGs are in kg/MT		
Project Element/Emission Source	**Criteria Air Pollutant Emissions (lbs)**						**GHG Emissions (kg)**		
	ROG	**NO_X**	**SO_2**	**PM_{10}**	**$PM_{2.5}$**	**CO**	**CO_2**	**CH_4**	**CO_2e**
Rail Upgrades and Site Improvements	1,751.5	19,644.9	28.1	1,379.3	1,337.9	9,157.6	*4,489,090.1*	*46.5*	*4,490,252.7*
Dock, Fender, and Stormwater Upgrades	217.6	2,211.1	2.8	149.9	145.2	1,237.3	*311,306.7*	*7.4*	*311,492.1*
Cargo Yard Relocation and Expansion	712.7	21,363.4	25.4	507.3	492.0	2,628.0	*4,279,604.1*	*22.7*	*4,280,172.8*
AGP Project	1,210.4	12,760.6	13.9	895.8	868.6	6,474.2	*1,955,902.6*	*34.8*	*1,956,772.7*
Fugitive Dust	-	-	-	9,436.7	1,492.5	-	-	-	-
Mobile (worker commute)	71.1	336.0	5.7	6.1	5.4	6,839.3	*388,515.8*	*10.4*	*388,775.6*
Hauling (truck)	128.8	4,690.1	7.0	70.1	64.5	3,070.8	*937,576.9*	*123.4*	*940,661.3*
Material Barges	26.1	310.8	0.2	17.9	15.9	91.3	*9,935.5*	*0.4*	*9,945.6*
Total (tons|MT)	2.1	30.7	0.0	6.2	2.2	14.7	*12,371.9*	*0.2*	*12,378.1*
Year 1 Total (tons|MT)	1.8	24.1	0.0	1.3	1.3	12.7	*9,681.4*	*0.2*	*9,686.5*
Year 2 Total (tons|MT)	0.3	6.6	0.0	0.2	0.2	2.0	2,690.5	0.0	*2,691.6*
Max Yearly Total (tons|*MT*)	1.8	24.1	0.0	1.3	1.3	12.7	*9,681.4*	*0.2*	*9,686.5*
PSD Thresholds[1] (tons)	40.0	40.0	40.0	15.0	10.0	100.0	-	-	-
GHG Reporting Threshold (MTCO2e/year)	-	-	-	-	-	-	-	-	*10,000.0*

Appendix A
Emissions Calculations

		Total Project Emissions (g), Year 2								Total Project Emissions (g)								Rail Upgrades and Site Improvements Emissions (g)							
Construction Category	Estimated Equipment Used, by MOVES category (Notes)	ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4	ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4	ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4
Demolition	Crawler Tractor/Dozers	2102.112	45429.36	94.576451	1976.97738	1917.6671	11216.092	34753146.9	130.90724	14364.43098	310433.94	646.272415	13509.35	13104.06	76643.29	237479837.1	894.5328	6656.688	143859.6	299.4921	6260.428	6072.613	35517.62	110051631.8	414.5396
Demolition	Concrete/Industrial Saws	1467.315	25626.58	19.478218	877.486309	851.16204	7156.2637	6976325.54	125.02322	10026.65509	175114.94	133.1011553	5996.156	5816.274	48901.14	47671557.87	854.3254	4646.499	81150.83	61.68102	2778.707	2695.346	22661.5	22091697.55	395.9069
Demolition	Tractors/Loaders/Backhoes	11797.74	60135.19	35.847744	7983.89671	7744.3788	53317.164	10948439.7	619.97909	80617.88632	410923.8	244.9595821	54556.63	52919.92	364334	74814337.96	4236.524	37359.51	190428.1	113.5179	25282.34	24523.87	168837.7	34670059.05	1963.267
Casting Basin Earthwork	Excavators	9787.461	189119.6	657.94223	8575.6599	8318.3917	42984.35	246313468	699.89782	19574.92108	378239.14	1315.884462	17151.32	16636.78	85968.7	492626935.1	1399.796	0	0	0	0	0	0	0	0
Casting Basin Earthwork	Off-highway Trucks	93057.85	3970174	3967.1782	62142.1627	60277.926	267781.37	1487766685	7096.2486	186115.6959	7940348.4	7934.356351	124284.3	120555.9	535562.7	2975533371	14192.5	0	0	0	0	0	0	0	0
Casting Basin Earthwork	Crawler Tractor/Dozers	7507.542	162247.7	337.77304	7060.63349	6848.8111	40057.47	124118382	467.52584	15015.08465	324495.41	675.5460784	14121.27	13697.62	80114.94	248236763.5	935.0517	0	0	0	0	0	0	0	0
Casting Basin Earthwork	Rollers	4221.616	78929.71	124.98155	3172.03427	3076.8736	20819.409	45689016.9	355.57218	8443.231734	157859.43	249.9630912	6344.069	6153.747	41638.82	91378033.84	711.1444	0	0	0	0	0	0	0	0
Grading	Crawler Tractor/Dozers	2102.112	45429.36	94.576451	1976.97738	1917.6671	11216.092	34753146.9	130.90724	24454.56787	528494.85	1100.23938	22998.84	22308.86	130480.5	404294942.1	1522.888	19269.36	416435.8	866.9508	18122.29	17578.62	102814.2	318570513.1	1199.983
Grading	Tractors/Loaders/Backhoes	11797.74	60135.19	35.847744	7983.89671	7744.3788	53317.164	10948439.7	619.97909	137247.0357	699572.72	417.028752	92879.33	90092.94	620256.3	127366848.5	7212.423	108145.9	551239.2	328.6043	73185.72	70990.14	488740.7	100360697.3	5683.142
Grading	Graders	994.3255	13548.63	72.898527	993.828093	964.01354	4502.6097	27229283.8	61.188999	11567.31969	157615.78	848.0528616	11561.53	11214.69	52380.36	316767335.1	711.832	9114.65	124195.8	668.2365	9110.091	8836.791	41273.92	249601768.4	560.8992
Grading	Excavators	1826.993	35302.32	122.81588	1600.78985	1552.7665	8023.7454	45978513.9	130.64759	21254.01431	410683.65	1428.758107	18622.52	18063.85	93342.9	534883378.9	1519.867	16747.43	323604.6	1125.812	14673.91	14233.69	73551	421469711.2	1197.603
Grading	Scrapers	6985.236	105506.1	299.92998	6537.52443	6341.3973	46023.291	108906728	448.82296	81261.57465	1227387.7	3489.185425	76053.2	73771.59	535404.3	1266948265	5221.307	64031.33	967139.3	2749.358	59927.31	58129.48	421880.2	998311669.9	4114.21
Building Construction	Cranes	5008.319	79985.95	148.39063	3506.36876	3401.1784	19739.143	52954275.7	317.01701	53839.43162	859848.92	1595.199299	37693.46	36562.67	212195.8	569258464.2	3407.933	14774.54	235958.5	437.7524	10343.79	10033.48	58230.47	156215113.4	935.2002
Building Construction	Rough Terrain Forklifts	3495.747	64378.62	89.481911	2987.58734	2897.9607	20310.979	32529415.8	248.48546	37579.2805	692070.19	961.9305396	32116.56	31153.08	218343	349691219.7	2671.219	10312.45	189916.9	263.9716	8813.383	8548.984	59917.39	95961776.58	733.0321
Building Construction	Tractors/Loaders/Backhoes	14044.93	71589.51	42.675885	9504.63894	9219.4986	63472.814	13033856.8	738.07034	150982.9753	769587.26	458.7657679	102174.9	99109.61	682332.8	140113960.5	7934.256	41432.54	211189.1	125.8939	28038.68	27197.52	187244.8	38449877.52	2177.308
Building Construction	Welders	20763.17	141248.5	85.96879	13622.5188	13213.871	100680.96	26973682.3	1235.8106	223204.079	1518421.7	924.1644917	146442.1	142049.1	1082320	289967084.6	13284.96	61251.35	416683.2	253.6079	40186.43	38980.92	297008.8	79572362.76	3645.641
Building Construction	Generator Sets	7885.245	86839.63	54.004345	4940.91998	4792.6884	32062.868	16966383.1	504.33013	84766.38083	933526.03	580.5467121	53114.89	51521.4	344675.8	182388617.9	5421.549	23261.47	256176.9	159.3128	14575.71	14138.43	94585.46	50050830.04	1487.774
Paving	Pavers	1039.565	22388.08	45.776503	937.610372	909.48178	5237.6294	16969818.1	92.176293	4782.000583	102985.17	210.5719129	4313.008	4183.616	24093.1	78061163.06	424.0109	3742.435	80597.09	164.7954	3375.397	3274.134	18855.47	61091345	331.8347
Paving	Cement & Mortar Mixers	3070.255	28662.15	11.67132	2068.06599	2006.0243	13005.483	3189299.55	138.1729	14123.17094	131845.87	53.68807119	9513.104	9227.712	59825.22	14670777.93	635.5953	11052.92	103183.7	42.01675	7445.038	7221.688	46819.74	11481478.38	497.4224
Paving	Rollers	2364.105	44200.64	69.989666	1776.33919	1723.0492	11658.869	25585849.5	199.12042	10874.88247	203322.95	321.9524615	8171.16	7926.026	53630.8	117694907.6	915.9539	8510.778	159122.3	251.9628	6394.821	6202.977	41971.93	92109058.12	716.8335
Paving	Tractors/Loaders/Backhoes	5898.87	30067.6	17.923872	3991.94835	3872.1894	26658.582	5474219.85	309.98954	27134.80076	138310.94	82.44981057	18362.96	17812.07	122629.5	25181411.31	1425.952	21235.93	108243.3	64.52594	14371.01	13939.88	95970.89	19707191.46	1115.962
Paving	Paving Equipment	1695.997	21037.4	26.98129	1053.42874	1021.8261	7038.651	9582002.01	129.37432	7801.58451	96772.026	124.1139322	4845.772	4700.4	32377.79	44077209.26	595.1219	6105.588	75734.63	97.13264	3792.343	3678.574	25339.14	34495207.25	465.7476
Trackwork	Rough Terrain Forklifts	978.8092	18026.01	25.054935	836.524456	811.429	5687.0742	9108236.42	69.575928	48157.41099	886879.9	1232.702801	41157	39922.31	279804	448125231.9	3423.136	43752.77	805762.8	1119.956	37392.64	36270.88	254212.2	407138168	3110.044
Trackwork	Railway Maintenance	1847.565	11803	8.2379591	1267.52708	1229.4999	7183.1639	2644928.3	85.612916	90900.20318	580707.68	405.3075864	62362.33	60491.39	353411.7	130130472.5	4212.155	82586.16	527594.2	368.2368	56658.46	54958.64	321087.4	118228295.1	3826.897
Trackwork	Graders	331.4418	4516.211	24.299509	331.276031	321.33785	1500.8699	9076427.94	20.396333	16306.93778	222197.6	1195.535839	16298.78	15809.82	73842.8	446560254.7	1003.5	14815.45	201874.6	1086.188	14808.04	14363.8	67088.88	405716329	911.7161
Trackwork	Other Construction Equipment	3821.133	59446.32	46.15691	3694.84223	3583.9974	26489.091	14582101.4	220.38535	187999.7447	2924758.7	2270.919981	181786.2	176332.7	1303263	717439390.8	10842.96	170804.6	2657250	2063.214	165159.4	160204.7	1184062	651819934.4	9851.225
Trackwork	Plate Compactors	332.7695	1866.243	0.9809609	110.313932	107.00449	1032.6471	266786.726	26.163558	16372.25709	91819.15	48.26327774	5427.445	5264.621	50806.24	13125906.9	1287.247	14874.79	83421.06	43.84895	4931.033	4783.101	46159.32	11925366.64	1169.511
Pile Installation	Derrick Crane	0	0	0	0	0	0	0	0	19333.95641	343459.04	1228.324709	3132.553	2789.45	253186.3	131407567.9	5330.466	0	0	0	0	0	0	0	0
Pile Installation	Tractors/Loaders/Backhoes	0	0	0	0	0	0	0	0	21067.3919	107384.27	64.01382808	14256.96	13829.25	95209.22	19550785.18	1107.106	0	0	0	0	0	0	0	0
Pile Installation	Other Construction Equipment	0	0	0	0	0	0	0	0	24564.42657	382154.89	296.7229941	23752.56	23039.98	170287	93742080.69	1416.763	0	0	0	0	0	0	0	0
Pile Installation	Welders	0	0	0	0	0	0	0	0	10381.58507	70624.263	42.98439496	6811.259	6606.935	50340.48	13486841.15	617.9053	0	0	0	0	0	0	0	0
Pile Installation	Other Construction Equipment	0	0	0	0	0	0	0	0	100206.9719	1558944.8	1210.437892	96895.07	93988.23	694660.9	382407055.7	5779.476	0	0	0	0	0	0	0	0
Dewatering	Pumps	0	0	0	0	0	0	0	0	5157.178592	55275.775	34.43985347	3359.223	3258.443	21486.23	10821542.3	322.3907	0	0	0	0	0	0	0	0
		226226	5477640	6561.4405	161511.777	156666.47	908173.84	2423318859	15221.381	1765479.069	25392067	31826.38382	1330066	1289915	8843750	11035903551	111471.8	794485.2	8910762	12756.07	625627	606858.2	4153831	4489090082	46505.7
		498.7429	12076.13	14.4655	356.072518	345.39044	2002.1806	2423318.86	15.221381	3892.215093	55979.925	70.16516573	2932.293	2843.776	19497.13	11035903.55	111.4718	1751.54	19644.87	28.12232	1379.271	1337.893	9157.63	4489090.082	46.5057
		0.249371	6.038064	0.0072328	0.17803626	0.1726952	1.0010903	2423.31886	0.0152214	1.946107547	27.989962	0.035082583	1.466147	1.421888	9.748566	11035.90355	0.111472	0.87577	9.822434	0.014061	0.689636	0.668947	4.578815	4489.090082	0.046506

Appendix A
Emissions Calculations

QA Table - do not print

ment/Emis	Criteria Air Pollutant Emissions (lbs)						GHG Emissions (kg)		
	ROG	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO	CO_2	CH_4	CO_2e
and Site Improvements	887.6	10,438.2	15.5	709.0	687.8	4,773.5	*2,478,640.7*	*24.1*	*2,479,243.9*
Stormwater Upgrades	100.0	1,007.9	1.4	67.0	64.8	582.6	*144,943.7*	*3.6*	*145,034.5*
location and Expansion	184.6	2,156.6	4.4	158.2	153.4	1,034.5	*728,214.6*	*5.2*	*728,345.2*
AGP Project	583.3	11,062.3	10.0	736.1	713.8	5,197.5	*1,385,942.9*	*28.9*	*1,386,666.6*
Fugitive Dust	-	-	-	9,341.6	1,469.2	-	-	-	-
bile (worker commute)	41.5	196.1	3.3	3.6	3.2	3,992.6	226,805.5	6.1	*226,957.2*
Hauling (truck)	128.8	4,690.1	7.0	70.1	64.5	3,070.8	937,576.9	123.4	*940,661.3*
Material Barges	87.1	1,035.8	0.7	59.6	53.1	304.4	33,118.4	1.3	*33,152.0*
Total (lbs|*kg*)	2,012.8	30,587.1	42.3	11,145.1	3,209.7	18,956.0	*5,935,243.0*	*192.7*	*5,940,060.7*
otal (Tons|*Metric tons*)	1.0	15.3	0.0	5.6	1.6	9.5	*2,967.6*	*0.1*	*2,970.0*
PSD Thresholds[1]	40.0	40.0	40.0	40.0	40.0	100.0	-	-	-
	864.0	9,206.7	12.6	670.2	650.1	4,384.1	2,010,449.4	22.4	2,011,008.8
	117.6	1,203.2	1.4	82.9	80.4	654.7	166,363.0	3.8	166,457.6
	528.0	19,206.8	20.9	349.1	338.6	1,593.4	3,551,389.5	17.5	3,551,827.7
	627.1	1,698.3	3.9	159.8	154.9	1,276.7	569,959.7	5.9	570,106.1
				95.1	23.3				
	29.6	139.8	2.4	2.5	2.3	2,846.7	161,710.3	4.3	161,818.4
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	-61.0	-725.1	-0.5	-41.7	-37.1	-213.0	-23,182.9	-0.9	-23,206.4
	-2,010.7	-30,556.4	-42.2	-11,138.8	-3,207.5	-18,941.2	-5,922,871.0	-192.5	-5,927,682.6
	0.8	8.8	0.0	-4.2	-0.3	3.3	6,713.8	0.1	6,716.5

Appendix A
Emissions Calculations

		Dock, Fender, and Stormwater Upgrades Emissions (g)								Cargo Yard Relocation and Expansion Emissions (g)								AGP Project Emissions (g)							
Construction Category	**Estimated Equipment Used, by MOVES category (Notes)**	**ROG**	**Nox**	**SO2**	**PM10**	**PM2.5**	**CO**	**CO2**	**CH4**	**ROG**	**Nox**	**SO2**	**PM10**	**PM2.5**	**CO**	**CO2**	**CH4**	**ROG**	**Nox**	**SO2**	**PM10**	**PM2.5**	**CO**	**CO2**	**CH4**
Demolition	Crawler Tractor/Dozers	2102.112	45429.36	94.57645	1976.977	1917.667	11216.09	34753146.89	130.9072	5605.632	121145	252.2039	5271.94	5113.779	29909.58	92675058.4	349.086	0	0	0	0	0	0	0	0
Demolition	Concrete/Industrial Saws	1467.315	25626.58	19.47822	877.4863	851.162	7156.264	6976325.542	125.0232	3912.841	68337.54	51.94191	2339.963	2269.765	19083.37	18603534.8	333.3953	0	0	0	0	0	0	0	0
Demolition	Tractors/Loaders/Backhoes	11797.74	60135.19	35.84774	7983.897	7744.379	53317.16	10948439.7	619.9791	31460.64	160360.5	95.59398	21290.39	20651.68	142179.1	29195839.2	1653.278	0	0	0	0	0	0	0	0
Casting Basin Earthwork	Excavators	0	0	0	0	0	0	0	0	19574.92	378239.1	1315.884	17151.32	16636.78	85968.7	492626935	1399.796	0	0	0	0	0	0	0	0
Casting Basin Earthwork	Off-highway Trucks	0	0	0	0	0	0	0	0	186115.7	7940348	7934.356	124284.3	120555.9	535562.7	2975533371	14192.5	0	0	0	0	0	0	0	0
Casting Basin Earthwork	Crawler Tractor/Dozers	0	0	0	0	0	0	0	0	15015.08	324495.4	675.5461	14121.27	13697.62	80114.94	248236763	935.0517	0	0	0	0	0	0	0	0
Casting Basin Earthwork	Rollers	0	0	0	0	0	0	0	0	8443.232	157859.4	249.9631	6344.069	6153.747	41638.82	91378033.8	711.1444	0	0	0	0	0	0	0	0
Grading	Crawler Tractor/Dozers	0	0	0	0	0	0	0	0	2102.112	45429.36	94.57645	1976.977	1917.667	11216.09	34753146.9	130.9072	3083.097	66629.72	138.7121	2899.567	2812.578	16450.27	50971282.1	191.9973
Grading	Tractors/Loaders/Backhoes	0	0	0	0	0	0	0	0	11797.74	60135.19	35.84774	7983.897	7744.379	53317.16	10948439.7	619.9791	17303.35	88198.28	52.57669	11709.72	11358.42	78198.51	16057711.6	909.3027
Grading	Graders	0	0	0	0	0	0	0	0	994.3255	13548.63	72.89853	993.8281	964.0135	4502.61	27229283.8	61.189	1458.344	19871.33	106.9178	1457.615	1413.887	6603.828	39936282.9	89.74387
Grading	Excavators	0	0	0	0	0	0	0	0	1826.993	35302.32	122.8159	1600.79	1552.766	8023.745	45978513.9	130.6476	2679.589	51776.74	180.13	2347.825	2277.391	11768.16	67435153.8	191.6165
Grading	Scrapers	0	0	0	0	0	0	0	0	6985.236	105506.1	299.93	6537.524	6341.397	46023.29	108906728	448.823	10245.01	154742.3	439.8973	9588.369	9300.716	67500.83	159729867	658.2737
Building Construction	Cranes	4507.487	71987.35	133.5516	3155.732	3061.061	17765.23	47658848.16	285.3153	1502.496	23995.78	44.51719	1051.911	1020.354	5921.743	15886282.7	95.1051	33054.91	527907.2	979.3782	23142.03	22447.78	130278.3	349498220	2092.312
Building Construction	Rough Terrain Forklifts	3146.172	57940.76	80.53372	2688.829	2608.165	18279.88	29276474.21	223.6369	1048.724	19313.59	26.84457	896.2762	869.3882	6093.294	9758824.74	74.54564	23071.93	424898.9	590.5806	19718.08	19126.54	134052.5	214694144	1640.004
Building Construction	Tractors/Loaders/Backhoes	12640.44	64430.56	38.4083	8554.175	8297.549	57125.53	11730471.11	664.2633	4213.478	21476.85	12.80277	2851.392	2765.85	19041.84	3910157.04	221.4211	92696.52	472490.8	281.6608	62730.62	60848.69	418920.6	86023454.8	4871.264
Building Construction	Welders	18686.85	127123.7	77.37191	12260.27	11892.48	90612.86	24276314.06	1112.23	6228.951	42374.56	25.79064	4086.756	3964.161	30204.29	8092104.69	370.7432	137036.9	932240.3	567.394	89908.62	87211.55	664494.3	178026303	8156.35
Building Construction	Generator Sets	7096.72	78155.67	48.60391	4446.828	4313.42	28856.58	15269744.76	453.8971	2365.573	26051.89	16.2013	1482.276	1437.807	9618.86	5089914.92	151.299	52042.62	573141.6	356.4287	32610.07	31631.74	211614.9	111978128	3328.579
Paving	Pavers	0	0	0	0	0	0	0	0	1039.565	22388.08	45.7765	937.6104	909.4818	5237.629	16969818.1	92.17629	0	0	0	0	0	0	0	0
Paving	Cement & Mortar Mixers	0	0	0	0	0	0	0	0	3070.255	28662.15	11.67132	2068.066	2006.024	13005.48	3189299.55	138.1729	0	0	0	0	0	0	0	0
Paving	Rollers	0	0	0	0	0	0	0	0	2364.105	44200.64	69.98967	1776.339	1723.049	11658.87	25585849.5	199.1204	0	0	0	0	0	0	0	0
Paving	Tractors/Loaders/Backhoes	0	0	0	0	0	0	0	0	5898.87	30067.6	17.92387	3991.948	3872.189	26658.58	5474219.85	309.9895	0	0	0	0	0	0	0	0
Paving	Paving Equipment	0	0	0	0	0	0	0	0	1695.997	21037.4	26.98129	1053.429	1021.826	7038.651	9582002.01	129.3743	0	0	0	0	0	0	0	0
Trackwork	Rough Terrain Forklifts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4404.641	81117.06	112.7472	3764.36	3651.431	25591.83	40987063.9	313.0917
Trackwork	Railway Maintenance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8314.043	53113.51	37.07082	5703.872	5532.749	32324.24	11902177.4	385.2581
Trackwork	Graders	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1491.488	20322.95	109.3478	1490.742	1446.02	6753.915	40843925.7	91.7835
Trackwork	Other Construction Equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17195.1	267508.4	207.7061	16626.79	16127.99	119200.9	65619456.5	991.7341
Trackwork	Plate Compactors	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1497.463	8398.093	4.414324	496.4127	481.5202	4646.912	1200540.27	117.736
Pile Installation	Derrick Crane	7733.583	137383.6	491.3299	1253.021	1115.78	101274.5	52563027.18	2132.186	0	0	0	0	0	0	0	0	11600.37	206075.4	736.9948	1879.532	1673.67	151911.8	78844540.8	3198.279
Pile Installation	Tractors/Loaders/Backhoes	8426.957	42953.71	25.60553	5702.783	5531.699	38083.69	7820314.072	442.8422	0	0	0	0	0	0	0	0	12640.44	64430.56	38.4083	8554.175	8297.549	57125.53	11730471.1	664.2633
Pile Installation	Other Construction Equipment	9825.771	152862	118.6892	9501.023	9215.993	68114.8	37496832.27	566.7052	0	0	0	0	0	0	0	0	14738.66	229292.9	178.0338	14251.53	13823.99	102172.2	56245248.4	850.0578
Pile Installation	Welders	4152.634	28249.71	17.19376	2724.504	2642.774	20136.19	5394736.458	247.1621	0	0	0	0	0	0	0	0	6228.951	42374.56	25.79064	4086.756	3964.161	30204.29	8092104.69	370.7432
Pile Installation	Other Construction Equipment	7112.371	110648.9	85.91302	6877.303	6670.985	49304.81	27142032.77	410.2088	0	0	0	0	0	0	0	0	93094.6	1448296	1124.525	90017.77	87317.24	645356.1	355265023	5369.268
Dewatering	Pumps	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5157.179	55275.77	34.43985	3359.223	3258.443	21486.23	10821542.3	322.3907
		98696.15	1002927	1267.103	68002.82	65863.12	561243.6	311306707.2	7414.356	323262.5	9690276	11500.06	230092.3	223189.6	1192019	4279604120	22747.74	549035.2	5788102	6303.155	406343.7	394004.1	2936656	1955902642	34804.05
		217.5878	2211.076	2.793484	149.9206	145.2033	1237.33	311306.7072	7.414356	712.6717	21363.4	25.35329	507.2667	492.0488	2627.953	4279604.12	22.74774	1210.415	12760.58	13.89608	895.8345	868.6303	6474.218	1955902.64	34.80405
		0.108794	1.105538	0.001397	0.07496	0.072602	0.618665	311.3067072	0.007414	0.356336	10.6817	0.012677	0.253633	0.246024	1.313976	4279.60412	0.022748	0.605208	6.380291	0.006948	0.447917	0.434315	3.237109	1955.90264	0.034804

Appendix A
Emissions Calculations

Appendix A
Emissions Calculations

SMAQMD Harborcraft, Dredge and Barge Emission Factor Calculator - Main Engine Emission Rates

Calendar Year: 2024 **Number o** 2

Vessel/Engine Information								Emission Rates (lb/hr; estimates for each row are totals over the number of engines listed in column J for that row)										Emission Rates for a Single Engine (g/bhp-hr)									
Vessel Name	Vessel Number	Home Port	Vessel Type	Engine Model Year	Engine Rated Power (hp)	Engine Load Factor	Number of engines	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e	PM_{10}	$PM_{2.5}$	NOx	ROG	CO	SO_2	CO_2	CH_4	N_2O	CO_2e
Derrick Barge			Dredge	2007	2883	0.45	1	0.420	0.374	14.794	0.502	3.289	0.016	1706.847	0.069	0.014	1712.704	0.147	0.131	5.173	0.176	1.150	0.006	596.868	0.024	0.005	598.9
Tug			Tug Boats	2003	1167	0.50	2	1.241	1.105	21.580	1.814	6.341	0.014	1521.118	0.062	0.012	1526.338	0.482	0.429	8.385	0.705	2.464	0.006	591.045	0.024	0.005	593.1

SMAQMD Harborcraft, Dredge and Barge Emission Factor Calculator - Auxiliary Engine Emission Rates

Calendar Year: 2024 **Number o** 1

Vessel/Engine Information									Emission Rates (lb/hr; estimates for each row are totals over the number of engines listed in column K for that row)										Emission Rates for a Single Engine (g/bhp-hr)									
Vessel Name	Vessel Number	Home Port	Vessel Type	Auxiliary Engine Type	Engine Model Year	Engine Rated Power (hp)	Engine Load Factor	Number of Engines	PM10	PM2.5	NOx	ROG	CO	SO2	CO2	CH4	N2O	CO2e	PM10	PM2.5	NOx	ROG	CO	SO2	CO2	CH4	N2O	CO2e
Derrick Barge			Dredge	Crane	2015	349	0.42	1	0.005	0.004	0.505	0.028	0.372	0.002	193.136	0.008	0.002	193.799	0.01	0.01	1.56	0.09	1.15	0.006	596.87	0.02	0.00	598.9

Estimate 3 barge/tug round trips

Tugs	Trips	Distance (r	Speed (mp	LF	Time (hr)	Engines	Emissions in lbm								
							ROG	NOx	SO_2	PM_{10}	$PM_{2.5}$	CO	CO_2	CH_4	CO_2e
	1	6	60	25	0.50	14.4	2	26.12817	310.7536	0.204747	17.87387	15.91618	91.3065	21904.09	0.888526	21926.31

Appendix A
Emissions Calculations

MOVESRunID	Year	Month	Day	State	County	Equipment Description	Fuel	Pollutant	EqPollID	Process	Emission Factor, g/hr	Emission Factor, g/hp-hr
1	2024	All	All	53	53027	Pavers	23	1	Pavers1		2.078842582	0.028335951
1	2024	All	All	53	53027	Pavers	23	2	Pavers2		12.47054615	0.169981501
1	2024	All	All	53	53027	Pavers	23	3	Pavers3		53.30495457	0.726580543
1	2024	All	All	53	53027	Pavers	23	5	Pavers5		0.219467364	0.00299148
1	2024	All	All	53	53027	Pavers	23	31	Pavers31		0.108991673	0.001485626
1	2024	All	All	53	53027	Pavers	23	79	Pavers79		1.859374917	0.025344467
1	2024	All	All	53	53027	Pavers	23	80	Pavers80		2.255689911	0.030746493
1	2024	All	All	53	53027	Pavers	23	86	Pavers86		2.475155581	0.03373795
1	2024	All	All	53	53027	Pavers	23	87	Pavers87		2.226572283	0.030349601
1	2024	All	All	53	53027	Pavers	23	90	Pavers90		40404.3287	550.7367807
1	2024	All	All	53	53027	Pavers	23	100	Pavers100		2.232405648	0.030429113
1	2024	All	All	53	53027	Pavers	23	110	Pavers110		2.165432798	0.029516231
1	2024	All	All	53	53027	Tampers/Rammers	23	1	Tampers/Rammers1		1.343027697	0.743647694
1	2024	All	All	53	53027	Tampers/Rammers	23	2	Tampers/Rammers2		4.831090276	2.675022378
1	2024	All	All	53	53027	Tampers/Rammers	23	3	Tampers/Rammers3		7.717751862	4.273395396
1	2024	All	All	53	53027	Tampers/Rammers	23	5	Tampers/Rammers5		0.126150175	0.069850597
1	2024	All	All	53	53027	Tampers/Rammers	23	31	Tampers/Rammers31		0.003904608	0.00216202
1	2024	All	All	53	53027	Tampers/Rammers	23	79	Tampers/Rammers79		1.216877397	0.673797028
1	2024	All	All	53	53027	Tampers/Rammers	23	80	Tampers/Rammers80		1.491642389	0.825937116
1	2024	All	All	53	53027	Tampers/Rammers	23	86	Tampers/Rammers86		1.617792736	0.895787809
1	2024	All	All	53	53027	Tampers/Rammers	23	87	Tampers/Rammers87		1.491267623	0.825729604
1	2024	All	All	53	53027	Tampers/Rammers	23	90	Tampers/Rammers90		1061.932927	588.0027448
1	2024	All	All	53	53027	Tampers/Rammers	23	100	Tampers/Rammers100		0.508906834	0.281786738
1	2024	All	All	53	53027	Tampers/Rammers	23	110	Tampers/Rammers110		0.493639728	0.273333191
1	2024	All	All	53	53027	Plate Compactors	23	1	Plate Compactors1		1.971359988	0.608731522
1	2024	All	All	53	53027	Plate Compactors	23	2	Plate Compactors2		7.376050646	2.277632984
1	2024	All	All	53	53027	Plate Compactors	23	3	Plate Compactors3		13.33030638	4.116233327
1	2024	All	All	53	53027	Plate Compactors	23	5	Plate Compactors5		0.186882557	0.057707016
1	2024	All	All	53	53027	Plate Compactors	23	31	Plate Compactors31		0.007006864	0.002163633
1	2024	All	All	53	53027	Plate Compactors	23	79	Plate Compactors79		1.784476717	0.551024285
1	2024	All	All	53	53027	Plate Compactors	23	80	Plate Compactors80		2.190042798	0.676258062
1	2024	All	All	53	53027	Plate Compactors	23	86	Plate Compactors86		2.376924664	0.733964865
1	2024	All	All	53	53027	Plate Compactors	23	87	Plate Compactors87		2.189618333	0.676126992
1	2024	All	All	53	53027	Plate Compactors	23	90	Plate Compactors90		1905.619469	588.4316642
1	2024	All	All	53	53027	Plate Compactors	23	100	Plate Compactors100		0.787956655	0.243311245
1	2024	All	All	53	53027	Plate Compactors	23	110	Plate Compactors110		0.764317812	0.236011864
1	2024	All	All	53	53027	Rollers	23	1	Rollers1		2.35356573	0.043239407
1	2024	All	All	53	53027	Rollers	23	2	Rollers2		13.8796057	0.254994334
1	2024	All	All	53	53027	Rollers	23	3	Rollers3		52.61980993	0.966724394
1	2024	All	All	53	53027	Rollers	23	5	Rollers5		0.237048118	0.004355018
1	2024	All	All	53	53027	Rollers	23	31	Rollers31		0.08332103	0.001530763
1	2024	All	All	53	53027	Rollers	23	79	Rollers79		2.116517239	0.038884383
1	2024	All	All	53	53027	Rollers	23	80	Rollers80		2.577362257	0.047350969
1	2024	All	All	53	53027	Rollers	23	86	Rollers86		2.814410578	0.05170599
1	2024	All	All	53	53027	Rollers	23	87	Rollers87		2.559922792	0.047030573
1	2024	All	All	53	53027	Rollers	23	90	Rollers90		30459.34461	559.5951695
1	2024	All	All	53	53027	Rollers	23	100	Rollers100		2.11468951	0.038850804
1	2024	All	All	53	53027	Rollers	23	110	Rollers110		2.051249041	0.037685284
1	2024	All	All	53	53027	Paving Equipment	23	1	Paving Equipment1		3.387338775	0.082623875
1	2024	All	All	53	53027	Paving Equipment	23	2	Paving Equipment2		16.7586929	0.408777582
1	2024	All	All	53	53027	Paving Equipment	23	3	Paving Equipment3		50.0890405	1.221770517
1	2024	All	All	53	53027	Paving Equipment	23	5	Paving Equipment5		0.308034098	0.007513559
1	2024	All	All	53	53027	Paving Equipment	23	31	Paving Equipment31		0.064241166	0.001566969
1	2024	All	All	53	53027	Paving Equipment	23	79	Paving Equipment79		3.079303944	0.075110298
1	2024	All	All	53	53027	Paving Equipment	23	80	Paving Equipment80		3.730053308	0.090983359
1	2024	All	All	53	53027	Paving Equipment	23	86	Paving Equipment86		4.03808722	0.098496914
1	2024	All	All	53	53027	Paving Equipment	23	87	Paving Equipment87		3.715780389	0.090635214
1	2024	All	All	53	53027	Paving Equipment	23	90	Paving Equipment90		22814.29051	556.485555
1	2024	All	All	53	53027	Paving Equipment	23	100	Paving Equipment100		2.508163668	0.06117906
1	2024	All	All	53	53027	Paving Equipment	23	110	Paving Equipment110		2.432919182	0.059343699
1	2024	All	All	53	53027	Surfacing Equipment	23	1	Surfacing Equipment1		10.86484654	0.168333342
1	2024	All	All	53	53027	Surfacing Equipment	23	2	Surfacing Equipment2		79.89259711	1.237807442
1	2024	All	All	53	53027	Surfacing Equipment	23	3	Surfacing Equipment3		194.9740107	3.020809063
1	2024	All	All	53	53027	Surfacing Equipment	23	5	Surfacing Equipment5		0.711991734	0.011031168
1	2024	All	All	53	53027	Surfacing Equipment	23	31	Surfacing Equipment31		0.115793438	0.001794033
1	2024	All	All	53	53027	Surfacing Equipment	23	79	Surfacing Equipment79		10.15285441	0.157302168
1	2024	All	All	53	53027	Surfacing Equipment	23	80	Surfacing Equipment80		11.90131783	0.1843918
1	2024	All	All	53	53027	Surfacing Equipment	23	86	Surfacing Equipment86		12.61331662	0.195423077
1	2024	All	All	53	53027	Surfacing Equipment	23	87	Surfacing Equipment87		11.86905159	0.183891886
1	2024	All	All	53	53027	Surfacing Equipment	23	90	Surfacing Equipment90		35828.33622	555.1025104
1	2024	All	All	53	53027	Surfacing Equipment	23	100	Surfacing Equipment100		10.66184856	0.165188215
1	2024	All	All	53	53027	Surfacing Equipment	23	110	Surfacing Equipment110		10.3419899	0.160232519
1	2024	All	All	53	53027	Signal Boards/Light Plants	23	1	Signal Boards/Light Plants1		2.913559102	0.281982059
1	2024	All	All	53	53027	Signal Boards/Light Plants	23	2	Signal Boards/Light Plants2		13.09364447	1.267238004
1	2024	All	All	53	53027	Signal Boards/Light Plants	23	3	Signal Boards/Light Plants3		36.46892565	3.529560366
1	2024	All	All	53	53027	Signal Boards/Light Plants	23	5	Signal Boards/Light Plants5		0.276894875	0.026798628
1	2024	All	All	53	53027	Signal Boards/Light Plants	23	31	Signal Boards/Light Plants31		0.020585318	0.001992302
1	2024	All	All	53	53027	Signal Boards/Light Plants	23	79	Signal Boards/Light Plants79		2.636664487	0.255183456
1	2024	All	All	53	53027	Signal Boards/Light Plants	23	80	Signal Boards/Light Plants80		3.222059112	0.311839516
1	2024	All	All	53	53027	Signal Boards/Light Plants	23	86	Signal Boards/Light Plants86		3.498952318	0.338637983

Appendix A
Emissions Calculations

MOVESRunID	Year	Month	Day	State	County	Equipment Description	Fuel	Pollutant	EqPollID	Process	Emission Factor, g/hr	Emission Factor, g/hp-hr
1	2024	All	All	53	53027	Signal Boards/Light Plants	23	87	Signal Boards/Light Plants87		3.220329579	0.311672127
1	2024	All	All	53	53027	Signal Boards/Light Plants	23	90	Signal Boards/Light Plants90		6056.662115	586.1799921
1	2024	All	All	53	53027	Signal Boards/Light Plants	23	100	Signal Boards/Light Plants100		1.627539061	0.157517592
1	2024	All	All	53	53027	Signal Boards/Light Plants	23	110	Signal Boards/Light Plants110		1.578712094	0.152791988
1	2024	All	All	53	53027	Trenchers	23	1	Trenchers1		4.236682213	0.094660681
1	2024	All	All	53	53027	Trenchers	23	2	Trenchers2		27.24414254	0.608719028
1	2024	All	All	53	53027	Trenchers	23	3	Trenchers3		95.10462737	2.124933695
1	2024	All	All	53	53027	Trenchers	23	5	Trenchers5		0.407180717	0.009097686
1	2024	All	All	53	53027	Trenchers	23	31	Trenchers31		0.072921844	0.001629301
1	2024	All	All	53	53027	Trenchers	23	79	Trenchers79		3.82950106	0.085562985
1	2024	All	All	53	53027	Trenchers	23	80	Trenchers80		4.591835198	0.102595905
1	2024	All	All	53	53027	Trenchers	23	86	Trenchers86		4.999015534	0.111693582
1	2024	All	All	53	53027	Trenchers	23	87	Trenchers87		4.575947011	0.102240913
1	2024	All	All	53	53027	Trenchers	23	90	Trenchers90		25847.33549	577.5100089
1	2024	All	All	53	53027	Trenchers	23	100	Trenchers100		3.562702311	0.07960187
1	2024	All	All	53	53027	Trenchers	23	110	Trenchers110		3.455820231	0.077213791
1	2024	All	All	53	53027	Bore/Drill Rigs	23	1	Bore/Drill Rigs1		23.98300397	0.315872016
1	2024	All	All	53	53027	Bore/Drill Rigs	23	2	Bore/Drill Rigs2		103.9531992	1.36913812
1	2024	All	All	53	53027	Bore/Drill Rigs	23	3	Bore/Drill Rigs3		353.4441602	4.655224005
1	2024	All	All	53	53027	Bore/Drill Rigs	23	5	Bore/Drill Rigs5		1.322569297	0.017421214
1	2024	All	All	53	53027	Bore/Drill Rigs	23	31	Bore/Drill Rigs31		0.147565475	0.001943864
1	2024	All	All	53	53027	Bore/Drill Rigs	23	79	Bore/Drill Rigs79		22.66043837	0.29845085
1	2024	All	All	53	53027	Bore/Drill Rigs	23	80	Bore/Drill Rigs80		26.21477581	0.345266828
1	2024	All	All	53	53027	Bore/Drill Rigs	23	86	Bore/Drill Rigs86		27.53734524	0.362688043
1	2024	All	All	53	53027	Bore/Drill Rigs	23	87	Bore/Drill Rigs87		26.14743479	0.344379949
1	2024	All	All	53	53027	Bore/Drill Rigs	23	90	Bore/Drill Rigs90		40938.15184	539.297281
1	2024	All	All	53	53027	Bore/Drill Rigs	23	100	Bore/Drill Rigs100		18.02136273	0.237352428
1	2024	All	All	53	53027	Bore/Drill Rigs	23	110	Bore/Drill Rigs110		17.48072074	0.23023184
1	2024	All	All	53	53027	Concrete/Industrial Saws	23	1	Concrete/Industrial Saws1		2.938699088	0.104682288
1	2024	All	All	53	53027	Concrete/Industrial Saws	23	2	Concrete/Industrial Saws2		17.03872313	0.606953098
1	2024	All	All	53	53027	Concrete/Industrial Saws	23	3	Concrete/Industrial Saws3		61.01565852	2.173498723
1	2024	All	All	53	53027	Concrete/Industrial Saws	23	5	Concrete/Industrial Saws5		0.297674342	0.01060375
1	2024	All	All	53	53027	Concrete/Industrial Saws	23	31	Concrete/Industrial Saws31		0.046376709	0.00165203
1	2024	All	All	53	53027	Concrete/Industrial Saws	23	79	Concrete/Industrial Saws79		2.641025265	0.094078556
1	2024	All	All	53	53027	Concrete/Industrial Saws	23	80	Concrete/Industrial Saws80		3.19593561	0.113845563
1	2024	All	All	53	53027	Concrete/Industrial Saws	23	86	Concrete/Industrial Saws86		3.493608045	0.124449245
1	2024	All	All	53	53027	Concrete/Industrial Saws	23	87	Concrete/Industrial Saws87		3.188238272	0.113571368
1	2024	All	All	53	53027	Concrete/Industrial Saws	23	90	Concrete/Industrial Saws90		16610.29891	591.691778
1	2024	All	All	53	53027	Concrete/Industrial Saws	23	100	Concrete/Industrial Saws100		2.089253118	0.074423338
1	2024	All	All	53	53027	Concrete/Industrial Saws	23	110	Concrete/Industrial Saws110		2.026576293	0.072190665
1	2024	All	All	53	53027	Cement & Mortar Mixers	23	1	Cement & Mortar Mixers1		6.394186649	0.474445406
1	2024	All	All	53	53027	Cement & Mortar Mixers	23	2	Cement & Mortar Mixers2		30.9654351	2.297497814
1	2024	All	All	53	53027	Cement & Mortar Mixers	23	3	Cement & Mortar Mixers3		68.24320489	5.063676415
1	2024	All	All	53	53027	Cement & Mortar Mixers	23	5	Cement & Mortar Mixers5		0.328983098	0.024422371
1	2024	All	All	53	53027	Cement & Mortar Mixers	23	31	Cement & Mortar Mixers31		0.027788857	0.002062336
1	2024	All	All	53	53027	Cement & Mortar Mixers	23	79	Cement & Mortar Mixers79		6.065202472	0.450022955
1	2024	All	All	53	53027	Cement & Mortar Mixers	23	80	Cement & Mortar Mixers80		6.981147286	0.518002563
1	2024	All	All	53	53027	Cement & Mortar Mixers	23	86	Cement & Mortar Mixers86		7.310129887	0.542424898
1	2024	All	All	53	53027	Cement & Mortar Mixers	23	87	Cement & Mortar Mixers87		6.962326877	0.516606792
1	2024	All	All	53	53027	Cement & Mortar Mixers	23	90	Cement & Mortar Mixers90		7593.570355	563.5761541
1	2024	All	All	53	53027	Cement & Mortar Mixers	23	100	Cement & Mortar Mixers100		4.923966648	0.365309557
1	2024	All	All	53	53027	Cement & Mortar Mixers	23	110	Cement & Mortar Mixers110		4.776248413	0.354350327
1	2024	All	All	53	53027	Cranes	23	1	Cranes1		4.251607257	0.04281082
1	2024	All	All	53	53027	Cranes	23	2	Cranes2		19.739143	0.198759868
1	2024	All	All	53	53027	Cranes	23	3	Cranes3		79.98594561	0.80540457
1	2024	All	All	53	53027	Cranes	23	5	Cranes5		0.317017012	0.003192148
1	2024	All	All	53	53027	Cranes	23	31	Cranes31		0.148390632	0.001494194
1	2024	All	All	53	53027	Cranes	23	79	Cranes79		3.934591755	0.039618687
1	2024	All	All	53	53027	Cranes	23	80	Cranes80		4.691300639	0.047238236
1	2024	All	All	53	53027	Cranes	23	86	Cranes86		5.00831922	0.050430399
1	2024	All	All	53	53027	Cranes	23	87	Cranes87		4.641215129	0.046733909
1	2024	All	All	53	53027	Cranes	23	90	Cranes90		52954.27574	533.2138711
1	2024	All	All	53	53027	Cranes	23	100	Cranes100		3.506368765	0.035306771
1	2024	All	All	53	53027	Cranes	23	110	Cranes110		3.401178367	0.034247574
1	2024	All	All	53	53027	Crushing/Proc. Equipment	23	1	Crushing/Proc. Equipment1		4.170871504	0.063487611
1	2024	All	All	53	53027	Crushing/Proc. Equipment	23	2	Crushing/Proc. Equipment2		20.81035075	0.316768197
1	2024	All	All	53	53027	Crushing/Proc. Equipment	23	3	Crushing/Proc. Equipment3		96.14589578	1.463500659
1	2024	All	All	53	53027	Crushing/Proc. Equipment	23	5	Crushing/Proc. Equipment5		0.364337757	0.005545827
1	2024	All	All	53	53027	Crushing/Proc. Equipment	23	31	Crushing/Proc. Equipment31		0.102251793	0.001556443
1	2024	All	All	53	53027	Crushing/Proc. Equipment	23	79	Crushing/Proc. Equipment79		3.806532119	0.057941758
1	2024	All	All	53	53027	Crushing/Proc. Equipment	23	80	Crushing/Proc. Equipment80		4.553558494	0.069312744
1	2024	All	All	53	53027	Crushing/Proc. Equipment	23	86	Crushing/Proc. Equipment86		4.917897036	0.074858583
1	2024	All	All	53	53027	Crushing/Proc. Equipment	23	87	Crushing/Proc. Equipment87		4.525043639	0.0688787
1	2024	All	All	53	53027	Crushing/Proc. Equipment	23	90	Crushing/Proc. Equipment90		35845.39722	545.626644
1	2024	All	All	53	53027	Crushing/Proc. Equipment	23	100	Crushing/Proc. Equipment100		3.19443648	0.048624643
1	2024	All	All	53	53027	Crushing/Proc. Equipment	23	110	Crushing/Proc. Equipment110		3.098601893	0.047165881
1	2024	All	All	53	53027	Rubber Tire Loaders	23	1	Rubber Tire Loaders1		6.505396905	0.045446328
1	2024	All	All	53	53027	Rubber Tire Loaders	23	2	Rubber Tire Loaders2		41.57616307	0.290448677
1	2024	All	All	53	53027	Rubber Tire Loaders	23	3	Rubber Tire Loaders3		140.5373586	0.981785883
1	2024	All	All	53	53027	Rubber Tire Loaders	23	5	Rubber Tire Loaders5		0.454487686	0.003175025

Appendix A
Emissions Calculations

MOVESRunID	Year	Month	Day	State	County	Equipment Description	Fuel	Pollutant	EqPollID	Process	Emission Factor, g/hr	Emission Factor, g/hp-hr
1	2024	All	All	53	53027	Rubber Tire Loaders	23	31	Rubber Tire Loaders31		0.216212306	0.001510447
1	2024	All	All	53	53027	Rubber Tire Loaders	23	79	Rubber Tire Loaders79		6.050908237	0.042271296
1	2024	All	All	53	53027	Rubber Tire Loaders	23	80	Rubber Tire Loaders80		7.163707604	0.050045248
1	2024	All	All	53	53027	Rubber Tire Loaders	23	86	Rubber Tire Loaders86		7.618194263	0.053220266
1	2024	All	All	53	53027	Rubber Tire Loaders	23	87	Rubber Tire Loaders87		7.093602955	0.049555501
1	2024	All	All	53	53027	Rubber Tire Loaders	23	90	Rubber Tire Loaders90		77283.67577	539.8993019
1	2024	All	All	53	53027	Rubber Tire Loaders	23	100	Rubber Tire Loaders100		6.866003573	0.047965505
1	2024	All	All	53	53027	Rubber Tire Loaders	23	110	Rubber Tire Loaders110		6.66002959	0.046526583
1	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	1	Tractors/Loaders/Backhoes1		12.12694328	0.617892296
1	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	2	Tractors/Loaders/Backhoes2		63.47281411	3.234068302
1	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	3	Tractors/Loaders/Backhoes3		71.5895125	3.647630507
1	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	5	Tractors/Loaders/Backhoes5		0.738070343	0.037606177
1	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	31	Tractors/Loaders/Backhoes31		0.042675885	0.002174423
1	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	79	Tractors/Loaders/Backhoes79		11.38886182	0.580285553
1	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	80	Tractors/Loaders/Backhoes80		13.30684913	0.678010886
1	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	86	Tractors/Loaders/Backhoes86		14.04492793	0.715617495
1	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	87	Tractors/Loaders/Backhoes87		13.27492364	0.676384218
1	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	90	Tractors/Loaders/Backhoes90		13033.85679	664.1013744
1	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	100	Tractors/Loaders/Backhoes100		9.50463894	0.484280584
1	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	110	Tractors/Loaders/Backhoes110		9.219498595	0.469752107
1	2024	All	All	53	53027	Skid Steer Loaders	23	1	Skid Steer Loaders1		12.19562132	1.05594139
1	2024	All	All	53	53027	Skid Steer Loaders	23	2	Skid Steer Loaders2		68.32394165	5.91585645
1	2024	All	All	53	53027	Skid Steer Loaders	23	3	Skid Steer Loaders3		62.91669435	5.44777745
1	2024	All	All	53	53027	Skid Steer Loaders	23	5	Skid Steer Loaders5		0.555764005	0.04812335
1	2024	All	All	53	53027	Skid Steer Loaders	23	31	Skid Steer Loaders31		0.028192711	0.00244121
1	2024	All	All	53	53027	Skid Steer Loaders	23	79	Skid Steer Loaders79		11.63985566	1.007817896
1	2024	All	All	53	53027	Skid Steer Loaders	23	80	Skid Steer Loaders80		13.29196257	1.150868181
1	2024	All	All	53	53027	Skid Steer Loaders	23	86	Skid Steer Loaders86		13.84772557	1.198991446
1	2024	All	All	53	53027	Skid Steer Loaders	23	87	Skid Steer Loaders87		13.24962471	1.147202563
1	2024	All	All	53	53027	Skid Steer Loaders	23	90	Skid Steer Loaders90		7989.031297	691.7813641
1	2024	All	All	53	53027	Skid Steer Loaders	23	100	Skid Steer Loaders100		9.557808818	0.827558412
1	2024	All	All	53	53027	Skid Steer Loaders	23	110	Skid Steer Loaders110		9.271073113	0.802731535
1	2024	All	All	53	53027	Dumpers/Tenders	23	1	Dumpers/Tenders1		7.986601142	1.144168625
1	2024	All	All	53	53027	Dumpers/Tenders	23	2	Dumpers/Tenders2		40.6530195	5.824057216
1	2024	All	All	53	53027	Dumpers/Tenders	23	3	Dumpers/Tenders3		38.51944913	5.519089064
1	2024	All	All	53	53027	Dumpers/Tenders	23	5	Dumpers/Tenders5		0.382248183	0.054773631
1	2024	All	All	53	53027	Dumpers/Tenders	23	31	Dumpers/Tenders31		0.017221466	0.002467803
1	2024	All	All	53	53027	Dumpers/Tenders	23	79	Dumpers/Tenders79		7.604353757	1.089395108
1	2024	All	All	53	53027	Dumpers/Tenders	23	80	Dumpers/Tenders80		8.700633856	1.246466542
1	2024	All	All	53	53027	Dumpers/Tenders	23	86	Dumpers/Tenders86		9.082883671	1.301240406
1	2024	All	All	53	53027	Dumpers/Tenders	23	87	Dumpers/Tenders87		8.675753714	1.242902889
1	2024	All	All	53	53027	Dumpers/Tenders	23	90	Dumpers/Tenders90		4760.026808	682.1311939
1	2024	All	All	53	53027	Dumpers/Tenders	23	100	Dumpers/Tenders100		5.987025354	0.857698213
1	2024	All	All	53	53027	Dumpers/Tenders	23	110	Dumpers/Tenders110		5.807413122	0.831967057
1	2024	All	All	53	53027	Other Construction Equipm	23	1	Other Construction Equipment1		23.40941275	0.120795132
1	2024	All	All	53	53027	Other Construction Equipm	23	2	Other Construction Equipment2		189.2077905	0.976332907
1	2024	All	All	53	53027	Other Construction Equipm	23	3	Other Construction Equipment3		424.6165402	2.191067819
1	2024	All	All	53	53027	Other Construction Equipm	23	5	Other Construction Equipment5		1.574181067	0.008122947
1	2024	All	All	53	53027	Other Construction Equipm	23	31	Other Construction Equipment31		0.329692216	0.001701248
1	2024	All	All	53	53027	Other Construction Equipm	23	79	Other Construction Equipment79		21.83523032	0.112672178
1	2024	All	All	53	53027	Other Construction Equipm	23	80	Other Construction Equipment80		25.71963828	0.132716148
1	2024	All	All	53	53027	Other Construction Equipm	23	86	Other Construction Equipment86		27.2938073	0.140839033
1	2024	All	All	53	53027	Other Construction Equipm	23	87	Other Construction Equipment87		25.62121628	0.13220828
1	2024	All	All	53	53027	Other Construction Equipm	23	90	Other Construction Equipment90		104157.8674	537.4659954
1	2024	All	All	53	53027	Other Construction Equipm	23	100	Other Construction Equipment100		26.39173024	0.136184216
1	2024	All	All	53	53027	Other Construction Equipm	23	110	Other Construction Equipment110		25.59998114	0.132098704
1	2024	All	All	53	53027	Scrapers	23	1	Scrapers1		7.03723819	0.029133443
1	2024	All	All	53	53027	Scrapers	23	2	Scrapers2		54.78963175	0.226823443
1	2024	All	All	53	53027	Scrapers	23	3	Scrapers3		125.6025024	0.519981449
1	2024	All	All	53	53027	Scrapers	23	5	Scrapers5		0.534313047	0.002212001
1	2024	All	All	53	53027	Scrapers	23	31	Scrapers31		0.357059499	0.00147819
1	2024	All	All	53	53027	Scrapers	23	79	Scrapers79		6.502929551	0.02692146
1	2024	All	All	53	53027	Scrapers	23	80	Scrapers80		7.781443415	0.032214376
1	2024	All	All	53	53027	Scrapers	23	86	Scrapers86		8.315756718	0.034426378
1	2024	All	All	53	53027	Scrapers	23	87	Scrapers87		7.636486115	0.031614268
1	2024	All	All	53	53027	Scrapers	23	90	Scrapers90		129650.8662	536.7412586
1	2024	All	All	53	53027	Scrapers	23	100	Scrapers100		7.782767184	0.032219856
1	2024	All	All	53	53027	Scrapers	23	110	Scrapers110		7.549282495	0.031253253
1	2024	All	All	53	53027	Excavators	23	1	Excavators1		1.841732402	0.018233318
1	2024	All	All	53	53027	Excavators	23	2	Excavators2		9.55207782	0.094566439
1	2024	All	All	53	53027	Excavators	23	3	Excavators3		42.02657078	0.416066873
1	2024	All	All	53	53027	Excavators	23	5	Excavators5		0.155532849	0.001539789
1	2024	All	All	53	53027	Excavators	23	31	Excavators31		0.146209385	0.001447486
1	2024	All	All	53	53027	Excavators	23	79	Excavators79		1.686199099	0.016693524
1	2024	All	All	53	53027	Excavators	23	80	Excavators80		2.019458586	0.019992824
1	2024	All	All	53	53027	Excavators	23	86	Excavators86		2.174991231	0.021532611
1	2024	All	All	53	53027	Excavators	23	87	Excavators87		1.972778724	0.019530689
1	2024	All	All	53	53027	Excavators	23	90	Excavators90		54736.32613	541.8946069
1	2024	All	All	53	53027	Excavators	23	100	Excavators100		1.9057022	0.018866625
1	2024	All	All	53	53027	Excavators	23	110	Excavators110		1.848531499	0.01830063

Appendix A
Emissions Calculations

MOVESRunID	Year	Month	Day	State	County	Equipment Description	Fuel	Pollutant	EqPollID	Process	Emission Factor, g/hr	Emission Factor, g/hp-hr
1	2024	All	All	53	53027	Graders	23	1	Graders1		2.014610033	0.016707491
1	2024	All	All	53	53027	Graders	23	2	Graders2		10.72049928	0.088906855
1	2024	All	All	53	53027	Graders	23	3	Graders3		32.25865271	0.267526287
1	2024	All	All	53	53027	Graders	23	5	Graders5		0.145688094	0.001208215
1	2024	All	All	53	53027	Graders	23	31	Graders31		0.173567921	0.001439427
1	2024	All	All	53	53027	Graders	23	79	Graders79		1.868922944	0.015499284
1	2024	All	All	53	53027	Graders	23	80	Graders80		2.22175429	0.018425372
1	2024	All	All	53	53027	Graders	23	86	Graders86		2.367441606	0.019633581
1	2024	All	All	53	53027	Graders	23	87	Graders87		2.156978411	0.017888175
1	2024	All	All	53	53027	Graders	23	90	Graders90		64831.62815	537.6593047
1	2024	All	All	53	53027	Graders	23	100	Graders100		2.366257365	0.01962376
1	2024	All	All	53	53027	Graders	23	110	Graders110		2.295270341	0.019035053
1	2024	All	All	53	53027	Off-highway Trucks	23	1	Off-highway Trucks1		12.92127792	0.027969701
1	2024	All	All	53	53027	Off-highway Trucks	23	2	Off-highway Trucks2		44.63022815	0.096607637
1	2024	All	All	53	53027	Off-highway Trucks	23	3	Off-highway Trucks3		661.6957031	1.432322014
1	2024	All	All	53	53027	Off-highway Trucks	23	5	Off-highway Trucks5		1.182708107	0.002560118
1	2024	All	All	53	53027	Off-highway Trucks	23	31	Off-highway Trucks31		0.661196363	0.001431241
1	2024	All	All	53	53027	Off-highway Trucks	23	79	Off-highway Trucks79		11.73858233	0.02540961
1	2024	All	All	53	53027	Off-highway Trucks	23	80	Off-highway Trucks80		14.3269399	0.03101243
1	2024	All	All	53	53027	Off-highway Trucks	23	86	Off-highway Trucks86		15.50964133	0.033572533
1	2024	All	All	53	53027	Off-highway Trucks	23	87	Off-highway Trucks87		14.20618369	0.030751038
1	2024	All	All	53	53027	Off-highway Trucks	23	90	Off-highway Trucks90		247961.1142	536.7424345
1	2024	All	All	53	53027	Off-highway Trucks	23	100	Off-highway Trucks100		10.35702712	0.022419063
1	2024	All	All	53	53027	Off-highway Trucks	23	110	Off-highway Trucks110		10.046321	0.021746502
1	2024	All	All	53	53027	Rough Terrain Forklifts	23	1	Rough Terrain Forklifts1		2.956862577	0.051769471
1	2024	All	All	53	53027	Rough Terrain Forklifts	23	2	Rough Terrain Forklifts2		20.31097913	0.355609573
1	2024	All	All	53	53027	Rough Terrain Forklifts	23	3	Rough Terrain Forklifts3		64.37862254	1.127156616
1	2024	All	All	53	53027	Rough Terrain Forklifts	23	5	Rough Terrain Forklifts5		0.248485457	0.004350544
1	2024	All	All	53	53027	Rough Terrain Forklifts	23	31	Rough Terrain Forklifts31		0.089481911	0.001566671
1	2024	All	All	53	53027	Rough Terrain Forklifts	23	79	Rough Terrain Forklifts79		2.708377038	0.047418925
1	2024	All	All	53	53027	Rough Terrain Forklifts	23	80	Rough Terrain Forklifts80		3.247263224	0.056853876
1	2024	All	All	53	53027	Rough Terrain Forklifts	23	86	Rough Terrain Forklifts86		3.495747023	0.061204391
1	2024	All	All	53	53027	Rough Terrain Forklifts	23	87	Rough Terrain Forklifts87		3.231088241	0.056570681
1	2024	All	All	53	53027	Rough Terrain Forklifts	23	90	Rough Terrain Forklifts90		32529.41579	569.5329408
1	2024	All	All	53	53027	Rough Terrain Forklifts	23	100	Rough Terrain Forklifts100		2.987587343	0.052307407
1	2024	All	All	53	53027	Rough Terrain Forklifts	23	110	Rough Terrain Forklifts110		2.897960716	0.050738203
1	2024	All	All	53	53027	Crawler Tractor/Dozers	23	1	Crawler Tractor/Dozers1		4.25026303	0.027723804
1	2024	All	All	53	53027	Crawler Tractor/Dozers	23	2	Crawler Tractor/Dozers2		26.70498005	0.174192425
1	2024	All	All	53	53027	Crawler Tractor/Dozers	23	3	Crawler Tractor/Dozers3		108.1651354	0.705544329
1	2024	All	All	53	53027	Crawler Tractor/Dozers	23	5	Crawler Tractor/Dozers5		0.311683893	0.002033065
1	2024	All	All	53	53027	Crawler Tractor/Dozers	23	31	Crawler Tractor/Dozers31		0.225182026	0.001468827
1	2024	All	All	53	53027	Crawler Tractor/Dozers	23	79	Crawler Tractor/Dozers79		3.938579255	0.025690739
1	2024	All	All	53	53027	Crawler Tractor/Dozers	23	80	Crawler Tractor/Dozers80		4.693346764	0.03061397
1	2024	All	All	53	53027	Crawler Tractor/Dozers	23	86	Crawler Tractor/Dozers86		5.005028217	0.032647019
1	2024	All	All	53	53027	Crawler Tractor/Dozers	23	87	Crawler Tractor/Dozers87		4.621128642	0.030142902
1	2024	All	All	53	53027	Crawler Tractor/Dozers	23	90	Crawler Tractor/Dozers90		82745.58782	539.7365803
1	2024	All	All	53	53027	Crawler Tractor/Dozers	23	100	Crawler Tractor/Dozers100		4.707088995	0.030703608
1	2024	All	All	53	53027	Crawler Tractor/Dozers	23	110	Crawler Tractor/Dozers110		4.565874064	0.029782485
1	2024	All	All	53	53027	Off-Highway Tractors	23	1	Off-Highway Tractors1		23.55818351	0.055105136
1	2024	All	All	53	53027	Off-Highway Tractors	23	2	Off-Highway Tractors2		144.0891644	0.33704012
1	2024	All	All	53	53027	Off-Highway Tractors	23	3	Off-Highway Tractors3		697.6803277	1.63194965
1	2024	All	All	53	53027	Off-Highway Tractors	23	5	Off-Highway Tractors5		1.495464556	0.003498053
1	2024	All	All	53	53027	Off-Highway Tractors	23	31	Off-Highway Tractors31		0.644813411	0.001508288
1	2024	All	All	53	53027	Off-Highway Tractors	23	79	Off-Highway Tractors79		22.06270877	0.051607059
1	2024	All	All	53	53027	Off-Highway Tractors	23	80	Off-Highway Tractors80		25.95412184	0.060709495
1	2024	All	All	53	53027	Off-Highway Tractors	23	86	Off-Highway Tractors86		27.4495926	0.064207562
1	2024	All	All	53	53027	Off-Highway Tractors	23	87	Off-Highway Tractors87		25.76861024	0.060275563
1	2024	All	All	53	53027	Off-Highway Tractors	23	90	Off-Highway Tractors90		229428.0996	536.6571076
1	2024	All	All	53	53027	Off-Highway Tractors	23	100	Off-Highway Tractors100		22.11558187	0.051730735
1	2024	All	All	53	53027	Off-Highway Tractors	23	110	Off-Highway Tractors110		21.45213263	0.050178855
2	2024	All	All	53	53027	Pavers	23	1	Pavers1		2.078842582	0.028335951
2	2024	All	All	53	53027	Pavers	23	2	Pavers2		12.47054615	0.169981501
2	2024	All	All	53	53027	Pavers	23	3	Pavers3		53.30495457	0.726580543
2	2024	All	All	53	53027	Pavers	23	5	Pavers5		0.219467364	0.00299148
2	2024	All	All	53	53027	Pavers	23	31	Pavers31		0.108991673	0.001485626
2	2024	All	All	53	53027	Pavers	23	79	Pavers79		1.859374917	0.025344467
2	2024	All	All	53	53027	Pavers	23	80	Pavers80		2.255689911	0.030746493
2	2024	All	All	53	53027	Pavers	23	86	Pavers86		2.475155581	0.03373795
2	2024	All	All	53	53027	Pavers	23	87	Pavers87		2.226572283	0.030349601
2	2024	All	All	53	53027	Pavers	23	90	Pavers90		40404.3287	550.7367807
2	2024	All	All	53	53027	Pavers	23	100	Pavers100		2.232405648	0.030429113
2	2024	All	All	53	53027	Pavers	23	110	Pavers110		2.165432798	0.029516231
2	2024	All	All	53	53027	Tampers/Rammers	23	1	Tampers/Rammers1		1.343027697	0.743647694
2	2024	All	All	53	53027	Tampers/Rammers	23	2	Tampers/Rammers2		4.831090276	2.675022378
2	2024	All	All	53	53027	Tampers/Rammers	23	3	Tampers/Rammers3		7.717751862	4.273395396
2	2024	All	All	53	53027	Tampers/Rammers	23	5	Tampers/Rammers5		0.126150175	0.069850597
2	2024	All	All	53	53027	Tampers/Rammers	23	31	Tampers/Rammers31		0.003904608	0.00216202
2	2024	All	All	53	53027	Tampers/Rammers	23	79	Tampers/Rammers79		1.216877397	0.673797028
2	2024	All	All	53	53027	Tampers/Rammers	23	80	Tampers/Rammers80		1.491642389	0.825937116
2	2024	All	All	53	53027	Tampers/Rammers	23	86	Tampers/Rammers86		1.617792736	0.895787809

Appendix A
Emissions Calculations

MOVESRunID	Year	Month	Day	State	County	Equipment Description	Fuel	Pollutant	EqPollID	Process	Emission Factor, g/hr	Emission Factor, g/hp-hr
2	2024	All	All	53	53027	Tampers/Rammers	23	87	Tampers/Rammers87		1.491267623	0.825729604
2	2024	All	All	53	53027	Tampers/Rammers	23	90	Tampers/Rammers90		1061.932927	588.0027448
2	2024	All	All	53	53027	Tampers/Rammers	23	100	Tampers/Rammers100		0.508906834	0.281786738
2	2024	All	All	53	53027	Tampers/Rammers	23	110	Tampers/Rammers110		0.493639728	0.273333191
2	2024	All	All	53	53027	Plate Compactors	23	1	Plate Compactors1		1.971359988	0.608731522
2	2024	All	All	53	53027	Plate Compactors	23	2	Plate Compactors2		7.376050646	2.277632984
2	2024	All	All	53	53027	Plate Compactors	23	3	Plate Compactors3		13.33030638	4.116233327
2	2024	All	All	53	53027	Plate Compactors	23	5	Plate Compactors5		0.186882557	0.057707016
2	2024	All	All	53	53027	Plate Compactors	23	31	Plate Compactors31		0.007006864	0.002163633
2	2024	All	All	53	53027	Plate Compactors	23	79	Plate Compactors79		1.784476717	0.551024285
2	2024	All	All	53	53027	Plate Compactors	23	80	Plate Compactors80		2.190042798	0.676258062
2	2024	All	All	53	53027	Plate Compactors	23	86	Plate Compactors86		2.376924664	0.733964865
2	2024	All	All	53	53027	Plate Compactors	23	87	Plate Compactors87		2.189618333	0.676126992
2	2024	All	All	53	53027	Plate Compactors	23	90	Plate Compactors90		1905.619469	588.4316642
2	2024	All	All	53	53027	Plate Compactors	23	100	Plate Compactors100		0.787956655	0.243311245
2	2024	All	All	53	53027	Plate Compactors	23	110	Plate Compactors110		0.764317812	0.236011864
2	2024	All	All	53	53027	Rollers	23	1	Rollers1		2.35356573	0.043239407
2	2024	All	All	53	53027	Rollers	23	2	Rollers2		13.8796057	0.254994334
2	2024	All	All	53	53027	Rollers	23	3	Rollers3		52.61980993	0.966724394
2	2024	All	All	53	53027	Rollers	23	5	Rollers5		0.237048118	0.004355018
2	2024	All	All	53	53027	Rollers	23	31	Rollers31		0.08332103	0.001530763
2	2024	All	All	53	53027	Rollers	23	79	Rollers79		2.116517239	0.038884383
2	2024	All	All	53	53027	Rollers	23	80	Rollers80		2.577362257	0.047350969
2	2024	All	All	53	53027	Rollers	23	86	Rollers86		2.814410578	0.05170599
2	2024	All	All	53	53027	Rollers	23	87	Rollers87		2.559922792	0.047030573
2	2024	All	All	53	53027	Rollers	23	90	Rollers90		30459.34461	559.5951695
2	2024	All	All	53	53027	Rollers	23	100	Rollers100		2.11468951	0.038850804
2	2024	All	All	53	53027	Rollers	23	110	Rollers110		2.051249041	0.037685284
2	2024	All	All	53	53027	Paving Equipment	23	1	Paving Equipment1		3.387338775	0.082623875
2	2024	All	All	53	53027	Paving Equipment	23	2	Paving Equipment2		16.7586929	0.408777582
2	2024	All	All	53	53027	Paving Equipment	23	3	Paving Equipment3		50.0890405	1.221770517
2	2024	All	All	53	53027	Paving Equipment	23	5	Paving Equipment5		0.308034098	0.007513559
2	2024	All	All	53	53027	Paving Equipment	23	31	Paving Equipment31		0.064241166	0.001566969
2	2024	All	All	53	53027	Paving Equipment	23	79	Paving Equipment79		3.079303944	0.075110298
2	2024	All	All	53	53027	Paving Equipment	23	80	Paving Equipment80		3.730053308	0.090983359
2	2024	All	All	53	53027	Paving Equipment	23	86	Paving Equipment86		4.03808722	0.098496914
2	2024	All	All	53	53027	Paving Equipment	23	87	Paving Equipment87		3.715780389	0.090635214
2	2024	All	All	53	53027	Paving Equipment	23	90	Paving Equipment90		22814.29051	556.485555
2	2024	All	All	53	53027	Paving Equipment	23	100	Paving Equipment100		2.508163668	0.06117906
2	2024	All	All	53	53027	Paving Equipment	23	110	Paving Equipment110		2.432919182	0.059343699
2	2024	All	All	53	53027	Surfacing Equipment	23	1	Surfacing Equipment1		10.86484654	0.168333342
2	2024	All	All	53	53027	Surfacing Equipment	23	2	Surfacing Equipment2		79.89259711	1.237807442
2	2024	All	All	53	53027	Surfacing Equipment	23	3	Surfacing Equipment3		194.9740107	3.020809063
2	2024	All	All	53	53027	Surfacing Equipment	23	5	Surfacing Equipment5		0.711991734	0.011031168
2	2024	All	All	53	53027	Surfacing Equipment	23	31	Surfacing Equipment31		0.115793438	0.001794033
2	2024	All	All	53	53027	Surfacing Equipment	23	79	Surfacing Equipment79		10.15285441	0.157302168
2	2024	All	All	53	53027	Surfacing Equipment	23	80	Surfacing Equipment80		11.90131783	0.1843918
2	2024	All	All	53	53027	Surfacing Equipment	23	86	Surfacing Equipment86		12.61331662	0.195423077
2	2024	All	All	53	53027	Surfacing Equipment	23	87	Surfacing Equipment87		11.86905159	0.183891886
2	2024	All	All	53	53027	Surfacing Equipment	23	90	Surfacing Equipment90		35828.33622	555.1025104
2	2024	All	All	53	53027	Surfacing Equipment	23	100	Surfacing Equipment100		10.66184856	0.165188215
2	2024	All	All	53	53027	Surfacing Equipment	23	110	Surfacing Equipment110		10.3419899	0.160232519
2	2024	All	All	53	53027	Signal Boards/Light Plants	23	1	Signal Boards/Light Plants1		2.913559102	0.281982059
2	2024	All	All	53	53027	Signal Boards/Light Plants	23	2	Signal Boards/Light Plants2		13.09364447	1.267238004
2	2024	All	All	53	53027	Signal Boards/Light Plants	23	3	Signal Boards/Light Plants3		36.46892565	3.529560366
2	2024	All	All	53	53027	Signal Boards/Light Plants	23	5	Signal Boards/Light Plants5		0.276894875	0.026798628
2	2024	All	All	53	53027	Signal Boards/Light Plants	23	31	Signal Boards/Light Plants31		0.020585318	0.001992302
2	2024	All	All	53	53027	Signal Boards/Light Plants	23	79	Signal Boards/Light Plants79		2.636664487	0.255183456
2	2024	All	All	53	53027	Signal Boards/Light Plants	23	80	Signal Boards/Light Plants80		3.222059112	0.311839516
2	2024	All	All	53	53027	Signal Boards/Light Plants	23	86	Signal Boards/Light Plants86		3.498952318	0.338637983
2	2024	All	All	53	53027	Signal Boards/Light Plants	23	87	Signal Boards/Light Plants87		3.220329579	0.311672127
2	2024	All	All	53	53027	Signal Boards/Light Plants	23	90	Signal Boards/Light Plants90		6056.662115	586.1799921
2	2024	All	All	53	53027	Signal Boards/Light Plants	23	100	Signal Boards/Light Plants100		1.627539061	0.157517592
2	2024	All	All	53	53027	Signal Boards/Light Plants	23	110	Signal Boards/Light Plants110		1.578712094	0.152791988
2	2024	All	All	53	53027	Trenchers	23	1	Trenchers1		4.236682213	0.094660681
2	2024	All	All	53	53027	Trenchers	23	2	Trenchers2		27.24414254	0.608719028
2	2024	All	All	53	53027	Trenchers	23	3	Trenchers3		95.10462737	2.124933695
2	2024	All	All	53	53027	Trenchers	23	5	Trenchers5		0.407180717	0.009097686
2	2024	All	All	53	53027	Trenchers	23	31	Trenchers31		0.072921844	0.001629301
2	2024	All	All	53	53027	Trenchers	23	79	Trenchers79		3.82950106	0.085562985
2	2024	All	All	53	53027	Trenchers	23	80	Trenchers80		4.591835198	0.102595905
2	2024	All	All	53	53027	Trenchers	23	86	Trenchers86		4.999015534	0.111693582
2	2024	All	All	53	53027	Trenchers	23	87	Trenchers87		4.575947011	0.102240913
2	2024	All	All	53	53027	Trenchers	23	90	Trenchers90		25847.33549	577.5100089
2	2024	All	All	53	53027	Trenchers	23	100	Trenchers100		3.562702311	0.07960187
2	2024	All	All	53	53027	Trenchers	23	110	Trenchers110		3.455820231	0.077213791
2	2024	All	All	53	53027	Bore/Drill Rigs	23	1	Bore/Drill Rigs1		23.98300397	0.315872016
2	2024	All	All	53	53027	Bore/Drill Rigs	23	2	Bore/Drill Rigs2		103.9531992	1.36913812
2	2024	All	All	53	53027	Bore/Drill Rigs	23	3	Bore/Drill Rigs3		353.4441602	4.655224005
2	2024	All	All	53	53027	Bore/Drill Rigs	23	5	Bore/Drill Rigs5		1.322569297	0.017421214

Appendix A
Emissions Calculations

MOVESRunID	Year	Month	Day	State	County	Equipment Description	Fuel	Pollutant	EqPollID	Process	Emission Factor, g/hr	Emission Factor, g/hp-hr
2	2024	All	All	53	53027	Bore/Drill Rigs	23	31	Bore/Drill Rigs31		0.147565475	0.001943864
2	2024	All	All	53	53027	Bore/Drill Rigs	23	79	Bore/Drill Rigs79		22.66043837	0.29845085
2	2024	All	All	53	53027	Bore/Drill Rigs	23	80	Bore/Drill Rigs80		26.21477581	0.345266828
2	2024	All	All	53	53027	Bore/Drill Rigs	23	86	Bore/Drill Rigs86		27.53734524	0.362688043
2	2024	All	All	53	53027	Bore/Drill Rigs	23	87	Bore/Drill Rigs87		26.14743479	0.344379949
2	2024	All	All	53	53027	Bore/Drill Rigs	23	90	Bore/Drill Rigs90		40938.15184	539.297281
2	2024	All	All	53	53027	Bore/Drill Rigs	23	100	Bore/Drill Rigs100		18.02136273	0.237352428
2	2024	All	All	53	53027	Bore/Drill Rigs	23	110	Bore/Drill Rigs110		17.48072074	0.23023184
2	2024	All	All	53	53027	Concrete/Industrial Saws	23	1	Concrete/Industrial Saws1		2.938699088	0.104682288
2	2024	All	All	53	53027	Concrete/Industrial Saws	23	2	Concrete/Industrial Saws2		17.03872313	0.606953098
2	2024	All	All	53	53027	Concrete/Industrial Saws	23	3	Concrete/Industrial Saws3		61.01565852	2.173498723
2	2024	All	All	53	53027	Concrete/Industrial Saws	23	5	Concrete/Industrial Saws5		0.297674342	0.01060375
2	2024	All	All	53	53027	Concrete/Industrial Saws	23	31	Concrete/Industrial Saws31		0.046376709	0.00165203
2	2024	All	All	53	53027	Concrete/Industrial Saws	23	79	Concrete/Industrial Saws79		2.641025265	0.094078556
2	2024	All	All	53	53027	Concrete/Industrial Saws	23	80	Concrete/Industrial Saws80		3.19593561	0.113845563
2	2024	All	All	53	53027	Concrete/Industrial Saws	23	86	Concrete/Industrial Saws86		3.493608045	0.124449245
2	2024	All	All	53	53027	Concrete/Industrial Saws	23	87	Concrete/Industrial Saws87		3.188238272	0.113571368
2	2024	All	All	53	53027	Concrete/Industrial Saws	23	90	Concrete/Industrial Saws90		16610.29891	591.691778
2	2024	All	All	53	53027	Concrete/Industrial Saws	23	100	Concrete/Industrial Saws100		2.089253118	0.074423338
2	2024	All	All	53	53027	Concrete/Industrial Saws	23	110	Concrete/Industrial Saws110		2.026576293	0.072190665
2	2024	All	All	53	53027	Cement & Mortar Mixers	23	1	Cement & Mortar Mixers1		6.394186649	0.474445406
2	2024	All	All	53	53027	Cement & Mortar Mixers	23	2	Cement & Mortar Mixers2		30.9654351	2.297497814
2	2024	All	All	53	53027	Cement & Mortar Mixers	23	3	Cement & Mortar Mixers3		68.24320489	5.063676415
2	2024	All	All	53	53027	Cement & Mortar Mixers	23	5	Cement & Mortar Mixers5		0.328983098	0.024422371
2	2024	All	All	53	53027	Cement & Mortar Mixers	23	31	Cement & Mortar Mixers31		0.027788857	0.002062336
2	2024	All	All	53	53027	Cement & Mortar Mixers	23	79	Cement & Mortar Mixers79		6.065202472	0.450022955
2	2024	All	All	53	53027	Cement & Mortar Mixers	23	80	Cement & Mortar Mixers80		6.981147286	0.518002563
2	2024	All	All	53	53027	Cement & Mortar Mixers	23	86	Cement & Mortar Mixers86		7.310129887	0.542424898
2	2024	All	All	53	53027	Cement & Mortar Mixers	23	87	Cement & Mortar Mixers87		6.962326877	0.516606792
2	2024	All	All	53	53027	Cement & Mortar Mixers	23	90	Cement & Mortar Mixers90		7593.570355	563.5761541
2	2024	All	All	53	53027	Cement & Mortar Mixers	23	100	Cement & Mortar Mixers100		4.923966648	0.365309557
2	2024	All	All	53	53027	Cement & Mortar Mixers	23	110	Cement & Mortar Mixers110		4.776248413	0.354350327
2	2024	All	All	53	53027	Cranes	23	1	Cranes1		4.251607257	0.04281082
2	2024	All	All	53	53027	Cranes	23	2	Cranes2		19.739143	0.198759868
2	2024	All	All	53	53027	Cranes	23	3	Cranes3		79.98594561	0.80540457
2	2024	All	All	53	53027	Cranes	23	5	Cranes5		0.317017012	0.003192148
2	2024	All	All	53	53027	Cranes	23	31	Cranes31		0.148390632	0.001494194
2	2024	All	All	53	53027	Cranes	23	79	Cranes79		3.934591755	0.039618687
2	2024	All	All	53	53027	Cranes	23	80	Cranes80		4.691300639	0.047238236
2	2024	All	All	53	53027	Cranes	23	86	Cranes86		5.00831922	0.050430399
2	2024	All	All	53	53027	Cranes	23	87	Cranes87		4.641215129	0.046733909
2	2024	All	All	53	53027	Cranes	23	90	Cranes90		52954.27574	533.2138711
2	2024	All	All	53	53027	Cranes	23	100	Cranes100		3.506368765	0.035306771
2	2024	All	All	53	53027	Cranes	23	110	Cranes110		3.401178367	0.034247574
2	2024	All	All	53	53027	Crushing/Proc. Equipment	23	1	Crushing/Proc. Equipment1		4.170871504	0.063487611
2	2024	All	All	53	53027	Crushing/Proc. Equipment	23	2	Crushing/Proc. Equipment2		20.81035075	0.316768197
2	2024	All	All	53	53027	Crushing/Proc. Equipment	23	3	Crushing/Proc. Equipment3		96.14589578	1.463500659
2	2024	All	All	53	53027	Crushing/Proc. Equipment	23	5	Crushing/Proc. Equipment5		0.364337757	0.005545827
2	2024	All	All	53	53027	Crushing/Proc. Equipment	23	31	Crushing/Proc. Equipment31		0.102251793	0.001556443
2	2024	All	All	53	53027	Crushing/Proc. Equipment	23	79	Crushing/Proc. Equipment79		3.806532119	0.057941758
2	2024	All	All	53	53027	Crushing/Proc. Equipment	23	80	Crushing/Proc. Equipment80		4.553558494	0.069312744
2	2024	All	All	53	53027	Crushing/Proc. Equipment	23	86	Crushing/Proc. Equipment86		4.917897036	0.074858583
2	2024	All	All	53	53027	Crushing/Proc. Equipment	23	87	Crushing/Proc. Equipment87		4.525043639	0.0688787
2	2024	All	All	53	53027	Crushing/Proc. Equipment	23	90	Crushing/Proc. Equipment90		35845.39722	545.626644
2	2024	All	All	53	53027	Crushing/Proc. Equipment	23	100	Crushing/Proc. Equipment100		3.19443648	0.048624643
2	2024	All	All	53	53027	Crushing/Proc. Equipment	23	110	Crushing/Proc. Equipment110		3.098601893	0.047165881
2	2024	All	All	53	53027	Rubber Tire Loaders	23	1	Rubber Tire Loaders1		6.505396905	0.045446328
2	2024	All	All	53	53027	Rubber Tire Loaders	23	2	Rubber Tire Loaders2		41.57616307	0.290448677
2	2024	All	All	53	53027	Rubber Tire Loaders	23	3	Rubber Tire Loaders3		140.5373586	0.981785883
2	2024	All	All	53	53027	Rubber Tire Loaders	23	5	Rubber Tire Loaders5		0.454487686	0.003175025
2	2024	All	All	53	53027	Rubber Tire Loaders	23	31	Rubber Tire Loaders31		0.216212306	0.001510447
2	2024	All	All	53	53027	Rubber Tire Loaders	23	79	Rubber Tire Loaders79		6.050908237	0.042271296
2	2024	All	All	53	53027	Rubber Tire Loaders	23	80	Rubber Tire Loaders80		7.163707604	0.050045248
2	2024	All	All	53	53027	Rubber Tire Loaders	23	86	Rubber Tire Loaders86		7.618194263	0.053220266
2	2024	All	All	53	53027	Rubber Tire Loaders	23	87	Rubber Tire Loaders87		7.093602955	0.049555501
2	2024	All	All	53	53027	Rubber Tire Loaders	23	90	Rubber Tire Loaders90		77283.67577	539.8993019
2	2024	All	All	53	53027	Rubber Tire Loaders	23	100	Rubber Tire Loaders100		6.866003573	0.047965505
2	2024	All	All	53	53027	Rubber Tire Loaders	23	110	Rubber Tire Loaders110		6.66002959	0.046526583
2	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	1	Tractors/Loaders/Backhoes1		12.12694328	0.617892296
2	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	2	Tractors/Loaders/Backhoes2		63.47281411	3.234068302
2	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	3	Tractors/Loaders/Backhoes3		71.5895125	3.647630507
2	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	5	Tractors/Loaders/Backhoes5		0.738070343	0.037606177
2	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	31	Tractors/Loaders/Backhoes31		0.042675885	0.002174423
2	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	79	Tractors/Loaders/Backhoes79		11.38886182	0.580285553
2	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	80	Tractors/Loaders/Backhoes80		13.30684913	0.678010886
2	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	86	Tractors/Loaders/Backhoes86		14.04492793	0.715617495
2	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	87	Tractors/Loaders/Backhoes87		13.27492364	0.676384218
2	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	90	Tractors/Loaders/Backhoes90		13033.85679	664.1013744
2	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	100	Tractors/Loaders/Backhoes100		9.50463894	0.484280584
2	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	110	Tractors/Loaders/Backhoes110		9.219498595	0.469752107

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Emissions Calculations

MOVESRunID	Year	Month	Day	State	County	Equipment Description	Fuel	Pollutant	EqPollID	Process	Emission Factor, g/hr	Emission Factor, g/hp-hr
2	2024	All	All	53	53027	Skid Steer Loaders	23	1	Skid Steer Loaders1		12.19562132	1.05594139
2	2024	All	All	53	53027	Skid Steer Loaders	23	2	Skid Steer Loaders2		68.32394165	5.91585645
2	2024	All	All	53	53027	Skid Steer Loaders	23	3	Skid Steer Loaders3		62.91669435	5.44777745
2	2024	All	All	53	53027	Skid Steer Loaders	23	5	Skid Steer Loaders5		0.555764005	0.04812335
2	2024	All	All	53	53027	Skid Steer Loaders	23	31	Skid Steer Loaders31		0.028192711	0.00244121
2	2024	All	All	53	53027	Skid Steer Loaders	23	79	Skid Steer Loaders79		11.63985566	1.007817896
2	2024	All	All	53	53027	Skid Steer Loaders	23	80	Skid Steer Loaders80		13.29196257	1.150868181
2	2024	All	All	53	53027	Skid Steer Loaders	23	86	Skid Steer Loaders86		13.84772557	1.198991446
2	2024	All	All	53	53027	Skid Steer Loaders	23	87	Skid Steer Loaders87		13.24962471	1.147202563
2	2024	All	All	53	53027	Skid Steer Loaders	23	90	Skid Steer Loaders90		7989.031297	691.7813641
2	2024	All	All	53	53027	Skid Steer Loaders	23	100	Skid Steer Loaders100		9.557808818	0.827558412
2	2024	All	All	53	53027	Skid Steer Loaders	23	110	Skid Steer Loaders110		9.271073113	0.802731535
2	2024	All	All	53	53027	Dumpers/Tenders	23	1	Dumpers/Tenders1		7.986601142	1.144168625
2	2024	All	All	53	53027	Dumpers/Tenders	23	2	Dumpers/Tenders2		40.6530195	5.824057216
2	2024	All	All	53	53027	Dumpers/Tenders	23	3	Dumpers/Tenders3		38.51944913	5.519089064
2	2024	All	All	53	53027	Dumpers/Tenders	23	5	Dumpers/Tenders5		0.382248183	0.054773631
2	2024	All	All	53	53027	Dumpers/Tenders	23	31	Dumpers/Tenders31		0.017221466	0.002467803
2	2024	All	All	53	53027	Dumpers/Tenders	23	79	Dumpers/Tenders79		7.604353757	1.089395108
2	2024	All	All	53	53027	Dumpers/Tenders	23	80	Dumpers/Tenders80		8.700633856	1.246466542
2	2024	All	All	53	53027	Dumpers/Tenders	23	86	Dumpers/Tenders86		9.082883671	1.301240406
2	2024	All	All	53	53027	Dumpers/Tenders	23	87	Dumpers/Tenders87		8.675753714	1.242902889
2	2024	All	All	53	53027	Dumpers/Tenders	23	90	Dumpers/Tenders90		4760.026808	682.1311939
2	2024	All	All	53	53027	Dumpers/Tenders	23	100	Dumpers/Tenders100		5.987025354	0.857698213
2	2024	All	All	53	53027	Dumpers/Tenders	23	110	Dumpers/Tenders110		5.807413122	0.831967057
2	2024	All	All	53	53027	Other Construction Equipm	23	1	Other Construction Equipment1		23.40941275	0.120795132
2	2024	All	All	53	53027	Other Construction Equipm	23	2	Other Construction Equipment2		189.2077905	0.976332907
2	2024	All	All	53	53027	Other Construction Equipm	23	3	Other Construction Equipment3		424.6165402	2.191067819
2	2024	All	All	53	53027	Other Construction Equipm	23	5	Other Construction Equipment5		1.574181067	0.008122947
2	2024	All	All	53	53027	Other Construction Equipm	23	31	Other Construction Equipment31		0.329692216	0.001701248
2	2024	All	All	53	53027	Other Construction Equipm	23	79	Other Construction Equipment79		21.83523032	0.112672178
2	2024	All	All	53	53027	Other Construction Equipm	23	80	Other Construction Equipment80		25.71963828	0.132716148
2	2024	All	All	53	53027	Other Construction Equipm	23	86	Other Construction Equipment86		27.2938073	0.140839033
2	2024	All	All	53	53027	Other Construction Equipm	23	87	Other Construction Equipment87		25.62121628	0.13220828
2	2024	All	All	53	53027	Other Construction Equipm	23	90	Other Construction Equipment90		104157.8674	537.4659954
2	2024	All	All	53	53027	Other Construction Equipm	23	100	Other Construction Equipment100		26.39173024	0.136184216
2	2024	All	All	53	53027	Other Construction Equipm	23	110	Other Construction Equipment110		25.59998114	0.132098704
2	2024	All	All	53	53027	Scrapers	23	1	Scrapers1		7.03723819	0.029133443
2	2024	All	All	53	53027	Scrapers	23	2	Scrapers2		54.78963175	0.226823443
2	2024	All	All	53	53027	Scrapers	23	3	Scrapers3		125.6025024	0.519981449
2	2024	All	All	53	53027	Scrapers	23	5	Scrapers5		0.534313047	0.002212001
2	2024	All	All	53	53027	Scrapers	23	31	Scrapers31		0.357059499	0.00147819
2	2024	All	All	53	53027	Scrapers	23	79	Scrapers79		6.502929551	0.02692146
2	2024	All	All	53	53027	Scrapers	23	80	Scrapers80		7.781443415	0.032214376
2	2024	All	All	53	53027	Scrapers	23	86	Scrapers86		8.315756718	0.034426378
2	2024	All	All	53	53027	Scrapers	23	87	Scrapers87		7.636486115	0.031614268
2	2024	All	All	53	53027	Scrapers	23	90	Scrapers90		129650.8662	536.7412586
2	2024	All	All	53	53027	Scrapers	23	100	Scrapers100		7.782767184	0.032219856
2	2024	All	All	53	53027	Scrapers	23	110	Scrapers110		7.549282495	0.031253253
2	2024	All	All	53	53027	Excavators	23	1	Excavators1		1.841732402	0.018233318
2	2024	All	All	53	53027	Excavators	23	2	Excavators2		9.55207782	0.094566439
2	2024	All	All	53	53027	Excavators	23	3	Excavators3		42.02657078	0.416066873
2	2024	All	All	53	53027	Excavators	23	5	Excavators5		0.155532849	0.001539789
2	2024	All	All	53	53027	Excavators	23	31	Excavators31		0.146209385	0.001447486
2	2024	All	All	53	53027	Excavators	23	79	Excavators79		1.686199099	0.016693524
2	2024	All	All	53	53027	Excavators	23	80	Excavators80		2.019458586	0.019992824
2	2024	All	All	53	53027	Excavators	23	86	Excavators86		2.174991231	0.021532611
2	2024	All	All	53	53027	Excavators	23	87	Excavators87		1.972778724	0.019530689
2	2024	All	All	53	53027	Excavators	23	90	Excavators90		54736.32613	541.8946069
2	2024	All	All	53	53027	Excavators	23	100	Excavators100		1.9057022	0.018866625
2	2024	All	All	53	53027	Excavators	23	110	Excavators110		1.848531499	0.01830063
2	2024	All	All	53	53027	Graders	23	1	Graders1		2.014610033	0.016707491
2	2024	All	All	53	53027	Graders	23	2	Graders2		10.72049928	0.088906855
2	2024	All	All	53	53027	Graders	23	3	Graders3		32.25865271	0.267526287
2	2024	All	All	53	53027	Graders	23	5	Graders5		0.145688094	0.001208215
2	2024	All	All	53	53027	Graders	23	31	Graders31		0.173567921	0.001439427
2	2024	All	All	53	53027	Graders	23	79	Graders79		1.868922944	0.015499284
2	2024	All	All	53	53027	Graders	23	80	Graders80		2.22175429	0.018425372
2	2024	All	All	53	53027	Graders	23	86	Graders86		2.367441606	0.019633581
2	2024	All	All	53	53027	Graders	23	87	Graders87		2.156978411	0.017888175
2	2024	All	All	53	53027	Graders	23	90	Graders90		64831.62815	537.6593047
2	2024	All	All	53	53027	Graders	23	100	Graders100		2.366257365	0.01962376
2	2024	All	All	53	53027	Graders	23	110	Graders110		2.295270341	0.019035053
2	2024	All	All	53	53027	Off-highway Trucks	23	1	Off-highway Trucks1		12.92127792	0.027969701
2	2024	All	All	53	53027	Off-highway Trucks	23	2	Off-highway Trucks2		44.63022815	0.096607637
2	2024	All	All	53	53027	Off-highway Trucks	23	3	Off-highway Trucks3		661.6957031	1.432322014
2	2024	All	All	53	53027	Off-highway Trucks	23	5	Off-highway Trucks5		1.182708107	0.002560118
2	2024	All	All	53	53027	Off-highway Trucks	23	31	Off-highway Trucks31		0.661196363	0.001431241
2	2024	All	All	53	53027	Off-highway Trucks	23	79	Off-highway Trucks79		11.73858233	0.02540961
2	2024	All	All	53	53027	Off-highway Trucks	23	80	Off-highway Trucks80		14.3269399	0.03101243
2	2024	All	All	53	53027	Off-highway Trucks	23	86	Off-highway Trucks86		15.50964133	0.033572533

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MOVESRunID	Year	Month	Day	State	County	Equipment Description	Fuel	Pollutant	EqPollID	Process	Emission Factor, g/hr	Emission Factor, g/hp-hr
2	2024	All	All	53	53027	Off-highway Trucks	23	87	Off-highway Trucks87		14.20618369	0.030751038
2	2024	All	All	53	53027	Off-highway Trucks	23	90	Off-highway Trucks90		247961.1142	536.7424345
2	2024	All	All	53	53027	Off-highway Trucks	23	100	Off-highway Trucks100		10.35702712	0.022419063
2	2024	All	All	53	53027	Off-highway Trucks	23	110	Off-highway Trucks110		10.046321	0.021746502
2	2024	All	All	53	53027	Rough Terrain Forklifts	23	1	Rough Terrain Forklifts1		2.956862577	0.051769471
2	2024	All	All	53	53027	Rough Terrain Forklifts	23	2	Rough Terrain Forklifts2		20.31097913	0.355609573
2	2024	All	All	53	53027	Rough Terrain Forklifts	23	3	Rough Terrain Forklifts3		64.37862254	1.127156616
2	2024	All	All	53	53027	Rough Terrain Forklifts	23	5	Rough Terrain Forklifts5		0.248485457	0.004350544
2	2024	All	All	53	53027	Rough Terrain Forklifts	23	31	Rough Terrain Forklifts31		0.089481911	0.001566671
2	2024	All	All	53	53027	Rough Terrain Forklifts	23	79	Rough Terrain Forklifts79		2.708377038	0.047418925
2	2024	All	All	53	53027	Rough Terrain Forklifts	23	80	Rough Terrain Forklifts80		3.247263224	0.056853876
2	2024	All	All	53	53027	Rough Terrain Forklifts	23	86	Rough Terrain Forklifts86		3.495747023	0.061204391
2	2024	All	All	53	53027	Rough Terrain Forklifts	23	87	Rough Terrain Forklifts87		3.231088241	0.056570681
2	2024	All	All	53	53027	Rough Terrain Forklifts	23	90	Rough Terrain Forklifts90		32529.41579	569.5329408
2	2024	All	All	53	53027	Rough Terrain Forklifts	23	100	Rough Terrain Forklifts100		2.987587343	0.052307407
2	2024	All	All	53	53027	Rough Terrain Forklifts	23	110	Rough Terrain Forklifts110		2.897960716	0.050738203
2	2024	All	All	53	53027	Crawler Tractor/Dozers	23	1	Crawler Tractor/Dozers1		4.25026303	0.027723804
2	2024	All	All	53	53027	Crawler Tractor/Dozers	23	2	Crawler Tractor/Dozers2		26.70498005	0.174192425
2	2024	All	All	53	53027	Crawler Tractor/Dozers	23	3	Crawler Tractor/Dozers3		108.1651354	0.705544329
2	2024	All	All	53	53027	Crawler Tractor/Dozers	23	5	Crawler Tractor/Dozers5		0.311683893	0.002033065
2	2024	All	All	53	53027	Crawler Tractor/Dozers	23	31	Crawler Tractor/Dozers31		0.225182026	0.001468827
2	2024	All	All	53	53027	Crawler Tractor/Dozers	23	79	Crawler Tractor/Dozers79		3.938579255	0.025690739
2	2024	All	All	53	53027	Crawler Tractor/Dozers	23	80	Crawler Tractor/Dozers80		4.693346764	0.03061397
2	2024	All	All	53	53027	Crawler Tractor/Dozers	23	86	Crawler Tractor/Dozers86		5.005028217	0.032647019
2	2024	All	All	53	53027	Crawler Tractor/Dozers	23	87	Crawler Tractor/Dozers87		4.621128642	0.030142902
2	2024	All	All	53	53027	Crawler Tractor/Dozers	23	90	Crawler Tractor/Dozers90		82745.58782	539.7365803
2	2024	All	All	53	53027	Crawler Tractor/Dozers	23	100	Crawler Tractor/Dozers100		4.707088995	0.030703608
2	2024	All	All	53	53027	Crawler Tractor/Dozers	23	110	Crawler Tractor/Dozers110		4.565874064	0.029782485
2	2024	All	All	53	53027	Off-Highway Tractors	23	1	Off-Highway Tractors1		23.55818351	0.055105136
2	2024	All	All	53	53027	Off-Highway Tractors	23	2	Off-Highway Tractors2		144.0891644	0.33704012
2	2024	All	All	53	53027	Off-Highway Tractors	23	3	Off-Highway Tractors3		697.6803277	1.63194965
2	2024	All	All	53	53027	Off-Highway Tractors	23	5	Off-Highway Tractors5		1.495464556	0.003498053
2	2024	All	All	53	53027	Off-Highway Tractors	23	31	Off-Highway Tractors31		0.644813411	0.001508288
2	2024	All	All	53	53027	Off-Highway Tractors	23	79	Off-Highway Tractors79		22.06270877	0.051607059
2	2024	All	All	53	53027	Off-Highway Tractors	23	80	Off-Highway Tractors80		25.95412184	0.060709495
2	2024	All	All	53	53027	Off-Highway Tractors	23	86	Off-Highway Tractors86		27.4495926	0.064207562
2	2024	All	All	53	53027	Off-Highway Tractors	23	87	Off-Highway Tractors87		25.76861024	0.060275563
2	2024	All	All	53	53027	Off-Highway Tractors	23	90	Off-Highway Tractors90		229428.0996	536.6571076
2	2024	All	All	53	53027	Off-Highway Tractors	23	100	Off-Highway Tractors100		22.11558187	0.051730735
2	2024	All	All	53	53027	Off-Highway Tractors	23	110	Off-Highway Tractors110		21.45213263	0.050178855
2	2024	All	All	53	53027	Railway Maintenance	23	1	Railway Maintenance1		11.5334487	0.387908074
2	2024	All	All	53	53027	Railway Maintenance	23	2	Railway Maintenance2		51.30831349	1.725668497
2	2024	All	All	53	53027	Railway Maintenance	23	3	Railway Maintenance3		84.30715516	2.835528823
2	2024	All	All	53	53027	Railway Maintenance	23	5	Railway Maintenance5		0.611520827	0.020567471
2	2024	All	All	53	53027	Railway Maintenance	23	31	Railway Maintenance31		0.058842565	0.00197907
2	2024	All	All	53	53027	Railway Maintenance	23	79	Railway Maintenance79		10.92193605	0.367340879
2	2024	All	All	53	53027	Railway Maintenance	23	80	Railway Maintenance80		12.58535859	0.423287288
2	2024	All	All	53	53027	Railway Maintenance	23	86	Railway Maintenance86		13.19689361	0.443855235
2	2024	All	All	53	53027	Railway Maintenance	23	87	Railway Maintenance87		12.54649627	0.421980219
2	2024	All	All	53	53027	Railway Maintenance	23	90	Railway Maintenance90		18892.34502	635.4121274
2	2024	All	All	53	53027	Railway Maintenance	23	100	Railway Maintenance100		9.053764831	0.304508094
2	2024	All	All	53	53027	Railway Maintenance	23	110	Railway Maintenance110		8.78214184	0.295372513
4	2024	All	All	53	53027	Pavers	23	1	Pavers1		2.078842582	0.028335951
4	2024	All	All	53	53027	Pavers	23	2	Pavers2		12.47054615	0.169981501
4	2024	All	All	53	53027	Pavers	23	3	Pavers3		53.30495457	0.726580543
4	2024	All	All	53	53027	Pavers	23	5	Pavers5		0.219467364	0.00299148
4	2024	All	All	53	53027	Pavers	23	31	Pavers31		0.108991673	0.001485626
4	2024	All	All	53	53027	Pavers	23	79	Pavers79		1.859374917	0.025344467
4	2024	All	All	53	53027	Pavers	23	80	Pavers80		2.255689911	0.030746493
4	2024	All	All	53	53027	Pavers	23	86	Pavers86		2.475155581	0.03373795
4	2024	All	All	53	53027	Pavers	23	87	Pavers87		2.226572283	0.030349601
4	2024	All	All	53	53027	Pavers	23	90	Pavers90		40404.3287	550.7367807
4	2024	All	All	53	53027	Pavers	23	100	Pavers100		2.232405648	0.030429113
4	2024	All	All	53	53027	Pavers	23	110	Pavers110		2.165432798	0.029516231
4	2024	All	All	53	53027	Tampers/Rammers	23	1	Tampers/Rammers1		1.343027697	0.743647694
4	2024	All	All	53	53027	Tampers/Rammers	23	2	Tampers/Rammers2		4.831090276	2.675022378
4	2024	All	All	53	53027	Tampers/Rammers	23	3	Tampers/Rammers3		7.717751862	4.273395396
4	2024	All	All	53	53027	Tampers/Rammers	23	5	Tampers/Rammers5		0.126150175	0.069850597
4	2024	All	All	53	53027	Tampers/Rammers	23	31	Tampers/Rammers31		0.003904608	0.00216202
4	2024	All	All	53	53027	Tampers/Rammers	23	79	Tampers/Rammers79		1.216877397	0.673797028
4	2024	All	All	53	53027	Tampers/Rammers	23	80	Tampers/Rammers80		1.491642389	0.825937116
4	2024	All	All	53	53027	Tampers/Rammers	23	86	Tampers/Rammers86		1.617792736	0.895787809
4	2024	All	All	53	53027	Tampers/Rammers	23	87	Tampers/Rammers87		1.491267623	0.825729604
4	2024	All	All	53	53027	Tampers/Rammers	23	90	Tampers/Rammers90		1061.932927	588.0027448
4	2024	All	All	53	53027	Tampers/Rammers	23	100	Tampers/Rammers100		0.508906834	0.281786738
4	2024	All	All	53	53027	Tampers/Rammers	23	110	Tampers/Rammers110		0.493639728	0.273333191
4	2024	All	All	53	53027	Plate Compactors	23	1	Plate Compactors1		1.971359988	0.608731522
4	2024	All	All	53	53027	Plate Compactors	23	2	Plate Compactors2		7.376050646	2.277632984
4	2024	All	All	53	53027	Plate Compactors	23	3	Plate Compactors3		13.33030638	4.116233327
4	2024	All	All	53	53027	Plate Compactors	23	5	Plate Compactors5		0.186882557	0.057707016

Appendix A
Emissions Calculations

MOVESRunID	Year	Month	Day	State	County	Equipment Description	Fuel	Pollutant	EqPollID	Process	Emission Factor, g/hr	Emission Factor, g/hp-hr
4	2024	All	All	53	53027	Plate Compactors	23	31	Plate Compactors31		0.007006864	0.002163633
4	2024	All	All	53	53027	Plate Compactors	23	79	Plate Compactors79		1.784476717	0.551024285
4	2024	All	All	53	53027	Plate Compactors	23	80	Plate Compactors80		2.190042798	0.676258062
4	2024	All	All	53	53027	Plate Compactors	23	86	Plate Compactors86		2.376924664	0.733964865
4	2024	All	All	53	53027	Plate Compactors	23	87	Plate Compactors87		2.189618333	0.676126992
4	2024	All	All	53	53027	Plate Compactors	23	90	Plate Compactors90		1905.619469	588.4316642
4	2024	All	All	53	53027	Plate Compactors	23	100	Plate Compactors100		0.787956655	0.243311245
4	2024	All	All	53	53027	Plate Compactors	23	110	Plate Compactors110		0.764317812	0.236011864
4	2024	All	All	53	53027	Rollers	23	1	Rollers1		2.35356573	0.043239407
4	2024	All	All	53	53027	Rollers	23	2	Rollers2		13.8796057	0.254994334
4	2024	All	All	53	53027	Rollers	23	3	Rollers3		52.61980993	0.966724394
4	2024	All	All	53	53027	Rollers	23	5	Rollers5		0.237048118	0.004355018
4	2024	All	All	53	53027	Rollers	23	31	Rollers31		0.08332103	0.001530763
4	2024	All	All	53	53027	Rollers	23	79	Rollers79		2.116517239	0.038884383
4	2024	All	All	53	53027	Rollers	23	80	Rollers80		2.577362257	0.047350969
4	2024	All	All	53	53027	Rollers	23	86	Rollers86		2.814410578	0.05170599
4	2024	All	All	53	53027	Rollers	23	87	Rollers87		2.559922792	0.047030573
4	2024	All	All	53	53027	Rollers	23	90	Rollers90		30459.34461	559.5951695
4	2024	All	All	53	53027	Rollers	23	100	Rollers100		2.11468951	0.038850804
4	2024	All	All	53	53027	Rollers	23	110	Rollers110		2.051249041	0.037685284
4	2024	All	All	53	53027	Paving Equipment	23	1	Paving Equipment1		3.387338775	0.082623875
4	2024	All	All	53	53027	Paving Equipment	23	2	Paving Equipment2		16.7586929	0.408777582
4	2024	All	All	53	53027	Paving Equipment	23	3	Paving Equipment3		50.0890405	1.221770517
4	2024	All	All	53	53027	Paving Equipment	23	5	Paving Equipment5		0.308034098	0.007513559
4	2024	All	All	53	53027	Paving Equipment	23	31	Paving Equipment31		0.064241166	0.001566969
4	2024	All	All	53	53027	Paving Equipment	23	79	Paving Equipment79		3.079303944	0.075110298
4	2024	All	All	53	53027	Paving Equipment	23	80	Paving Equipment80		3.730053308	0.090983359
4	2024	All	All	53	53027	Paving Equipment	23	86	Paving Equipment86		4.03808722	0.098496914
4	2024	All	All	53	53027	Paving Equipment	23	87	Paving Equipment87		3.715780389	0.090635214
4	2024	All	All	53	53027	Paving Equipment	23	90	Paving Equipment90		22814.29051	556.485555
4	2024	All	All	53	53027	Paving Equipment	23	100	Paving Equipment100		2.508163668	0.06117906
4	2024	All	All	53	53027	Paving Equipment	23	110	Paving Equipment110		2.432919182	0.059343699
4	2024	All	All	53	53027	Surfacing Equipment	23	1	Surfacing Equipment1		10.86484654	0.168333342
4	2024	All	All	53	53027	Surfacing Equipment	23	2	Surfacing Equipment2		79.89259711	1.237807442
4	2024	All	All	53	53027	Surfacing Equipment	23	3	Surfacing Equipment3		194.9740107	3.020809063
4	2024	All	All	53	53027	Surfacing Equipment	23	5	Surfacing Equipment5		0.711991734	0.011031168
4	2024	All	All	53	53027	Surfacing Equipment	23	31	Surfacing Equipment31		0.115793438	0.001794033
4	2024	All	All	53	53027	Surfacing Equipment	23	79	Surfacing Equipment79		10.15285441	0.157302168
4	2024	All	All	53	53027	Surfacing Equipment	23	80	Surfacing Equipment80		11.90131783	0.1843918
4	2024	All	All	53	53027	Surfacing Equipment	23	86	Surfacing Equipment86		12.61331662	0.195423077
4	2024	All	All	53	53027	Surfacing Equipment	23	87	Surfacing Equipment87		11.86905159	0.183891886
4	2024	All	All	53	53027	Surfacing Equipment	23	90	Surfacing Equipment90		35828.33622	555.1025104
4	2024	All	All	53	53027	Surfacing Equipment	23	100	Surfacing Equipment100		10.66184856	0.165188215
4	2024	All	All	53	53027	Surfacing Equipment	23	110	Surfacing Equipment110		10.3419899	0.160232519
4	2024	All	All	53	53027	Signal Boards/Light Plants	23	1	Signal Boards/Light Plants1		2.913559102	0.281982059
4	2024	All	All	53	53027	Signal Boards/Light Plants	23	2	Signal Boards/Light Plants2		13.09364447	1.267238004
4	2024	All	All	53	53027	Signal Boards/Light Plants	23	3	Signal Boards/Light Plants3		36.46892565	3.529560366
4	2024	All	All	53	53027	Signal Boards/Light Plants	23	5	Signal Boards/Light Plants5		0.276894875	0.026798628
4	2024	All	All	53	53027	Signal Boards/Light Plants	23	31	Signal Boards/Light Plants31		0.020585318	0.001992302
4	2024	All	All	53	53027	Signal Boards/Light Plants	23	79	Signal Boards/Light Plants79		2.636664487	0.255183456
4	2024	All	All	53	53027	Signal Boards/Light Plants	23	80	Signal Boards/Light Plants80		3.222059112	0.311839516
4	2024	All	All	53	53027	Signal Boards/Light Plants	23	86	Signal Boards/Light Plants86		3.498952318	0.338637983
4	2024	All	All	53	53027	Signal Boards/Light Plants	23	87	Signal Boards/Light Plants87		3.220329579	0.311672127
4	2024	All	All	53	53027	Signal Boards/Light Plants	23	90	Signal Boards/Light Plants90		6056.662115	586.1799921
4	2024	All	All	53	53027	Signal Boards/Light Plants	23	100	Signal Boards/Light Plants100		1.627539061	0.157517592
4	2024	All	All	53	53027	Signal Boards/Light Plants	23	110	Signal Boards/Light Plants110		1.578712094	0.152791988
4	2024	All	All	53	53027	Trenchers	23	1	Trenchers1		4.236682213	0.094660681
4	2024	All	All	53	53027	Trenchers	23	2	Trenchers2		27.24414254	0.608719028
4	2024	All	All	53	53027	Trenchers	23	3	Trenchers3		95.10462737	2.124933695
4	2024	All	All	53	53027	Trenchers	23	5	Trenchers5		0.407180717	0.009097686
4	2024	All	All	53	53027	Trenchers	23	31	Trenchers31		0.072921844	0.001629301
4	2024	All	All	53	53027	Trenchers	23	79	Trenchers79		3.82950106	0.085562985
4	2024	All	All	53	53027	Trenchers	23	80	Trenchers80		4.591835198	0.102595905
4	2024	All	All	53	53027	Trenchers	23	86	Trenchers86		4.999015534	0.111693582
4	2024	All	All	53	53027	Trenchers	23	87	Trenchers87		4.575947011	0.102240913
4	2024	All	All	53	53027	Trenchers	23	90	Trenchers90		25847.33549	577.5100089
4	2024	All	All	53	53027	Trenchers	23	100	Trenchers100		3.562702311	0.07960187
4	2024	All	All	53	53027	Trenchers	23	110	Trenchers110		3.455820231	0.077213791
4	2024	All	All	53	53027	Bore/Drill Rigs	23	1	Bore/Drill Rigs1		23.98300397	0.315872016
4	2024	All	All	53	53027	Bore/Drill Rigs	23	2	Bore/Drill Rigs2		103.9531992	1.36913812
4	2024	All	All	53	53027	Bore/Drill Rigs	23	3	Bore/Drill Rigs3		353.4441602	4.655224005
4	2024	All	All	53	53027	Bore/Drill Rigs	23	5	Bore/Drill Rigs5		1.322569297	0.017421214
4	2024	All	All	53	53027	Bore/Drill Rigs	23	31	Bore/Drill Rigs31		0.147565475	0.001943864
4	2024	All	All	53	53027	Bore/Drill Rigs	23	79	Bore/Drill Rigs79		22.66043837	0.29845085
4	2024	All	All	53	53027	Bore/Drill Rigs	23	80	Bore/Drill Rigs80		26.21477581	0.345266828
4	2024	All	All	53	53027	Bore/Drill Rigs	23	86	Bore/Drill Rigs86		27.53734524	0.362688043
4	2024	All	All	53	53027	Bore/Drill Rigs	23	87	Bore/Drill Rigs87		26.14743479	0.344379949
4	2024	All	All	53	53027	Bore/Drill Rigs	23	90	Bore/Drill Rigs90		40938.15184	539.297281
4	2024	All	All	53	53027	Bore/Drill Rigs	23	100	Bore/Drill Rigs100		18.02136273	0.237352428
4	2024	All	All	53	53027	Bore/Drill Rigs	23	110	Bore/Drill Rigs110		17.48072074	0.23023184

Appendix A
Emissions Calculations

MOVESRunID	Year	Month	Day	State	County	Equipment Description	Fuel	Pollutant	EqPollID	Process	Emission Factor, g/hr	Emission Factor, g/hp-hr
4	2024	All	All	53	53027	Concrete/Industrial Saws	23	1	Concrete/Industrial Saws1		2.938699088	0.104682288
4	2024	All	All	53	53027	Concrete/Industrial Saws	23	2	Concrete/Industrial Saws2		17.03872313	0.606953098
4	2024	All	All	53	53027	Concrete/Industrial Saws	23	3	Concrete/Industrial Saws3		61.01565852	2.173498723
4	2024	All	All	53	53027	Concrete/Industrial Saws	23	5	Concrete/Industrial Saws5		0.297674342	0.01060375
4	2024	All	All	53	53027	Concrete/Industrial Saws	23	31	Concrete/Industrial Saws31		0.046376709	0.00165203
4	2024	All	All	53	53027	Concrete/Industrial Saws	23	79	Concrete/Industrial Saws79		2.641025265	0.094078556
4	2024	All	All	53	53027	Concrete/Industrial Saws	23	80	Concrete/Industrial Saws80		3.19593561	0.113845563
4	2024	All	All	53	53027	Concrete/Industrial Saws	23	86	Concrete/Industrial Saws86		3.493608045	0.124449245
4	2024	All	All	53	53027	Concrete/Industrial Saws	23	87	Concrete/Industrial Saws87		3.188238272	0.113571368
4	2024	All	All	53	53027	Concrete/Industrial Saws	23	90	Concrete/Industrial Saws90		16610.29891	591.691778
4	2024	All	All	53	53027	Concrete/Industrial Saws	23	100	Concrete/Industrial Saws100		2.089253118	0.074423338
4	2024	All	All	53	53027	Concrete/Industrial Saws	23	110	Concrete/Industrial Saws110		2.026576293	0.072190665
4	2024	All	All	53	53027	Cement & Mortar Mixers	23	1	Cement & Mortar Mixers1		6.394186649	0.474445406
4	2024	All	All	53	53027	Cement & Mortar Mixers	23	2	Cement & Mortar Mixers2		30.9654351	2.297497814
4	2024	All	All	53	53027	Cement & Mortar Mixers	23	3	Cement & Mortar Mixers3		68.24320489	5.063676415
4	2024	All	All	53	53027	Cement & Mortar Mixers	23	5	Cement & Mortar Mixers5		0.328983098	0.024422371
4	2024	All	All	53	53027	Cement & Mortar Mixers	23	31	Cement & Mortar Mixers31		0.027788857	0.002062336
4	2024	All	All	53	53027	Cement & Mortar Mixers	23	79	Cement & Mortar Mixers79		6.065202472	0.450022955
4	2024	All	All	53	53027	Cement & Mortar Mixers	23	80	Cement & Mortar Mixers80		6.981147286	0.518002563
4	2024	All	All	53	53027	Cement & Mortar Mixers	23	86	Cement & Mortar Mixers86		7.310129887	0.542424898
4	2024	All	All	53	53027	Cement & Mortar Mixers	23	87	Cement & Mortar Mixers87		6.962326877	0.516606792
4	2024	All	All	53	53027	Cement & Mortar Mixers	23	90	Cement & Mortar Mixers90		7593.570355	563.5761541
4	2024	All	All	53	53027	Cement & Mortar Mixers	23	100	Cement & Mortar Mixers100		4.923966648	0.365309557
4	2024	All	All	53	53027	Cement & Mortar Mixers	23	110	Cement & Mortar Mixers110		4.776248413	0.354350327
4	2024	All	All	53	53027	Cranes	23	1	Cranes1		4.251607257	0.04281082
4	2024	All	All	53	53027	Cranes	23	2	Cranes2		19.739143	0.198759868
4	2024	All	All	53	53027	Cranes	23	3	Cranes3		79.98594561	0.80540457
4	2024	All	All	53	53027	Cranes	23	5	Cranes5		0.317017012	0.003192148
4	2024	All	All	53	53027	Cranes	23	31	Cranes31		0.148390632	0.001494194
4	2024	All	All	53	53027	Cranes	23	79	Cranes79		3.934591755	0.039618687
4	2024	All	All	53	53027	Cranes	23	80	Cranes80		4.691300639	0.047238236
4	2024	All	All	53	53027	Cranes	23	86	Cranes86		5.00831922	0.050430399
4	2024	All	All	53	53027	Cranes	23	87	Cranes87		4.641215129	0.046733909
4	2024	All	All	53	53027	Cranes	23	90	Cranes90		52954.27574	533.2138711
4	2024	All	All	53	53027	Cranes	23	100	Cranes100		3.506368765	0.035306771
4	2024	All	All	53	53027	Cranes	23	110	Cranes110		3.401178367	0.034247574
4	2024	All	All	53	53027	Crushing/Proc. Equipment	23	1	Crushing/Proc. Equipment1		4.170871504	0.063487611
4	2024	All	All	53	53027	Crushing/Proc. Equipment	23	2	Crushing/Proc. Equipment2		20.81035075	0.316768197
4	2024	All	All	53	53027	Crushing/Proc. Equipment	23	3	Crushing/Proc. Equipment3		96.14589578	1.463500659
4	2024	All	All	53	53027	Crushing/Proc. Equipment	23	5	Crushing/Proc. Equipment5		0.364337757	0.005545827
4	2024	All	All	53	53027	Crushing/Proc. Equipment	23	31	Crushing/Proc. Equipment31		0.102251793	0.001556443
4	2024	All	All	53	53027	Crushing/Proc. Equipment	23	79	Crushing/Proc. Equipment79		3.806532119	0.057941758
4	2024	All	All	53	53027	Crushing/Proc. Equipment	23	80	Crushing/Proc. Equipment80		4.553558494	0.069312744
4	2024	All	All	53	53027	Crushing/Proc. Equipment	23	86	Crushing/Proc. Equipment86		4.917897036	0.074858583
4	2024	All	All	53	53027	Crushing/Proc. Equipment	23	87	Crushing/Proc. Equipment87		4.525043639	0.0688787
4	2024	All	All	53	53027	Crushing/Proc. Equipment	23	90	Crushing/Proc. Equipment90		35845.39722	545.626644
4	2024	All	All	53	53027	Crushing/Proc. Equipment	23	100	Crushing/Proc. Equipment100		3.19443648	0.048624643
4	2024	All	All	53	53027	Crushing/Proc. Equipment	23	110	Crushing/Proc. Equipment110		3.098601893	0.047165881
4	2024	All	All	53	53027	Rubber Tire Loaders	23	1	Rubber Tire Loaders1		6.505396905	0.045446328
4	2024	All	All	53	53027	Rubber Tire Loaders	23	2	Rubber Tire Loaders2		41.57616307	0.290448677
4	2024	All	All	53	53027	Rubber Tire Loaders	23	3	Rubber Tire Loaders3		140.5373586	0.981785883
4	2024	All	All	53	53027	Rubber Tire Loaders	23	5	Rubber Tire Loaders5		0.454487686	0.003175025
4	2024	All	All	53	53027	Rubber Tire Loaders	23	31	Rubber Tire Loaders31		0.216212306	0.001510447
4	2024	All	All	53	53027	Rubber Tire Loaders	23	79	Rubber Tire Loaders79		6.050908237	0.042271296
4	2024	All	All	53	53027	Rubber Tire Loaders	23	80	Rubber Tire Loaders80		7.163707604	0.050045248
4	2024	All	All	53	53027	Rubber Tire Loaders	23	86	Rubber Tire Loaders86		7.618194263	0.053220266
4	2024	All	All	53	53027	Rubber Tire Loaders	23	87	Rubber Tire Loaders87		7.093602955	0.049555501
4	2024	All	All	53	53027	Rubber Tire Loaders	23	90	Rubber Tire Loaders90		77283.67577	539.8993019
4	2024	All	All	53	53027	Rubber Tire Loaders	23	100	Rubber Tire Loaders100		6.866003573	0.047965505
4	2024	All	All	53	53027	Rubber Tire Loaders	23	110	Rubber Tire Loaders110		6.66002959	0.046526583
4	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	1	Tractors/Loaders/Backhoes1		12.12694328	0.617892296
4	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	2	Tractors/Loaders/Backhoes2		63.47281411	3.234068302
4	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	3	Tractors/Loaders/Backhoes3		71.5895125	3.647630507
4	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	5	Tractors/Loaders/Backhoes5		0.738070343	0.037606177
4	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	31	Tractors/Loaders/Backhoes31		0.042675885	0.002174423
4	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	79	Tractors/Loaders/Backhoes79		11.38886182	0.580285553
4	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	80	Tractors/Loaders/Backhoes80		13.30684913	0.678010886
4	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	86	Tractors/Loaders/Backhoes86		14.04492793	0.715617495
4	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	87	Tractors/Loaders/Backhoes87		13.27492364	0.676384218
4	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	90	Tractors/Loaders/Backhoes90		13033.85679	664.1013744
4	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	100	Tractors/Loaders/Backhoes100		9.50463894	0.484280584
4	2024	All	All	53	53027	Tractors/Loaders/Backhoes	23	110	Tractors/Loaders/Backhoes110		9.219498595	0.469752107
4	2024	All	All	53	53027	Skid Steer Loaders	23	1	Skid Steer Loaders1		12.19562132	1.05594139
4	2024	All	All	53	53027	Skid Steer Loaders	23	2	Skid Steer Loaders2		68.32394165	5.91585645
4	2024	All	All	53	53027	Skid Steer Loaders	23	3	Skid Steer Loaders3		62.91669435	5.44777745
4	2024	All	All	53	53027	Skid Steer Loaders	23	5	Skid Steer Loaders5		0.555764005	0.04812335
4	2024	All	All	53	53027	Skid Steer Loaders	23	31	Skid Steer Loaders31		0.028192711	0.00244121
4	2024	All	All	53	53027	Skid Steer Loaders	23	79	Skid Steer Loaders79		11.63985566	1.007817896
4	2024	All	All	53	53027	Skid Steer Loaders	23	80	Skid Steer Loaders80		13.29196257	1.150868181
4	2024	All	All	53	53027	Skid Steer Loaders	23	86	Skid Steer Loaders86		13.84772557	1.198991446

Appendix A
Emissions Calculations

MOVESRunID	Year	Month	Day	State	County	Equipment Description	Fuel	Pollutant	EqPollID	Process	Emission Factor, g/hr	Emission Factor, g/hp-hr
4	2024	All	All	53	53027	Skid Steer Loaders	23	87	Skid Steer Loaders87		13.24962471	1.147202563
4	2024	All	All	53	53027	Skid Steer Loaders	23	90	Skid Steer Loaders90		7989.031297	691.7813641
4	2024	All	All	53	53027	Skid Steer Loaders	23	100	Skid Steer Loaders100		9.557808818	0.827558412
4	2024	All	All	53	53027	Skid Steer Loaders	23	110	Skid Steer Loaders110		9.271073113	0.802731535
4	2024	All	All	53	53027	Dumpers/Tenders	23	1	Dumpers/Tenders1		7.986601142	1.144168625
4	2024	All	All	53	53027	Dumpers/Tenders	23	2	Dumpers/Tenders2		40.6530195	5.824057216
4	2024	All	All	53	53027	Dumpers/Tenders	23	3	Dumpers/Tenders3		38.51944913	5.519089064
4	2024	All	All	53	53027	Dumpers/Tenders	23	5	Dumpers/Tenders5		0.382248183	0.054773631
4	2024	All	All	53	53027	Dumpers/Tenders	23	31	Dumpers/Tenders31		0.017221466	0.002467803
4	2024	All	All	53	53027	Dumpers/Tenders	23	79	Dumpers/Tenders79		7.604353757	1.089395108
4	2024	All	All	53	53027	Dumpers/Tenders	23	80	Dumpers/Tenders80		8.700633856	1.246466542
4	2024	All	All	53	53027	Dumpers/Tenders	23	86	Dumpers/Tenders86		9.082883671	1.301240406
4	2024	All	All	53	53027	Dumpers/Tenders	23	87	Dumpers/Tenders87		8.675753714	1.242902889
4	2024	All	All	53	53027	Dumpers/Tenders	23	90	Dumpers/Tenders90		4760.026808	682.1311939
4	2024	All	All	53	53027	Dumpers/Tenders	23	100	Dumpers/Tenders100		5.987025354	0.857698213
4	2024	All	All	53	53027	Dumpers/Tenders	23	110	Dumpers/Tenders110		5.807413122	0.831967057
4	2024	All	All	53	53027	Other Construction Equipm	23	1	Other Construction Equipment1		23.40941275	0.120795132
4	2024	All	All	53	53027	Other Construction Equipm	23	2	Other Construction Equipment2		189.2077905	0.976332907
4	2024	All	All	53	53027	Other Construction Equipm	23	3	Other Construction Equipment3		424.6165402	2.191067819
4	2024	All	All	53	53027	Other Construction Equipm	23	5	Other Construction Equipment5		1.574181067	0.008122947
4	2024	All	All	53	53027	Other Construction Equipm	23	31	Other Construction Equipment31		0.329692216	0.001701248
4	2024	All	All	53	53027	Other Construction Equipm	23	79	Other Construction Equipment79		21.83523032	0.112672178
4	2024	All	All	53	53027	Other Construction Equipm	23	80	Other Construction Equipment80		25.71963828	0.132716148
4	2024	All	All	53	53027	Other Construction Equipm	23	86	Other Construction Equipment86		27.2938073	0.140839033
4	2024	All	All	53	53027	Other Construction Equipm	23	87	Other Construction Equipment87		25.62121628	0.13220828
4	2024	All	All	53	53027	Other Construction Equipm	23	90	Other Construction Equipment90		104157.8674	537.4659954
4	2024	All	All	53	53027	Other Construction Equipm	23	100	Other Construction Equipment100		26.39173024	0.136184216
4	2024	All	All	53	53027	Other Construction Equipm	23	110	Other Construction Equipment110		25.59998114	0.132098704
4	2024	All	All	53	53027	Generator Sets	23	1	Generator Sets1		4.81080571	0.225706696
4	2024	All	All	53	53027	Generator Sets	23	2	Generator Sets2		22.90204873	1.07448649
4	2024	All	All	53	53027	Generator Sets	23	3	Generator Sets3		62.02830787	2.910157933
4	2024	All	All	53	53027	Generator Sets	23	5	Generator Sets5		0.360235805	0.016901043
4	2024	All	All	53	53027	Generator Sets	23	31	Generator Sets31		0.038574532	0.001809786
4	2024	All	All	53	53027	Generator Sets	23	79	Generator Sets79		4.45057264	0.208805781
4	2024	All	All	53	53027	Generator Sets	23	80	Generator Sets80		5.272084514	0.247348333
4	2024	All	All	53	53027	Generator Sets	23	86	Generator Sets86		5.632317663	0.264249252
4	2024	All	All	53	53027	Generator Sets	23	87	Generator Sets87		5.261344861	0.246844465
4	2024	All	All	53	53027	Generator Sets	23	90	Generator Sets90		12118.84505	568.5751274
4	2024	All	All	53	53027	Generator Sets	23	100	Generator Sets100		3.529228559	0.16557944
4	2024	All	All	53	53027	Generator Sets	23	110	Generator Sets110		3.423348835	0.160611922
4	2024	All	All	53	53027	Pumps	23	1	Pumps1		5.249788621	0.231523898
4	2024	All	All	53	53027	Pumps	23	2	Pumps2		25.57884326	1.128067036
4	2024	All	All	53	53027	Pumps	23	3	Pumps3		65.80449372	2.902081201
4	2024	All	All	53	53027	Pumps	23	5	Pumps5		0.383798424	0.016926111
4	2024	All	All	53	53027	Pumps	23	31	Pumps31		0.040999826	0.001808156
4	2024	All	All	53	53027	Pumps	23	79	Pumps79		4.865996018	0.214598043
4	2024	All	All	53	53027	Pumps	23	80	Pumps80		5.755695227	0.253835171
4	2024	All	All	53	53027	Pumps	23	86	Pumps86		6.139498324	0.270761488
4	2024	All	All	53	53027	Pumps	23	87	Pumps87		5.743818072	0.25331137
4	2024	All	All	53	53027	Pumps	23	90	Pumps90		12882.78845	568.1511409
4	2024	All	All	53	53027	Pumps	23	100	Pumps100		3.999075403	0.176365487
4	2024	All	All	53	53027	Pumps	23	110	Pumps110		3.879098583	0.171074321
4	2024	All	All	53	53027	Air Compressors	23	1	Air Compressors1		2.50207919	0.070229511
4	2024	All	All	53	53027	Air Compressors	23	2	Air Compressors2		15.29296821	0.429250078
4	2024	All	All	53	53027	Air Compressors	23	3	Air Compressors3		61.70933357	1.732086006
4	2024	All	All	53	53027	Air Compressors	23	5	Air Compressors5		0.256080662	0.00718779
4	2024	All	All	53	53027	Air Compressors	23	31	Air Compressors31		0.057669648	0.001618698
4	2024	All	All	53	53027	Air Compressors	23	79	Air Compressors79		2.245997132	0.063041682
4	2024	All	All	53	53027	Air Compressors	23	80	Air Compressors80		2.724839713	0.076482056
4	2024	All	All	53	53027	Air Compressors	23	86	Air Compressors86		2.980923486	0.083669934
4	2024	All	All	53	53027	Air Compressors	23	87	Air Compressors87		2.715395936	0.076216984
4	2024	All	All	53	53027	Air Compressors	23	90	Air Compressors90		20455.27083	574.1479659
4	2024	All	All	53	53027	Air Compressors	23	100	Air Compressors100		2.388919496	0.067053293
4	2024	All	All	53	53027	Air Compressors	23	110	Air Compressors110		2.317254462	0.065041766
4	2024	All	All	53	53027	Welders	23	1	Welders1		4.250114099	0.458846971
4	2024	All	All	53	53027	Welders	23	2	Welders2		23.97165691	2.588006324
4	2024	All	All	53	53027	Welders	23	3	Welders3		33.63060158	3.630796565
4	2024	All	All	53	53027	Welders	23	5	Welders5		0.294240627	0.03176654
4	2024	All	All	53	53027	Welders	23	31	Welders31		0.02046876	0.00220983
4	2024	All	All	53	53027	Welders	23	79	Welders79		3.95587538	0.427080637
4	2024	All	All	53	53027	Welders	23	80	Welders80		4.649371546	0.501951242
4	2024	All	All	53	53027	Welders	23	86	Welders86		4.943611938	0.533717757
4	2024	All	All	53	53027	Welders	23	87	Welders87		4.640094173	0.500949647
4	2024	All	All	53	53027	Welders	23	90	Welders90		6422.305308	693.3591121
4	2024	All	All	53	53027	Welders	23	100	Welders100		3.243456858	0.350167153
4	2024	All	All	53	53027	Welders	23	110	Welders110		3.146159716	0.339662847
4	2024	All	All	53	53027	Pressure Washers	23	1	Pressure Washers1		5.412515473	0.239280316
4	2024	All	All	53	53027	Pressure Washers	23	2	Pressure Washers2		22.83430692	1.009475207
4	2024	All	All	53	53027	Pressure Washers	23	3	Pressure Washers3		64.12695807	2.834969964
4	2024	All	All	53	53027	Pressure Washers	23	5	Pressure Washers5		0.369474903	0.016334008

Appendix A
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MOVESRunID	Year	Month	Day	State	County	Equipment Description	Fuel	Pollutant	EqPollID	Process	Emission Factor, g/hr	Emission Factor, g/hp-hr
4	2024	All	All	53	53027	Pressure Washers	23	31	Pressure Washers31		0.040661666	0.0017976
4	2024	All	All	53	53027	Pressure Washers	23	79	Pressure Washers79		5.043049973	0.222946724
4	2024	All	All	53	53027	Pressure Washers	23	80	Pressure Washers80		5.921722995	0.261791723
4	2024	All	All	53	53027	Pressure Washers	23	86	Pressure Washers86		6.29118141	0.278125002
4	2024	All	All	53	53027	Pressure Washers	23	87	Pressure Washers87		5.907817698	0.261176988
4	2024	All	All	53	53027	Pressure Washers	23	90	Pressure Washers90		12557.03741	555.1304002
4	2024	All	All	53	53027	Pressure Washers	23	100	Pressure Washers100		3.363298926	0.1486871
4	2024	All	All	53	53027	Pressure Washers	23	110	Pressure Washers110		3.262400367	0.144226505
4	2024	All	All	53	53027	Hydro Power Units	23	1	Hydro Power Units1		2.344785328	0.087948173
4	2024	All	All	53	53027	Hydro Power Units	23	2	Hydro Power Units2		13.08587244	0.490824709
4	2024	All	All	53	53027	Hydro Power Units	23	3	Hydro Power Units3		51.51568289	1.932249468
4	2024	All	All	53	53027	Hydro Power Units	23	5	Hydro Power Units5		0.243288709	0.009125269
4	2024	All	All	53	53027	Hydro Power Units	23	31	Hydro Power Units31		0.043825241	0.001643797
4	2024	All	All	53	53027	Hydro Power Units	23	79	Hydro Power Units79		2.101497423	0.078822934
4	2024	All	All	53	53027	Hydro Power Units	23	80	Hydro Power Units80		2.560920231	0.096054958
4	2024	All	All	53	53027	Hydro Power Units	23	86	Hydro Power Units86		2.804208966	0.105180228
4	2024	All	All	53	53027	Hydro Power Units	23	87	Hydro Power Units87		2.555068205	0.09583546
4	2024	All	All	53	53027	Hydro Power Units	23	90	Hydro Power Units90		15378.16277	576.8039007
4	2024	All	All	53	53027	Hydro Power Units	23	100	Hydro Power Units100		1.956560755	0.073386652
4	2024	All	All	53	53027	Hydro Power Units	23	110	Hydro Power Units110		1.897865774	0.071185121
4	2024	All	All	53	53027	Scrapers	23	1	Scrapers1		7.03723819	0.029133443
4	2024	All	All	53	53027	Scrapers	23	2	Scrapers2		54.78963175	0.226823443
4	2024	All	All	53	53027	Scrapers	23	3	Scrapers3		125.6025024	0.519981449
4	2024	All	All	53	53027	Scrapers	23	5	Scrapers5		0.534313047	0.002212001
4	2024	All	All	53	53027	Scrapers	23	31	Scrapers31		0.357059499	0.00147819
4	2024	All	All	53	53027	Scrapers	23	79	Scrapers79		6.502929551	0.02692146
4	2024	All	All	53	53027	Scrapers	23	80	Scrapers80		7.781443415	0.032214376
4	2024	All	All	53	53027	Scrapers	23	86	Scrapers86		8.315756718	0.034426378
4	2024	All	All	53	53027	Scrapers	23	87	Scrapers87		7.636486115	0.031614268
4	2024	All	All	53	53027	Scrapers	23	90	Scrapers90		129650.8662	536.7412586
4	2024	All	All	53	53027	Scrapers	23	100	Scrapers100		7.782767184	0.032219856
4	2024	All	All	53	53027	Scrapers	23	110	Scrapers110		7.549282495	0.031253253
4	2024	All	All	53	53027	Excavators	23	1	Excavators1		1.841732402	0.018233318
4	2024	All	All	53	53027	Excavators	23	2	Excavators2		9.55207782	0.094566439
4	2024	All	All	53	53027	Excavators	23	3	Excavators3		42.02657078	0.416066873
4	2024	All	All	53	53027	Excavators	23	5	Excavators5		0.155532849	0.001539789
4	2024	All	All	53	53027	Excavators	23	31	Excavators31		0.146209385	0.001447486
4	2024	All	All	53	53027	Excavators	23	79	Excavators79		1.686199099	0.016693524
4	2024	All	All	53	53027	Excavators	23	80	Excavators80		2.019458586	0.019992824
4	2024	All	All	53	53027	Excavators	23	86	Excavators86		2.174991231	0.021532611
4	2024	All	All	53	53027	Excavators	23	87	Excavators87		1.972778724	0.019530689
4	2024	All	All	53	53027	Excavators	23	90	Excavators90		54736.32613	541.8946069
4	2024	All	All	53	53027	Excavators	23	100	Excavators100		1.9057022	0.018866625
4	2024	All	All	53	53027	Excavators	23	110	Excavators110		1.848531499	0.01830063
4	2024	All	All	53	53027	Graders	23	1	Graders1		2.014610033	0.016707491
4	2024	All	All	53	53027	Graders	23	2	Graders2		10.72049928	0.088906855
4	2024	All	All	53	53027	Graders	23	3	Graders3		32.25865271	0.267526287
4	2024	All	All	53	53027	Graders	23	5	Graders5		0.145688094	0.001208215
4	2024	All	All	53	53027	Graders	23	31	Graders31		0.173567921	0.001439427
4	2024	All	All	53	53027	Graders	23	79	Graders79		1.868922944	0.015499284
4	2024	All	All	53	53027	Graders	23	80	Graders80		2.22175429	0.018425372
4	2024	All	All	53	53027	Graders	23	86	Graders86		2.367441606	0.019633581
4	2024	All	All	53	53027	Graders	23	87	Graders87		2.156978411	0.017888175
4	2024	All	All	53	53027	Graders	23	90	Graders90		64831.62815	537.6593047
4	2024	All	All	53	53027	Graders	23	100	Graders100		2.366257365	0.01962376
4	2024	All	All	53	53027	Graders	23	110	Graders110		2.295270341	0.019035053
4	2024	All	All	53	53027	Off-highway Trucks	23	1	Off-highway Trucks1		12.92127792	0.027969701
4	2024	All	All	53	53027	Off-highway Trucks	23	2	Off-highway Trucks2		44.63022815	0.096607637
4	2024	All	All	53	53027	Off-highway Trucks	23	3	Off-highway Trucks3		661.6957031	1.432322014
4	2024	All	All	53	53027	Off-highway Trucks	23	5	Off-highway Trucks5		1.182708107	0.002560118
4	2024	All	All	53	53027	Off-highway Trucks	23	31	Off-highway Trucks31		0.661196363	0.001431241
4	2024	All	All	53	53027	Off-highway Trucks	23	79	Off-highway Trucks79		11.73858233	0.02540961
4	2024	All	All	53	53027	Off-highway Trucks	23	80	Off-highway Trucks80		14.3269399	0.03101243
4	2024	All	All	53	53027	Off-highway Trucks	23	86	Off-highway Trucks86		15.50964133	0.033572533
4	2024	All	All	53	53027	Off-highway Trucks	23	87	Off-highway Trucks87		14.20618369	0.030751038
4	2024	All	All	53	53027	Off-highway Trucks	23	90	Off-highway Trucks90		247961.1142	536.7424345
4	2024	All	All	53	53027	Off-highway Trucks	23	100	Off-highway Trucks100		10.35702712	0.022419063
4	2024	All	All	53	53027	Off-highway Trucks	23	110	Off-highway Trucks110		10.046321	0.021746502
4	2024	All	All	53	53027	Rough Terrain Forklifts	23	1	Rough Terrain Forklifts1		2.956862577	0.051769471
4	2024	All	All	53	53027	Rough Terrain Forklifts	23	2	Rough Terrain Forklifts2		20.31097913	0.355609573
4	2024	All	All	53	53027	Rough Terrain Forklifts	23	3	Rough Terrain Forklifts3		64.37862254	1.127156616
4	2024	All	All	53	53027	Rough Terrain Forklifts	23	5	Rough Terrain Forklifts5		0.248485457	0.004350544
4	2024	All	All	53	53027	Rough Terrain Forklifts	23	31	Rough Terrain Forklifts31		0.089481911	0.001566671
4	2024	All	All	53	53027	Rough Terrain Forklifts	23	79	Rough Terrain Forklifts79		2.708377038	0.047418925
4	2024	All	All	53	53027	Rough Terrain Forklifts	23	80	Rough Terrain Forklifts80		3.247263224	0.056853876
4	2024	All	All	53	53027	Rough Terrain Forklifts	23	86	Rough Terrain Forklifts86		3.495747023	0.061204391
4	2024	All	All	53	53027	Rough Terrain Forklifts	23	87	Rough Terrain Forklifts87		3.231088241	0.056570681
4	2024	All	All	53	53027	Rough Terrain Forklifts	23	90	Rough Terrain Forklifts90		32529.41579	569.5329408
4	2024	All	All	53	53027	Rough Terrain Forklifts	23	100	Rough Terrain Forklifts100		2.987587343	0.052307407
4	2024	All	All	53	53027	Rough Terrain Forklifts	23	110	Rough Terrain Forklifts110		2.897960716	0.050738203

Appendix A
Emissions Calculations

MOVESRunID	Year	Month	Day	State	County	Equipment Description	Fuel	Pollutant	EqPollID	Process	Emission Factor, g/hr	Emission Factor, g/hp-hr
4	2024	All	All	53	53027	Crawler Tractor/Dozers	23	1	Crawler Tractor/Dozers1		4.25026303	0.027723804
4	2024	All	All	53	53027	Crawler Tractor/Dozers	23	2	Crawler Tractor/Dozers2		26.70498005	0.174192425
4	2024	All	All	53	53027	Crawler Tractor/Dozers	23	3	Crawler Tractor/Dozers3		108.1651354	0.705544329
4	2024	All	All	53	53027	Crawler Tractor/Dozers	23	5	Crawler Tractor/Dozers5		0.311683893	0.002033065
4	2024	All	All	53	53027	Crawler Tractor/Dozers	23	31	Crawler Tractor/Dozers31		0.225182026	0.001468827
4	2024	All	All	53	53027	Crawler Tractor/Dozers	23	79	Crawler Tractor/Dozers79		3.938579255	0.025690739
4	2024	All	All	53	53027	Crawler Tractor/Dozers	23	80	Crawler Tractor/Dozers80		4.693346764	0.03061397
4	2024	All	All	53	53027	Crawler Tractor/Dozers	23	86	Crawler Tractor/Dozers86		5.005028217	0.032647019
4	2024	All	All	53	53027	Crawler Tractor/Dozers	23	87	Crawler Tractor/Dozers87		4.621128642	0.030142902
4	2024	All	All	53	53027	Crawler Tractor/Dozers	23	90	Crawler Tractor/Dozers90		82745.58782	539.7365803
4	2024	All	All	53	53027	Crawler Tractor/Dozers	23	100	Crawler Tractor/Dozers100		4.707088995	0.030703608
4	2024	All	All	53	53027	Crawler Tractor/Dozers	23	110	Crawler Tractor/Dozers110		4.565874064	0.029782485
4	2024	All	All	53	53027	Off-Highway Tractors	23	1	Off-Highway Tractors1		23.55818351	0.055105136
4	2024	All	All	53	53027	Off-Highway Tractors	23	2	Off-Highway Tractors2		144.0891644	0.33704012
4	2024	All	All	53	53027	Off-Highway Tractors	23	3	Off-Highway Tractors3		697.6803277	1.63194965
4	2024	All	All	53	53027	Off-Highway Tractors	23	5	Off-Highway Tractors5		1.495464556	0.003498053
4	2024	All	All	53	53027	Off-Highway Tractors	23	31	Off-Highway Tractors31		0.644813411	0.001508288
4	2024	All	All	53	53027	Off-Highway Tractors	23	79	Off-Highway Tractors79		22.06270877	0.051607059
4	2024	All	All	53	53027	Off-Highway Tractors	23	80	Off-Highway Tractors80		25.95412184	0.060709495
4	2024	All	All	53	53027	Off-Highway Tractors	23	86	Off-Highway Tractors86		27.4495926	0.064207562
4	2024	All	All	53	53027	Off-Highway Tractors	23	87	Off-Highway Tractors87		25.76861024	0.060275563
4	2024	All	All	53	53027	Off-Highway Tractors	23	90	Off-Highway Tractors90		229428.0996	536.6571076
4	2024	All	All	53	53027	Off-Highway Tractors	23	100	Off-Highway Tractors100		22.11558187	0.051730735
4	2024	All	All	53	53027	Off-Highway Tractors	23	110	Off-Highway Tractors110		21.45213263	0.050178855
4	2024	All	All	53	53027	Railway Maintenance	23	1	Railway Maintenance1		11.5334487	0.387908074
4	2024	All	All	53	53027	Railway Maintenance	23	2	Railway Maintenance2		51.30831349	1.725668497
4	2024	All	All	53	53027	Railway Maintenance	23	3	Railway Maintenance3		84.30715516	2.835528823
4	2024	All	All	53	53027	Railway Maintenance	23	5	Railway Maintenance5		0.611520827	0.020567471
4	2024	All	All	53	53027	Railway Maintenance	23	31	Railway Maintenance31		0.058842565	0.00197907
4	2024	All	All	53	53027	Railway Maintenance	23	79	Railway Maintenance79		10.92193605	0.367340879
4	2024	All	All	53	53027	Railway Maintenance	23	80	Railway Maintenance80		12.58535859	0.423287288
4	2024	All	All	53	53027	Railway Maintenance	23	86	Railway Maintenance86		13.19689361	0.443855235
4	2024	All	All	53	53027	Railway Maintenance	23	87	Railway Maintenance87		12.54649627	0.421980219
4	2024	All	All	53	53027	Railway Maintenance	23	90	Railway Maintenance90		18892.34502	635.4121274
4	2024	All	All	53	53027	Railway Maintenance	23	100	Railway Maintenance100		9.053764831	0.304508094
4	2024	All	All	53	53027	Railway Maintenance	23	110	Railway Maintenance110		8.78214184	0.295372513
						Derrick Crane		100	Derrick Crane100		2.088368545	
						Derrick Crane		110	Derrick Crane110		1.859633414	
						Derrick Crane		3	Derrick Crane3		228.9726937	
						Derrick Crane		86	Derrick Crane86		12.88930427	
						Derrick Crane		2	Derrick Crane2		168.7908568	
						Derrick Crane		31	Derrick Crane31		0.818883139	
						Derrick Crane		90	Derrick Crane90		87605.0453	
						Derrick Crane		5	Derrick Crane5		3.553643813	

Source: MOVES3 Offroad emissions factor model run. USEPA (2020) Motor Vehicle Emission Simulator: MOVES3. Office of Transportation and Air Quality. US Environmental Protection Agency. Ann Arbor, MI. November 2020. https://www.epa.gov/moves.
Derrick crane emissions derived using SMAQMD Harborcraft, Dredge and Barge Emission Factor Calculator

pollutantID	pollutantName
1	Total Gaseous Hydrocarbons
2	Carbon Monoxide (CO)
3	Oxides of Nitrogen
5	Methane (CH4)
31	Sulfur Dioxide (SO2)
79	Non-Methane Hydrocarbons
80	Non-Methane Organic Gases
86	Total Organic Gases
87	Volatile Organic Compounds
90	Atmospheric CO2
100	Primary Exhaust PM10 - Total
110	Primary Exhaust PM2.5 - Total

Appendix A
Emissions Calculations

Construction Trips

Category	Number of Vehicles	Trips/ Day	Miles/ Trip	Total miles	Emissions (lbs)						Emissions (kg)		
					ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4	CO2e
Worker Commute (Rail & Dock/Fender)	30	2	20	566400	29.57306	139.8351	2.355303	2.542894	2.250172	2846.713	161.7103	0.004324	161.8184
Cargo Yard Commute	30	2	20	494400	25.81377	122.0595	2.0559	2.219645	1.964133	2484.843	141.1539	0.003774	141.2483
AGP Commute	25	2	20	300000	15.6637	74.06521	1.247512	1.346872	1.191829	1507.793	85.65164	0.00229	85.7089
Worker Commute All				794400	71.05053	335.9598	5.658714	6.109411	5.406134	6839.35	388.5158	0.010389	388.7756
Cargo Yard Hauling	n/a	n/a	40	280000	56.33241	2051.938	3.064266	30.66247	28.20713	1343.483	410.1899	0.053977	411.5393
AGP Project Hauling	1	30	40	360000	72.42739	2638.206	3.939771	39.42318	36.26631	1727.336	527.387	0.069399	529.122
Hauling				640000	128.7598	4690.143	7.004038	70.08565	64.47345	3070.819	937.5769	0.123376	940.6613

Operations Trips

AGP Project Operations

Category	Number of Vehicles	Trips/ Day	Miles/ Trip	Total miles	Emissions (lbs)						Emissions (kg)		
					ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4	CO2e
Worker Commute	161	2	20	1680840	87.76057	414.9725	6.98956	7.546254	6.677577	8447.863	479.889	0.012832	480.2098
	Total hours of delay				ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4	CO2e
Crossing Delays	37130.28552				93.54222	1131.017	6.722874	18.55902	16.86636	7000.068	547.3809	0.028177	548.0854
Total (lb/yr| MT/yr)					181.3028	1545.989	13.71243	26.10527	23.54393	15447.93	1027.27	0.041009	1028.295
Total (tpy|MT per year)					0.090651	0.772995	0.006856	0.013053	0.011772	7.723966	1027.27	0.041009	1028.295

Baseline Operations

Category	Number of Vehicles	Trips/ Day	Miles/ Trip	Total miles	Emissions (lbs)						Emissions (kg)		
					ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4	CO2e
Worker Commute	106	2	20	1106640	57.78025	273.2117	4.601822	4.968341	4.396417	5561.947	315.9518	0.008448	316.163
	Total hours of delay				ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4	CO2e
Crossing Delays	20367.17693				51.31097	620.3996	3.687717	10.18023	9.251749	3839.767	300.2564	0.015456	300.6428
Total (lb/yr| MT/yr)					109.0912	893.6113	8.289539	15.14857	13.64817	9401.714	616.2081	0.023904	616.8058
Total (tpy|MT per year)					0.054546	0.446806	0.004145	0.007574	0.006824	4.700857	616.2081	0.023904	616.8058

Appendix A
Emissions Calculations

Crossing delays

V=0.5*((q*T^2))/(1-(q/d))	1.534247	q = vehicle arrival rate (vehicles/min)					25	4
	5.365255	tT = gate down time (min)					48	0.25
		V = total delay for a blockage						1.534247
	40	d= departure rate (minutes/vehicle)						

729	trips (one way,baseline)							
1329	trips (one way, project)		railcar leng	39	ft			
73	crossings from port to centralia		number	110		112	with locomotives	
22.96316	minute/crossing		train length	4368	ft			
				0.827273	mi			
2227817	minutes delayed per year (project)	crossing time (5mph)	0.165455	9.927273	10.58727		25	10.58727
1222031	minutes delayed per year (project)	Crossing time (25 mph)	0.033091	1.985455	2.645455		48	2.645455
								5.365255

Workdays per project element

412	Cargo Yard
300	AGP Project
180	Dock/Fender Upgrades
292	Rail Upgrades

261 Workdays/year

Appendix A
Emissions Calculations

Vessel

100 Ships/yr Round trip

31 Barges/yr Round trip

Rail

225 RT unit trains

140 RT manifest trains Average of 70 (low) and 209 (high) from 2017-2021

Vehicle

Current Methodologies and Best Practices for Preparing Port Emission Inventories

Marine Vessel Efs

Baseline Operations (tpy)		ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4	CO2e
Traffic	Rail	0.4	0.1	0.0	0.3	0.3	4.7	1,416.3	0.0	1,416.3
	Vessel	3.5	117.6	62.8	8.2	6.8	9.1	4,705.0	0.1	4,706.9
	Truck/Vehicle/RR Maint.									0.0
Stationary	Grain loading to shi	-	-	-	0.7	0.1	-	-	-	-
Off-site	Worker Vehicles & Crossing delays	0.1	0.4	0.0	0.0	0.0	4.7	616.2	0.0	616.8
	Total	4.0	118.1	62.8	9.3	7.2	18.5	6,737.5	0.1	6,740.1
Project Operations (tpy)		ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4	CO2e
Mobile	Rail	0.8	0.2	0.0	0.6	0.6	8.5	2,582.1	0.0	2,582.1
	Vessel	4.2	143.5	83.9	10.8	8.9	11.0	5,810.1	0.1	5,812.4
	Truck/Vehicle/RR Maint.									0.0
Stationary	Ship Loader	-	-	-	1.4	0.2	-	-	-	-
Off-site	Worker Vehicles & Crossing delays	0.1	0.8	0.0	0.0	0.0	7.7	1,027.3	0.0	1,028.3
	Total	5.1	144.5	84.0	12.9	9.7	27.2	9,419.5	0.1	9,422.7
	NET	1.1	26.3	21.1	3.6	2.5	8.7	2681.9	0.0	2682.7

From PD

Transportation Type	Baseline Round Trips	Future Round Trips		One way tr distance		One way trips, project	
		Without Proposed Project	With Proposed Project				
Vessel[1]	131	131	191	262	15	382	15
Rail[2]	295–434[3]	295–434	595–734	729	55	1329	55
Vehicle	???	???	???				

Notes:

1. Includes 100 ships and 31 barge trips
2. Includes unit trains and manifest trains
3. Baseline rail traffic is presented as a range to reflect that records reflect the number of railcars, which can vary for manifest trains.

	One-way Trips				power (kw)		Load factors			
vessel type	Base count	Project count	Hotelling Tir	speed	main engine	aux eng	Hotelling	Maneuvering	Transit	Fuel
Auto/RoRo	100	100	96	18	11593	2999	0.26	0.45	0.15	Marine Distillate
Bulk	100	220	96	15	7803	2459	0.1	0.45	0.17	Marine Distillate
Tug/Barge	62	62	96	15	1785	117	0.43	0.43	0.68	Marine Distillate
Auto/RoRo	100	100	96	18	11593	2999	0.26	0.45	0.15	Heavy Fuel Oil
Bulk	100	220	96	15	7803	2459	0.1	0.45	0.17	Heavy Fuel Oil
Tug/Barge	62	62	96	15	1785	117	0.43	0.43	0.68	Heavy Fuel Oil

Appendix A
Emissions Calculations

Modeling Change Technical Memo

Methodology for vessel emissions inventory (CARB)

Assumptions
All new ships are bulk carriers
Slow speed engines (<300 rpm) on all non-tug vessels
50-50 auto-bulk used for baseline vessel counts
Main engines burn heavy fuel oil
71% of aux engines burn heavy fuel oil, 29% burn distillate

Vessel Emissions

Baseline									
Transit		ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4
Main	Auto/RoRo	413035.704	12449658	7069980.5	971848.72	791651.7669	963749.9771	426803561.3	8260.714089
Main	Bulk	667213.167	19507704	5921667.1	918399.3	767295.142	1556830.723	672217265.7	13344.26334
Main	Ocean Tug	15022.9367	456625.93	6687.5082	43256.615	33580.49066	98365.83478	52396887.94	2070.948314
Aux	Auto/RoRo	13030.2987	469918.32	279201.62	34919.668	28770.89963	35833.32156	23182033.05	260.6059749
Aux	Bulk	14530.3255	524014.55	311342.86	38939.563	32082.95878	39958.39522	25850710.97	290.6065107
Aux	Ocean Tug	2230.36309	62321.218	33419.742	4789.3515	3788.185925	4718.075767	30701.12853	386.024381
	Subtotal (g)	1125062.8	33470242	13622299	2012153.2	1657169.444	2699456.327	1200481160	24613.16261
	Subtotal (tons)	1.24016944	36.894626	15.016015	2.2180192	1.826716622	2.975641243	1323.303961	0.027131368
Hotelling		ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4
Main	Auto/RoRo	-	-	-	-	-	-	-	-
Main	Bulk	-	-	-	-	-	-	-	-
Main	Tug/Barge	-	-	-	-	-	-	-	-
Aux	Auto/RoRo	1497100.8	53990711	32078541	4012054	3305598.566	4117027.2	2663472335	29942.016
Aux	Bulk	472128	17026593	10116338	1265247.5	1042458.624	1298352	839956712.6	9442.56
Aux	Ocean Tug	77905.5588	2176851.5	1167336.2	167289.85	132319.5952	164800.2205	1072376.324	13483.6544
	Subtotal (g)	2047134.36	73194155	43362215	5444591.4	4480376.786	5580179.42	3504501423	52868.2304
	Subtotal (tons)	2.25657936	80.682745	47.79866	6.0016346	4.938770008	6.151094892	3863.051558	0.058277248

Appendix A
Emissions Calculations

GHGs expressed in metric tons/year

NAA Operations (2045)		ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4	CO2e
Traffic	Rail	0.2	4.3	0.0	0.1	0.1	4.7	1,416.3	0.0	1,416.3
	Vessel	3.5	117.6	62.8	8.2	6.8	9.1	4,705.0	0.1	4,706.9
	Truck/Vehicle/RR Maint.									0.0
Stationary F	Grain loadir	-	-	-	0.7	0.1	-	-	-	
Off-site	Vehicles & Crossing	0.1	0.4	0.0	0.0	0.0	4.7	616.2	0.0	616.8
	Total	3.7	122.3	62.8	9.0	6.9	18.5	6,737.5	0.1	6,740.1

GHGs expressed in metric tons/year

Project Operations, 204		ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4	CO2e
Mobile	Rail	0.3	7.8	0.0	0.1	0.1	8.5	2,582.1	0.0	2,582.1
	Vessel	4.2	143.5	83.9	10.8	8.9	11.0	5,810.1	0.1	5,812.4
	Truck/Vehicle/RR Maint.									0.0
Stationary F	Ship Loade	-	-	-	1.4	0.2	-	-	-	
Off-site	Vehicles & Crossing	0.1	0.8	0.0	0.0	0.0	7.7	1,027.3	0.0	1,028.3
	Total	4.6	152.1	84.0	12.4	9.2	27.2	9,419.5	0.1	9,422.7

GHGs expressed in metric tons/year

	NET	0.9	29.8	21.1	3.4	2.3	8.7	2681.9	0.0	2682.7

Transit EFS (g/kW-hr)

ROG	Nox	Sox	PM10	PM2.5	CO	CO2	CH4
0.6	17	0.38	0.24	0.23	1.4	589	0.012
0.6	17	0.38	0.24	0.23	1.4	589	0.012
0.11	3.38	0.00	0.10	0.09	0.75	390.30	0.02
0.6	18.085106	10.27027027	1.411764706	1.15	1.4	620	0.012
0.6	18.085106	10.27027027	1.411764706	1.15	1.4	620	0.012
0.1148492	3.5988365	0.098602711	0.565288237	0.4278673	0.7519995	410.84136	0.015832247

Aux Engine Efs (Transit, Maneuvering, Hotelling)

ROG	Nox	Sox	PM10	PM2.5	CO	CO2	CH4
0.4	13.8	0.44	0.24	0.23	1.1	686	0.008
0.4	13.8	0.44	0.24	0.23	1.1	686	0.008
0.52	13.9	0.4	0.25	0.23	1.1	6.9	0.09
0.4	14.68085106	11.89189	1.411764706	1.15	1.1	722.1053	0.008
0.4	14.68085106	11.89189	1.411764706	1.15	1.1	722.1053	0.008
0.52	14.78723404	10.81081	1.470588235	1.15	1.1	7.263158	0.09

Appendix A
Emissions Calculations

Project									
Transit		ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4
Main	Auto/RoRo	413035.7045	12449658	7069980.5	971848.72	791651.7669	963749.98	426803561.3	8260.714
Main	Bulk	733934.4837	22122139	12562843	1726904.7	1406707.76	1712513.8	758398966.5	14678.69
Main	Ocean Tug	9057.947103	283833.58	7776.6135	44583.238	33745.10091	59308.812	32402298.73	1248.66
Aux	Auto/RoRo	13030.29875	469918.32	279201.62	34919.668	28770.89963	35833.322	23182033.05	260.606
Aux	Bulk	31966.71618	1152832	684954.28	85667.039	70582.50932	87908.469	56871564.14	639.3343
Aux	Ocean Tug	2230.36309	62321.218	33419.742	4789.3515	3788.185925	4718.0758	30701.12853	386.0244
	Subtotal (g)	1203255.513	36540702	20638175	2868712.7	2335246.223	2864032.5	1297689125	25474.03
	Subtotal (tons)	1.326362162	40.279229	22.749694	3.1622144	2.574168325	3.1570554	1430.4574	0.02808
Hotelling		ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4
Main	Auto/RoRo	-	-	-	-	-	-	-	-
Main	Bulk	-	-	-	-	-	-	-	-
Main	Tug/Barge	-	-	-	-	-	-	-	-
Aux	Auto/RoRo	1497100.8	53990711	32078541	4012054	3305598.566	4117027.2	2663472335	29942.02
Aux	Bulk	1038681.6	37458505	22255943	2783544.5	2293408.973	2856374.4	1847904768	20773.63
Aux	Ocean Tug	77905.55876	2176851.5	1167336.2	167289.85	132319.5952	164800.22	1072376.324	13483.65
	Subtotal (g)	2613687.959	93626067	55501820	6962888.4	5731327.134	7138201.8	4512449479	64199.3
	Subtotal (tons)	2.8810978	103.20507	61.180284	7.6752706	6.317706727	7.8685206	4974.1241	0.070768

From GHG Inv:

Bunker fuel	6800000	MT CO2e	in 2019
	1,105.5	MT CO2e	project
	0.0163%		

State Locomotive GHGs

334000	1,165.7		
	0.349%		
	2,682.7	0.0026%	
	102100000		

Appendix A
Emissions Calculations

Year	Large line haul NOx (g/gal)	PM10 (g/gal)	HC (g/gal)	SO2 (g/gal)	CO2 (g/gal)	CO (g/gal)	Large switch NOx (g/gal)	PM10 (g/gal)	HC (g/gal)	overall average NOx (g/gal)	PM10 (g/gal)	HC (g/gal)
2007	175	6.3	9.3				249	6.5	15	183	6.3	9.8
2008	169	5.1	9				243	5.5	14.5	177	5.1	9.5
2009	165	4.9	8.7				241	5.5	14.5	172	4.9	9.1
2010	157	4.7	8.3				236	5.4	14.1	165	4.7	8.8
2011	149	4.4	7.7				235	5.3	14	157	4.5	8.2
2012	144	4.1	7.1				227	5.1	13.3	152	4.2	7.6
2013	139	3.8	6.5				225	5	13.3	147	3.9	7.1
2014	135	3.6	6.1				217	4.8	12.7	143	3.7	6.7
2015	129	3.4	5.7				215	4.8	12.6	137	3.5	6.3
2016	121	3.1	5.1				208	4.6	12	129	3.3	5.7
2017	114	2.9	4.6				206	4.5	11.8	122	3	5.2
2018	108	2.7	4.2				202	4.4	11.5	117	2.8	4.8
2019	103	2.5	3.9				200	4.4	11.4	112	2.6	4.5
2020	99	2.3	3.6				187	4.1	10.5	107	2.5	4.2
2021	94	2.2	3.4				185	4	10.4	102	2.4	4
2022	89	2	3.2				177	3.9	9.8	97	2.2	3.8
2023	84	1.9	3				172	3.7	9.5	92	2.1	3.6
2024	79	1.7	2.8				162	3.5	8.9	87	1.9	3.4
2025	74	1.6	2.6	0.093888	10217.28	26.624	150	3.2	8	81	1.8	3.1
2026	69	1.5	2.5				144	3.1	7.6	77	1.6	2.9
2027	65	1.4	2.3				138	3	7.3	72	1.5	2.8
2028	61	1.3	2.1				132	2.8	6.9	68	1.4	2.6
2029	57	1.1	2				126	2.7	6.5	64	1.3	2.4
2030	53	1	1.9				119	2.5	6.2	60	1.2	2.3
2031	49	1	1.7				112	2.4	5.8	56	1.1	2.2
2032	46	0.9	1.6				105	2.2	5.5	52	1	2
2033	43	0.8	1.5				98	2.1	5.1	49	0.9	1.9
2034	40	0.7	1.4				91	1.9	4.7	46	0.9	1.8
2035	37	0.7	1.3				84	1.7	4.4	43	0.8	1.7
2036	35	0.6	1.2				77	1.6	4	40	0.7	1.6
2037	33	0.6	1.2				71	1.5	3.7	38	0.7	1.5
2038	31	0.5	1.1				67	1.4	3.6	36	0.6	1.4
2039	29	0.5	1.1				63	1.3	3.4	34	0.6	1.4
2040	28	0.4	1				60	1.2	3.2	32	0.5	1.3
2041	28	0.4	1				60	1.2	3.2	32	0.5	1.3
2042	28	0.4	1				60	1.2	3.2	32	0.5	1.3
2043	28	0.4	1				60	1.2	3.2	32	0.5	1.3
2044	28	0.4	1				60	1.2	3.2	32	0.5	1.3
2045	28	0.4	1	0.093888	10217.28	26.624	60	1.2	3.2	32	0.5	1.3

Appendix A
Emissions Calculations

Source: EPA 2009. Emission Factors for Locomotives. US EPA, April 2009.

On-Site Exhaust - Running ER-on = EF * On-Site Running Hours * Number of Locomotives * HP * LF / C

On-Site Exhaust - Idling EI-on = EF * On-Site Idling Hours * Number of Locomotives * HP * LF / C

EF: emission factor (g/gal). From

4000 HP: horsepower. Typical for locomotives in Project area

0.1 LF: load factor. From USEPA based on throttle notch position from EPA and typical for Project area movements.

C: unit conversion factor (hp-hr/gal). From .

fuel consumption rate			load factor	
20.8	hp-hr/gal	running	0.1	running
15.2	hp-hr/gal	switching	0.0056	idling

HC to VOC conversion 1.053

			Locomotiv	hrs/trip	trips	hrs/year	ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4	CO2e
Project	2025	Running	3	3.268	1329	4343.172	1512.38	51.86439	51.86439	883.8513	857.3357	14707.28	5644097		5644097
Project	2025	Idling	3	1	664.5	664.5	12.95797	350.2409	7.935188	350.2409	339.7337	2250.197	48358.24		48358.24
						total	1525.338	402.1053	59.79958	1234.092	1197.069	16957.48	5692456	0	5692456
Project	2045	Running	3	3.268	1329	4343.172	581.6846	15467.4	51.86439	220.9628	214.3339	14707.28	5644097		5644097
Project	2045	Idling	3	1	664.5	664.5	4.983834	132.5236	7.935188	1.893194	1.836398	2250.197	48358.24		48358.24
						total	586.6684	15599.92	59.79958	222.856	216.1703	16957.48	5692456	0	5692456

NAA	2025	Running	3	3.268	729	2382.372	829.5899	28.44932	28.44932	484.8213	470.2767	8067.427	3095972		3095972
NAA	2025	Idling	3	1	364.5	364.5	7.10787	192.1186	4.352711	192.1186	186.3551	1234.306	26526.08		26526.08
						total	836.6978	220.5679	32.80203	676.94	656.6318	9301.734	3122498	0	3122498
NAA	2045	Running	3	3.268	729	2382.372	319.073	8484.373	28.44932	121.2053	117.5692	8067.427	3095972		3095972
NAA	2045	Idling	3	1	364.5	364.5	2.733796	72.69353	4.352711	1.038479	1.007325	1234.306	26526.08		26526.08
						total	321.8068	8557.067	32.80203	122.2438	118.5765	9301.734	3122498	0	3122498

Appendix A
Emissions Calculations

Fugitive Dust		Emissions (tpy)	
Construction		PM10	PM2.5
Dumping Fill	mat handling eq	2.504201122	0.379208
Levelling Fill	dozer eq	0.130336069	0.018247
Filling Trucks (Onsite)	mat handling eq	1.727035257	0.261522
Unpaved Road Use	unpaved eq	0.001985053	0.000199
Commute	paved road	0.354787494	0.087084
		4.718344996	0.74626
Operational			
commute	paved road		
rail?			

Appendix A
Emissions Calculations

		2006 EPA	Mat Handling Eq
			PM10
		1.85903E-05	EF = emission factor (lbs/ton
		0.35	k = particle size multiplier (dimensionless) = 0.74 for PM, 0.35 for PM10, and 0.053 for PM2.5
		1.34	U = mean wind speed (mph)
		11	M = material moisture content (%)
onsite dumping of fill		2.504201122	E = emission rate (lbs/day or tons/yr)
290000	929	269410000	Q = material transferred (tons/day or tons/yr)
cu yards	lb/cu yd	0	C = control efficiency
			PM2.5
		2.8151E-06	EF = emission factor (lbs/ton
		0.053	k = particle size multiplier (dimensionless) = 0.74 for PM, 0.35 for PM10, and 0.053 for PM2.5
		1.34	U = mean wind speed (mph)
		11	M = material moisture content (%)
		0.379207599	E = emission rate (lbs/day or tons/yr)
		269410000	Q = material transferred (tons/day or tons/yr)
		0	C = control efficiency
		2006 EPA	
			PM10
		1.85903E-05	EF = emission factor (lbs/ton
		0.35	k = particle size multiplier (dimensionless) = 0.74 for PM, 0.35 for PM10, and 0.053 for PM2.5
		1.34	U = mean wind speed (mph)
		11	M = material moisture content (%)
onsite truck filling		1.727035257	E = emission rate (lbs/day or tons/yr)
200000	929	185800000	Q = material transferred (tons/day or tons/yr)
cu yards	lb/cu yd	0	C = control efficiency
			PM2.5
		2.8151E-06	EF = emission factor (lbs/ton
		0.053	k = particle size multiplier (dimensionless) = 0.74 for PM, 0.35 for PM10, and 0.053 for PM2.5
		1.34	U = mean wind speed (mph)
		11	M = material moisture content (%)
		0.261522482	E = emission rate (lbs/day or tons/yr)
		185800000	Q = material transferred (tons/day or tons/yr)
		0	C = control efficiency

Appendix A
Emissions Calculations

Dozer eq			Scaling Factors	
((1.0*s^1.5)/(M^1.4))	1.448179	lb/hr TSM	1.086134	lb/hr PM10
Where s = silt content (%)			0.152059	lb/hr PM2.5
M =moisture content (%)				
		30 days	260.6721	lb PM10 for grading casting basin
		8 hrs/day	36.4941	lb PM2.5 for grading casting basin

					Industry	Silt Conten	Mean content (%)		
	unpaved road (onsite hauling dust)				Constructic	0.56-23	8.5		
	200000	cu yards							
	25	cu yd/trip			E= k[(2/12)^a]*[(W/3)^b]				
	8000	trips							
	1.0874	miles distance round trip			where k, a, b, c and d are empirical constants (Reference 6) given below and				
	8699.197	VMT on-site haul trucks			E = size-specific emission factor (lb/VMT)				
					s = surface material silt content (%)			W=	70
PM10	3.970106	PM2.5	0.397011		W = mean vehicle weight (tons)			52	34
					k (PM10)	1.5	k (PM2.5)	0.15	
					a	0.9	a	0.9	
					b	0.45	b	0.45	

Paved road fugitive dust				PM10	PM2.5	
	lb/VMT	Emissions (tons				E = k (sL)^0.91x (W)^1.02
PM10	0.000521	709.575	0.354787	0.0022	0.00054	E = particulate emission factor (having units matching the units of k),
PM2.5	0.000128	174.1684	0.087084			k = particle size multiplier for particle size range and units of interest (see below),
					0.06	sL = road surface silt loading (grams per square meter) (g/m2), and
					3	W = average weight (tons) of the vehicles traveling the road.

Appendix A
Emissions Calculations

	AGP Project Operation - Stationary Source Emissions

		PM10
	0.000428755	EF = emission factor (lbs/ton)
	0.35	k = particle size multiplier (dimensionless) = 0.74 for PM, 0.35 for PM10, and 0.053 for PM2.5
	6.408333333	U = mean wind speed (mph)
	5	M = material moisture content (%)
	1.417865859	E = emission rate (lbs/day or tons/yr)
6 MMT/yr	6613867.866	Q = material transferred (tons/day or tons/yr)
per AGP	0	C = control efficiency
		PM2.5
	6.49258E-05	EF = emission factor (lbs/ton)
	0.053	k = particle size multiplier (dimensionless) = 0.74 for PM, 0.35 for PM10, and 0.053 for PM2.5
	6.408333333	U = mean wind speed (mph)
	5	M = material moisture content (%)
	0.214705402	E = emission rate (lbs/day or tons/yr)
	6613867.866	Q = material transferred (tons/day or tons/yr)
	0	C = control efficiency

	Existing/Baseline	
		PM10
	0.000428755	EF = emission factor (lbs/ton)
	0.35	k = particle size multiplier (dimensionless) = 0.74 for PM, 0.35 for PM10, and 0.053 for PM2.5
	6.408333333	U = mean wind speed (mph)
	5	M = material moisture content (%)
	0.70893293	E = emission rate (lbs/day or tons/yr)
3 MMT/yr	3306933.933	Q = material transferred (tons/day or tons/yr)
per AGP	0	C = control efficiency
		PM2.5
	6.49258E-05	EF = emission factor (lbs/ton)
	0.053	k = particle size multiplier (dimensionless) = 0.74 for PM, 0.35 for PM10, and 0.053 for PM2.5
	6.408333333	U = mean wind speed (mph)
	5	M = material moisture content (%)
	0.107352701	E = emission rate (lbs/day or tons/yr)
	3306933.933	Q = material transferred (tons/day or tons/yr)
	0	C = control efficiency

Source: AP-42 Section 13 Materials Handling Emission Factors. USEPA. 2016
Wind speed based on Average Wind Speed at Bowerman Airport, per weatherspark.com

3000000	MT soybeans
3306933.933	tons meal

Appendix A
Emissions Calculations

Onroad Vehicle Emission Factors - MOVES3 aggregated results

Vehicle Class	YearID	StateID	CountyID	SourceTypeID	regClassId	ActivityTypeId	Activity (miles)	ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4
HHD	2024	53	53027	62	49	1	64811061.51	0.00020119	0.007328	1.094E-05	0.00010951	0.00010074	0.0048	3.229693	0.000425
MHD	2024	53	53027	62	46	1	13366273.86	0.00014511	0.00279	7.569E-06	5.3769E-05	4.9445E-05	0.00326	2.11587	2.217E-05
LHD	2024	53	53027	53	42	1	58598011.64	5.9949E-05	0.000876	3.013E-06	1.9291E-05	1.7686E-05	0.00163	0.752011	9.333E-06
LDT	2024	53	53027	32	30	1	504622980.6	6.1228E-05	0.000324	4.717E-06	5.1346E-06	4.5438E-06	0.00537	0.714929	1.875E-05
LDV	2024	53	53027	21	20	1	368125456.4	4.3197E-05	0.00017	3.599E-06	3.8446E-06	3.4017E-06	0.00468	0.543935	1.491E-05

from
POGH T4 Onroad.V4 Efs.xls
12/29/2022

Weighted average vehicular EFs in lb/hr, for railroad crossing delay emissions									
	Activity	ROG	Nox	SO2	PM10	PM2.5	CO	CO2	CH4
All Vehicles	25891189	0.0025193	0.03046075	0.00018	0.0005	0.0004542	0.188527	32.50092	0.001673

Appendix A
Emissions Calculations

Puget-Sound-Maritime-Air-Forum-Puget-Sound-Maritime-Air-Emissions-Inventory-2018_04.pdf (safety4sea.com)

Appendix B

Table B.2: Emission Factors for Propulsion Engines using 0.1 %S MDO, g/kW-hr

Engine Category	Model Year	NOx	HC	CO	SO2	PM10	PM2.5	DPM	Black Carb	CO2	N2O	CH4
Slow speed main (Tier 0)	1999 and older	17	0.6	1.4	0.38	0.24	0.23	0.24	0.0137	589	0.029	0.012
Slow speed main (Tier 1)	2000 to 2011	16	0.6	1.4	0.38	0.24	0.23	0.24	0.0137	589	0.029	0.012
Slow speed main (Tier 2)	2011 to 2016	14.4	0.6	1.4	0.38	0.24	0.23	0.24	0.0137	589	0.029	0.012
Slow speed main (Tier 3)	2016 +	3.4	0.6	1.4	0.38	0.24	0.23	0.24	0.0137	589	0.029	0.012
Medium speed main (Tier 0)	1999 and older	13.2	0.5	1.1	0.42	0.24	0.23	0.24	0.0137	649	0.029	0.01
Medium speed main (Tier 1)	2000 to 2011	12.2	0.5	1.1	0.42	0.24	0.23	0.24	0.0137	649	0.029	0.01
Medium speed main (Tier 2)	2011 to 2016	10.5	0.5	1.1	0.42	0.24	0.23	0.24	0.0137	649	0.029	0.01
Medium speed main (Tier 3)	2016 +	2.6	0.5	1.1	0.42	0.24	0.23	0.24	0.0137	649	0.029	0.01
Gas turbine	All	5.7	0.1	0.2	0.6	0.01	0.01	0	0.0006	922	0.075	0.002
Steam main engine and boiler	All	2	0.1	0.2	0.6	0.16	0.15	0	0.0089	922	0.075	0.002
Ocean Tug	All	13	0.27	2.5	1.3	0.3	0.28	0.3	0.2156	690	0.031	0.01

Table B.7: Auxiliary Engine Emission Factors, g/kW-h

Engine Category	Model Year	NOx	HC	CO	SO2	PM10	PM2.5	DPM	Black Carb	CO2	N2O	CH4
Medium speed auxiliary (Tier 0)	1999 and older	13.8	0.4	1.1	0.44	0.24	0.23	0.24	0.0138	686	0.029	0.008
Medium speed auxiliary (Tier 1)	2000 to 2011	12.2	0.4	1.1	0.44	0.24	0.23	0.24	0.0138	686	0.029	0.008
Medium speed auxiliary (Tier 2)	2011 to 2016	10.5	0.4	1.1	0.44	0.24	0.23	0.24	0.0138	686	0.029	0.008
Medium speed auxiliary (Tier 3)	2016 +	2.6	0.4	1.1	0.44	0.24	0.23	0.24	0.0138	686	0.029	0.008
High speed auxiliary (Tier 0)	1999 and older	10.9	0.4	0.9	0.44	0.24	0.23	0.24	0.0138	656	0.029	0.008
High speed auxiliary (Tier 1)	2000 to 2011	9.8	0.4	0.9	0.44	0.24	0.23	0.24	0.0138	656	0.029	0.008
High speed auxiliary (Tier 2)	2011 to 2016	7.7	0.4	0.9	0.44	0.24	0.23	0.24	0.0138	656	0.029	0.008
High speed auxiliary (Tier 3)	2016 +	2	0.4	0.9	0.44	0.24	0.23	0.24	0.0138	656	0.029	0.008
Ocean Tug	All	13	0.27	2.5	1.3	0.3	0.28	0.3	0.2156	690	0.031	0.01

Table B.8: 2016 Auxiliary Engine Load Defaults, kW

Vessel Type	Transit	Maneuveri	Berth Hote	Anchorage Hotelling
Auto Carrier	590	1,224	996	622
Bulk	266	384	376	253
Bulk - Heavy Load	462	1,223	272	253
Bulk - Self Discharging	305	807	179	305
Container - 1000	892	1,275	558	1,000
Container - 2000	1,280	1,911	644	1,012
Container - 3000	888	1,685	710	694
Container - 4000	1,499	2,528	980	1,200
Container - 5000	1,444	2,458	979	967
Container - 6000	1,598	2,665	928	1,645
Container - 7000	1,332	2,675	1,758	1,000
Container - 8000	1,497	2,550	1,018	986
Container - 9000	1,495	2,576	980	968
Container - 10000	1,662	2,130	1,104	1,129
Container - 11000	1,250	2,450	1,500	2,000
Container - 17000	1,500	1,750	1,000	1,000
General Cargo 471	1,096	829	180	
ATB	79	208	102	79
Miscellaneous	834	820	300	200
Reefer	1,247	1,168	1,033	630
RoRo	132	396	229	132
Tanker - Chemical	417	583	1,271	402
Tanker - Handysize	560	600	900	560
Tanker - Panamax	488	600	797	379
Tanker - Aframax	556	628	909	474
Tanker - Suezmax	858	1,289	2,902	773
Ocean Tug				

Table B.10: Auxiliary Boiler Emission Factors, g/kW-hr

Engine Category	Model Year	NOx	HC	CO	SO2	PM10	PM2.5	DPM	Black Carb	CO2	N2O	CH4
Steam main engine and boiler	All	2	0.1	0.2	0.6	0.16	0.15	0	0.0089	922	0.075	0.002