Appendix D
Air Quality and Greenhouse Gases Resource Analysis Report

December 2022

Proposed Goldendale Energy Storage Project

Air Quality and Greenhouse Gases Resource Analysis Report

Prepared for

DEPARTMENT OF ECOLOGY
State of Washington

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Acronyms and Abbreviations

CAA	Clean Air Act
CCA	Washington Climate Commitment Act
CETA	Washington Clean Energy Transformation Act
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
DPM	diesel particulate matter
Ecology	Washington Department of Ecology
EIS	Environmental Impact Statement
GHG	greenhouse gas
HAP	hazardous air pollutant
mph	miles per hour
MTCA	Model Toxics Control Act
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NOC	Notice of Construction
NO_2	nitrogen dioxide
NO_x	oxides of nitrogen
NSPS	New Source Performance Standards
O_3	ozone
PM	particulate matter
PM_{10}	Particulate matter with an equivalent aerodynamic diameter less than or equal to 10 microns
$PM_{2.5}$	Particulate matter with an equivalent aerodynamic diameter less than or equal to 2.5 microns
ppb	parts per billion
ppm	parts per million
PSD	Prevention of Significant Deterioration
RCW	Revised Code of Washington

SO_2	sulfur dioxide
TAP	toxic air pollutant
tpy	tons per year
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compounds
WAC	Washington Administrative Code
WSI	West Surface Impoundment
$\mu g/m^3$	micrograms per cubic meter of air

Summary

This report describes the air quality and greenhouse gas (GHG) existing conditions in the study area. It also describes the potential impacts on these resources from the proposed project and the No Action Alternative.

Construction and operation phase air emissions of criteria pollutants and GHGs were quantified according to planned and anticipated aspects of the proposed project. Best engineering practices and published emission factors were used to estimate total emission rates. Assumptions were made to address any uncertainties in elements of emissions calculations. Assumptions were conservative to avoid understating emission rates.

As described in this report, construction and operation phase emissions and GHG pollutants were determined to not result in significant adverse impacts. Mitigation measures were proposed to reduce impacts related to construction phase criteria and GHG pollutants, as summarized in Table 1.

Table 1
Air Quality and GHG Impact Summary

TYPE OF IMPACT	SIGNIFICANT ADVERSE IMPACT FINDING	MITIGATION REQUIRED BY PERMIT	ADDITIONAL MITIGATION PROPOSED	SIGNIFICANT AND UNAVOIDABLE ADVERSE IMPACT
Proposed Project: Construction				
Ambient air emissions (non-GHGs)	No	Use of best management practices during the construction phase	None	No
GHGs	No	None	Selection of most efficient and lowest practical emissions equipment	No
Hazardous and toxic air pollutants	No	None	None	No
Proposed Project: Operations				
Ambient air emissions (non-GHGs)	No	Non-road engines must meet emission standards in 40 Code of Federal Regulations (CFR) Part 60 Subpart JJJJ, or more stringent if required by Washington Department of Ecology Central Region during air permit application-specific Best Available Control Technology analysis	Selection of most efficient and lowest practical emissions	No
GHGs	No	None	None	No
Hazardous and toxic air pollutants	No	None	None	No

TYPE OF IMPACT	SIGNIFICANT ADVERSE IMPACT FINDING	MITIGATION REQUIRED BY PERMIT	ADDITIONAL MITIGATION PROPOSED	SIGNIFICANT AND UNAVOIDABLE ADVERSE IMPACT
No Action Alternative				
Ambient air emissions (non-GHGs)	No	None	None	No
GHGs	No	None	None	No

Note: Additional mitigation measures are proposed by the Applicant and/or Washington Department of Ecology.

1 Introduction

Free Flow Power Project 101, LLC (the Applicant) proposes to build a pumped-water energy storage system that is capable of generating energy through release of water from an upper reservoir down to a lower reservoir. This is referred to as the “proposed project.” This report describes air quality and GHG emissions related to the proposed project within the study area and assesses probable significant adverse impacts related to these resources that would be associated with construction and operation of the proposed project and a No Action Alternative. Chapter 2 of the State Environmental Policy Act Environmental Impact Statement (EIS) provides a more detailed description of the proposed project and No Action Alternative.

1.1 Resource Description

The proposed project has the potential to release emissions of air pollutants and GHGs during construction and operation phases. Criteria pollutants include particulate matter (PM), oxides of nitrogen, sulfur dioxide, carbon monoxide, and ozone. Emissions are also possible for volatile organic compounds (VOC) and hazardous or toxic air pollutants (HAPs/TAPs). These pollutants, in general, have the potential to directly impact the health and welfare of nearby human, plant, and animal species. The emission rate of criteria pollutants and HAPs/TAPs forms the foundation of the air quality analysis to determine the magnitude of potential impacts from project emission rates.

Gases that trap heat in the atmosphere are referred to as GHGs because they capture heat radiated from the sun as it is reflected back into the atmosphere from the Earth, much like a greenhouse. The accumulation of GHGs such as carbon dioxide, methane (CH_4), and nitrous oxide contributes to global climate change. The emission rate of each GHG species is multiplied by the global warming potential of the gas to compute the total carbon dioxide equivalent (CO_2e) emission rate, which forms the foundation of the GHG analysis. Chapter 5, Climate Change, of the EIS will evaluate adverse impacts that contribute to the effects of climate change (e.g., the effects of any new sources of GHG emissions that are identified in this report).

GHGs

Primary GHGs associated with project emission sources include carbon dioxide, methane, and nitrous oxide.

1.2 Regulatory Context

Table 2 identifies the laws, plans, and policies relevant to the evaluation of air quality and GHGs in the study area. Additional narrative descriptions for the major regulatory components are included in subsections for each regulatory body, following Table 2.

Table 2
Applicable Laws, Plans, and Policies

REGULATION, STATUTE, GUIDELINE	DESCRIPTION
Federal	
Clean Air Act (United States Code 42.7401 et seq.)	• Applicable to construction and operation phase emissions of air pollutants (criteria and HAPs). Will require a Washington Department of Ecology Notice of Construction (NOC) permit for construction phase emissions and operating phase emissions.
National Ambient Air Quality Standards (NAAQS) (CFR 40.50)	• Applicable to construction and operation phase emissions. Permitting and enforcement is delegated to the Washington Department of Ecology. NAAQS compliance may be demonstrated with ambient dispersion modeling if potential emission rates are above criteria pollutant exemption levels codified in Washington Administrative Code (WAC) 173.400.110.
Federal New Source Review and Prevention of Significant Deterioration (CFR 40.51.165 and CFR 40.51.166)	• Discussed in further detail in Section 2.3.1. The proposed project will not require Federal New Source Review or a Prevention of Significant Deterioration Permit due to potential emissions below applicable thresholds.
Federal Title V Operating Permit Requirements (CFR 40.70)	• Discussed in further detail in Section 2.3.1. The proposed project will not require Federal Operating Permit due to potential emissions below applicable thresholds.
New Source Performance Standards (NSPS) (CFR 40.60)	• NSPS Subpart IIII covers operational phase stationary engine-generator sets and includes emission limits and work-practice standards.
National Emissions Standards for Hazardous Air Pollutants (NESHAP) (CFR 40.61 and CFR 40.63)	• NESHAP Subpart ZZZZ covers operational phase stationary engine-generator sets and includes emission limits and work-practice standards.
State	
WAC 173.400 series general regulations for air pollution sources	• Applicable to construction and operation phase emissions of air pollutants (criteria and TAPs). Will require a Washington Department of Ecology NOC permit for construction phase emissions and will require an NOC for operation phase emissions. May require approval to operate non road engines. • WAC 173.476 includes state ambient air quality standards, which are identical to the NAAQS with the addition of standards for 24-hour and annual averaged sulfur dioxide.
Revised Code of Washington (RCW) 70A.15 Washington Clean Air Act	• Applicable to construction and operation phase emissions of air pollutants (criteria and TAPs). Will require a Washington Department of Ecology NOC permit for construction phase emissions and will require an NOC for operation phase emissions.
WAC 173.401 Operating Permit Regulations	• Establishes state operating permit requirements for facilities exceeding applicability thresholds. The proposed project will not require a state operating permit due to potential emissions below applicable thresholds.

REGULATION, STATUTE, GUIDELINE	DESCRIPTION
RCW 70A.45 Limiting GHG Emissions	• Sets statewide GHG emission reduction targets in reference to 1990 emission levels. As a statewide goal, RCW 70A.45 is not directly applicable to the proposed project but is a tool for the state to make progress on reducing statewide emissions toward GHG reduction goals.
Washington Climate Commitment Act (CCA)	• Establishes a GHG cap-and-invest program that would start in 2023. • CCA rulemaking is underway by Washington Department of Ecology to amend WAC 173.441 (Reporting of Emissions of Greenhouse Gases) to expand persons subject to reporting and improve reporting requirements. The draft rule would initially be applicable to industrial facilities, certain fuel suppliers, in-state electricity generators, electricity importers, and natural gas distributors with annual GHG emissions above 25,000 metric tons CO_2e.
Washington Clean Energy Transformation Act (CETA)	• CETA commits Washington to an electricity supply free of GHG emissions by 2045.
Local	
Not applicable	• Klickitat County does not have a local air quality or GHG code.

1.2.1 U.S. Environmental Protection Agency

The regulatory framework for air quality includes both federal and state rules, regulations, and standards promulgated by the U.S. Environmental Protection Agency (USEPA) and implemented by the Washington Department of Ecology (Ecology). On the federal level, the 1970 Clean Air Act (CAA) and subsequent amendments specify regulations for control of the nation's air quality.

One of the primary components of the CAA was the establishment of health-based air quality concentration standards. These standards, known as the National Ambient Air Quality Standards (NAAQS) are meant to establish pollutant concentrations that are protective of public health and welfare, and they specify the concentrations of pollutants (with an adequate margin of safety) to which the public can be exposed without adverse health effects. The NAAQS are designed to protect those segments of the public most susceptible to respiratory distress, including people with asthma, chronic obstructive pulmonary disease, or other lung diseases, as well as very young people, elderly people, and people engaged in strenuous work or exercise.

As required by the CAA, USEPA initially identified six criteria air pollutants that are pervasive in urban environments and for which state and federal health-based ambient air quality standards had been established. PM, oxides of nitrogen, sulfur dioxide, carbon monoxide, ozone, and lead were the six criteria air pollutants originally identified by USEPA. Since initial promulgation of the NAAQS, USEPA has refined the NAAQS to include size categories of PM to include PM_{10} (matter less than or equal to 10 microns in diameter) and $PM_{2.5}$ (matter less than or equal to 2.5 microns in diameter). Table 3 identifies the current federally enforceable NAAQS and the form of the standard (i.e., how the standard is applied). The determination of an area of ambient air being in compliance with the NAAQS is based on pollutant concentrations as averaged across applicable time intervals, such as 1-hour, 24-hour, annual, etc. The form of the standard also varies by pollutant and is described in Table 3. Primary standards provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Table 3 also describes additional ambient standards specific to the State of Washington.

Pursuant to the CAA, USEPA has developed classifications for distinct geographical regions that have atmospheric concentrations of pollutants above or below the NAAQS. USEPA designates whole or partial counties as Attainment, Non-Attainment, or Maintenance for each criteria air pollutant. Regions classified as Attainment are areas in which the pollutant has not exceeded the NAAQS. A Non-Attainment classification represents an area in which the pollutant has exceeded the NAAQS. The Maintenance designation is used when monitored pollutants have been reduced from the Non-Attainment to the Attainment levels. Finally, areas in which USEPA is not able to determine an attainment status are designated Unclassifiable.

Table 3

National Ambient Air Quality Standards and State Standards

POLLUTANT		PRIMARY/ SECONDARY	AVERAGING TIME	STANDARD	FORM (I.E., HOW STANDARD IS APPLIED)	FEDERAL OR STATE STANDARD
Carbon monoxide (CO)		Primary	8-hour	9 ppm	Not to be exceeded more than once a year	Federal and state
		Primary	1-hour	35 ppm	Not to be exceeded more than once a year	Federal and state
Lead		Primary and secondary	Rolling 3-month average	0.15 µg/m³	Not to be exceeded	Federal and state
Nitrogen dioxide (NO_2)		Primary	1-hour	100 ppb	98th percentile of 1-hour daily maximum concentration, averaged over 3 years	Federal and state
		Primary and secondary	Annual	53 ppb	Annual mean	Federal and state
Ozone		Primary and secondary	8-hour	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years	Federal and state
Particle pollution	$PM_{2.5}$	Primary	Annual	12 µg/m³	Annual mean, averaged over 3 years	Federal and state
		Secondary	Annual	15 µg/m³	Annual mean, averaged over 3 years	Federal and state
		Primary and Secondary	24-hour	35 µg/m³	98th percentile, averaged over 3 years	Federal and state
	PM_{10}	Primary and secondary	24-hour	150 µg/m³	Not to be exceeded more than once per year on average over 3 years	Federal and state
Sulfur dioxide (SO_2)		Primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years	Federal and state
		Secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year	Federal and state
		Not applicable	24-hour	0.14 ppm	Not to be exceeded more than once per calendar year; the 24-hour averages must be determined from successive nonoverlapping 24-hour blocks starting at midnight each calendar day	State only
		Not applicable	Annual	0.02 ppm	Not to be exceeded in a calendar year	State only

Source: USEPA 2021 and WAC 173.476

The CAA also divides areas where air quality is already cleaner than required by federal standards into three classes, and specifies the increments of sulfur dioxide, nitrogen dioxide, and particulate pollution allowed in each class as regulated by the Prevention of Significant Deterioration (PSD) regulations (Code of Federal Regulations [CFR] 40.52.21). Class I areas include international and national parks, wilderness, and other pristine areas; allowable increments of new pollution in these areas are very small. Class II areas include all Attainment and Unclassifiable areas that are not designated as Class I; allowable increments of new pollution in these areas are modest. Class III represents selected areas that states may designate for development; allowable increments of new pollution are large (but not exceeding NAAQS). No Class III areas are designated in Washington. All areas not designated as Class I are initially designated as Class II areas. The proposed project would be in a Class II area. State agencies may designate sensitive non-Class I areas to have Class I protections applied. Examples of such sensitive locations include historically significant areas, protected forest and wilderness areas, or protected scenic areas.

The PSD regulations are applicable to a source pollutant if the source has the potential to exceed the major source thresholds of either 100 or 250 tons per year (tpy) of a regulated New Source Review pollutant, depending on the facility's regulated source category. For stationary source categories listed in the regulation, such as Kraft pulp mills and Portland cement plants, the threshold is 100 tpy. For source categories that are not listed, such as the proposed project operations, the threshold is 250 tpy. The potential to emit calculations do not include fugitive dust emissions for the purpose of determining if the facility exceeds the 250-tpy threshold.

Fugitive Emissions

Fugitive emissions are defined by USEPA as "those emissions that could not reasonably pass through a stack, chimney, vent, or other functionally-equivalent opening."

Federal PSD regulations limit the maximum allowable increase in ambient pollutant concentration in Class I, Class II, and Class III areas (Table 4). The nearest Class I areas to the proposed project are the Mount Adams Wilderness, 50 miles (80 kilometers) northwest, and the Mount Hood Wilderness, 53 miles (85 kilometers) southwest. Both are generally upwind of the project area. The newest Class I area is the Eagle Cap Wilderness, 147 miles (250 kilometers) southeast. The Columbia Gorge National Scenic area is a potential sensitive non-Class I area located approximately 8.5 miles to the southwest of the project area boundary.

Table 4
Federal Prevention of Significant Deterioration Limits

		MAXIMUM ALLOWABLE INCREASE (µG/M³)		
POLLUTANT	AVERAGING TIME	CLASS I AREA AND SENSITIVE NON CLASS I AREA	CLASS II AREA	CLASS III AREA
$PM_{2.5}$	Annual	1	4	8
	24-hour	2	9	18
PM_{10}	Annual	4	17	34
	24-hour	8	30	60
SO_2	Annual	2	20	40
	24-hour	5	91	182
	3-hour	25	512	700
NO_2	Annual	2.5	25	50

The CAA also enacted the New Source Performance Standards (NSPS) and National Emissions Standards for Hazardous Air Pollutants (NESHAP) for specific types of equipment located at new or modified stationary pollutant sources. NSPS and NESHAP regulations limit emissions from source categories to minimize the deterioration of air quality. Stationary sources are required to meet these limits by installing newer equipment or adding pollution controls to older equipment that reduce emissions below the specified limit.

The CAA Amendments of 1990 introduced a new facility-wide Federal Operating Permit program. Federal Operating Permits, also known as Title V permits, are required for facilities with the potential to emit more than 100 tpy of a regulated pollutant, 10 tpy of any single HAP, or 25 tpy of any combination of HAPs. These Title V applicable facilities are considered to be major sources of air quality emissions. No NAAQS exist for HAPs. Instead, emissions of these pollutants are regulated by a variety of laws (e.g., NESHAPs) that target the specific source class and industrial sectors for stationary, mobile, and product use/formulations. However, Title V permitting is still required if HAP emissions rise above the defined thresholds.

Source Classes

Source classes are groups of sources that generate a specific pollutant (beryllium, asbestos, etc.) or operate in a particular industrial sector

1.2.2 Washington Department of Ecology

Ecology's Air Quality Program safeguards public health and the environment by preventing and reducing air pollution. Emissions sources within Washington occur from both anthropogenic and non-anthropogenic sources. Anthropogenic sources include motor vehicles, area sources (like home and building heating), and regulated industrial sources. For non-anthropogenic sources, emissions occur from wildfire smoke and dispersed wind-blown dust sources.

Ecology implements the federal CAA through the State Implementation Plan, which allows for planning and implementation of the NAAQS and federal stationary source permitting programs. Ecology further implements source permitting requirements under Washington Administrative Codes (WAC) 173.400, 173.401, and 173.460 to regulate source permit requirements, emissions controls, and regulatory requirements based on source class and source operating requirements. Ecology additionally implements State Ambient Air Quality Standards under WAC 173.476.

Finally, Ecology also oversees the statewide air monitoring network and ensures that collected monitoring data meet the requirements of CFR 40.58. The nearest monitors to the proposed project and the monitored concentrations are described in Section 3.2.

1.2.3 Ecology Central Regional Office

Air quality in Washington State is regulated by Ecology and authority is delegated to clean air agencies in individual locations. Seven clean air agencies regulate air quality within certain counties while Ecology regulates air quality in counties not represented by a clean air agency. The proposed project falls within Klickitat County, which is overseen by Ecology's Central Regional Office Air Quality Program (which oversees Chelan, Douglas, Kittitas, Klickitat, and Okanogan counties). As such, no additional local regulatory body would be relevant to the proposed project area.

2 Methodology

2.1 Study Area

The study area encompasses evaluation of the sources of air emissions associated with the construction and operation phases of the proposed project and the associated impacts. Operational phase emissions were quantified for sources within the proposed project area and according to planned regular operating scenarios.

The study area for evaluating air quality and GHG emissions includes the project footprint, areas traveled by construction vehicles and equipment within the project area, and immediately surrounding areas where odors may be perceptible, or health risks could result from emissions.

Construction phase emissions were evaluated for total magnitude and anticipated length of construction phase. These include on-site emissions for all construction-related activities. Construction phase emissions would be heavily influenced by non-patterned travel of mobile equipment around the project site. The variability in location of emission sources and operating scenarios presents difficulty for associating emission magnitudes with stationary locations and specific time intervals. Therefore, construction phase emissions were evaluated only for total magnitude across the entire project footprint and full length of time for the construction phase.

Operational phase emissions are similarly evaluated for the immediate proposed project area as well as the foreseeable regional impacts associated with operating and servicing the completed project.

The emissions quantification for each phase of the project was based on average projected emissions. The quantified emissions are compared to state and federal permitting thresholds for context and assessment of significance; however, the emissions quantified are not meant to determine final permit applicability for the facility. Once final equipment is selected and operating scenarios are specified, maximum potential emissions will be required to be calculated for determination of final permit applicability.

2.2 Technical Approach

The total magnitude of emissions from on-site sources was quantified for the full period of construction. The annualized average emissions within the control of the site operator (limited to on-site sources) was calculated (or quantified) for the operation phase of the project. Emission factors for construction and operation were sourced from AP-42 (USEPA 1995), CFR 40.98, or manufacturer supplied information. Operation phase emission rates were compared to thresholds in WAC 173 for pre-construction stationary source permitting.

2.3 Impact Assessment

2.3.1 Air Pollutant Emissions (Non-GHGs)

Criteria pollutant emission rates for the construction phase of the proposed project were compared to federal thresholds for the PSD and Title V program. Sources considered Major Stationary Sources per CFR 40.51(B)(1)(i) are subject to the PSD program based on annualized potential emissions of criteria pollutants (PM_{10}, $PM_{2.5}$,

Prevention of Significant Deterioration (PSD)

The PSD program is the USEPA-mandated pre-construction air permitting program for major stationary industrial sources.

carbon monoxide, oxides of nitrogen, sulfur dioxide, and VOC) greater than 250 tpy. For Title V operating permits, the threshold is 100 tpy for classification as a Major Source. Emissions from mobile sources and fugitive sources are not included for comparison to major source thresholds, per CFR 40.51. Temporary construction-related activities are typically exempted from the PSD/Title V permitting requirements. However, the purpose of this resource analysis is to juxtapose project emissions with relative impact indicators. The PSD/Title V major source thresholds have been identified as the most relevant thresholds for comparison for the construction phase in lieu of specific federal air permitting thresholds for temporary construction activities.

Analysis for the operational phase incorporated both the federal PSD/Title V thresholds and state air permitting thresholds requiring an Ecology Notice of Construction (NOC) and Air Operating Permit pursuant to WACs 173.400, 174.401, and 173.460. The NOC thresholds were added to the impact assessment for the operational phase because NOC permitting is potentially applicable to the operation phase based on stationary source emission rates. The operation phase would require an NOC permit if potential emissions of non-exempt sources are above the levels in WAC 173.400.110(5). These thresholds are different for each criteria pollutant. Example thresholds include 2.0 tpy of oxides of nitrogen, 0.75 tpy of PM_{10}, and 0.5 tpy of $PM_{2.5}$. Additionally, specific types of emission sources are exempt from NOC permitting requirements such as small combustion units (limited use of small generators, portable lighting, pumps, etc.) or small emergency generators. Operational phase air emissions are considered relative to whether an NOC permit would be required and whether the PSD permitting program would be applicable.

2.3.2 Greenhouse Gases

The State of Washington has multiple regulatory platforms aimed at reducing GHG emissions statewide, as summarized in Table 2 and Section 1.2.2, including Revised Code of Washington (RCW) 70A.45, Limiting GHG Emissions; the Washington Climate Commitment Act (CCA); and the Washington Clean Energy Transformation Act (CETA). The project GHG emissions were compared to these regulations for potential applicability. The CCA is the most relevant quantitative indicator, because it establishes thresholds and applicability criteria for the inclusion in the cap-and-invest program. RCW 70A.45 is a statewide goal that does not directly affect the project. The project is inherently in alignment with the goals of CETA by facilitating greater utilization of renewable energy sources and not producing GHGs associated with electricity generation itself. Provisions within RCW 70A.15.2200 require reporting of GHG emissions, with applicability thresholds as low as 10,000 metric tons per year of actual emissions. Reporting of GHG emissions will be potentially applicable to the project.

3 Technical Analysis and Results

3.1 Overview

This section describes the affected environment, or the conditions before any construction begins (Section 3.2), as well as findings of probable air quality and GHG impacts from the proposed project (Section 3.3) and the No Action Alternative (Section 3.4). For the proposed project, required permit conditions and regulatory program applicability that could address the impacts are identified (Section 3.3.3). The report also identifies mitigation measures that could avoid, minimize, or reduce potential impacts (Section 3.3.4) and determines if there would be significant and unavoidable adverse environmental impacts remaining after mitigation (Section 3.3.5).

3.2 Affected Environment

3.2.1 Climate

The proposed project would occur in Klickitat County in south central Washington, a region dominated by the climatological impact of the warming and drying that occurs on the western side of the Cascade Mountain Range. Washington has a predominantly marine-type climate west of the Cascades, and a climate that possesses both continental and marine characteristics east of the Cascades.

The predominate climate patterns are driven by the location and intensity of semi-permanent high and low-pressure areas over the North Pacific Ocean. Air circulates in a clockwise direction around the semi-permanent high-pressure cell and in a counter-clockwise direction around the semi-permanent low-pressure cell. During the spring and summer, the low-pressure cell becomes weak and moves north of the Aleutian Islands. At the same time, the high-pressure area spreads over most of the North Pacific Ocean. A circulation of air around the high-pressure center brings a prevailing westerly and northwesterly flow of comparatively dry, cool, and stable air into the Pacific Northwest. As the air moves inland, it becomes warmer and drier, which results in a dry season beginning in the late spring and reaching a peak in mid-summer.

In the fall and winter, the Aleutian low-pressure center intensifies and moves southward reaching a maximum intensity in midwinter. At the same time, the high-pressure area becomes weaker and moves southward. A circulation of air around these two pressure centers over the ocean brings a prevailing southwesterly and westerly flow of air into the Pacific Northwest. This air from over the ocean is moist and near the temperature of the water. Condensation occurs as the air moves inland over the cooler land and rises along the windward slopes of the mountains. This results in a wet season beginning in October, reaching a peak in winter, then gradually decreasing in the spring.

Although the Cascade Range divides the state into two major climatic regions, there are several district climatic areas within each of these regions. The study area in south central Washington is defined by warmer summer conditions and colder but drier winters. The average number of clear or only partly cloudy days each month varies from five to 10 in winter, 12 to 18 in spring and fall, and 20 to 28 in summer. The percent of possible sunshine received each month is from 20% to 30% in winter, 50% to 60% in spring and fall, and 80% to 85% in summer (WRCC 2021).

Annual precipitation ranges from seven to nine inches in the region with annual high temperature ranges that vary from 80°F to 90°F in the summer months to 30°F to 40°F in the winter months. During most of the year, the prevailing direction of the wind is from the southwest or west. The frequency of northeasterly winds is greatest in the fall and winter. Wind velocities ranging from 4 to 12 mph can be expected 60% to 70% of the time; 13 to 24 mph, 15% to 24% of the time; and 25 mph or higher, 1% to 2% of the time (WRCC 2021).

3.2.2 Air Quality Attainment Status and General Conformity

The study area is located within an area designated Attainment or Unclassifiable for all criteria pollutants. This designation means that the area is currently meeting air quality standards, and USEPA and Ecology expect the area to continue to meet air quality standards. Further, the State of Washington is in Attainment or Maintenance of all NAAQs except for a small portion of Whatcom County, which is far from the project area. Table 5 depicts all current areas within the state that have a current maintenance designation and notes the end of that maintenance period (Ecology 2019a).

As detailed in Section 1.2.1, pursuant to the CAA, USEPA has developed classifications for distinct geographical regions that have atmospheric concentrations of pollutants above or below the NAAQS, as follows:

- Regions classified as **Attainment** are areas in which the criteria air pollutant has not violated the NAAQS
- A **Non-Attainment** classification represents an area in which the criteria air pollutant has violated the NAAQS
- The **Maintenance** designation is used when monitored pollutants have been reduced from the Non-Attainment to the Attainment levels
- Areas in which USEPA is not able to determine an attainment status are designated **Unclassifiable**

Table 5
Status of Washington Maintenance Areas

CURRENT OR HISTORIC MAINTENANCE AREA	END OF MAINTENANCE PERIOD	NAAQS ATTAINMENT METHOD
Seattle (PM_{10}) Estimated PM_{10} from Kent-Central and James $PM_{2.5}$ (530332004)	5/14/2021	Estimated PM_{10} from Seattle-Duwamish $PM_{2.5}$ (530330057)
Kent (PM_{10})	5/14/2021	Estimated PM_{10} from Kent-Central and James $PM_{2.5}$ (530332004)
Tacoma (PM_{10})	5/14/2021	Estimated PM_{10} from Tacoma-Alexander nephelometer $PM_{2.5}$ (530530031)
Thurston County (PM_{10})	12/4/2020	Estimated PM_{10} from Lacey-College Street nephelometer $PM_{2.5}$ (530670013)
Wallula (PM_{10})	9/26/2025	Burbank-Maple St PM_{10} monitor (530710006)
Spokane (PM_{10})	8/30/2025	Spokane-Augusta PM_{10} monitor (530630021)
Yakima (PM_{10})	3/10/2025	Yakima-4th Avenue South PM_{10} monitor (530770009)
Tacoma ($PM_{2.5}$)	3/12/2035	Tacoma-L Street $PM_{2.5}$ monitor (530530029)
Yakima (CO)	12/31/2022	Modeled CO vehicle emissions
Spokane (CO)	8/30/2025	Modeled onroad, nonroad, and residential wood combustion CO emissions

Source: Ecology 2019a

3.2.3 Regional Air Quality Monitoring

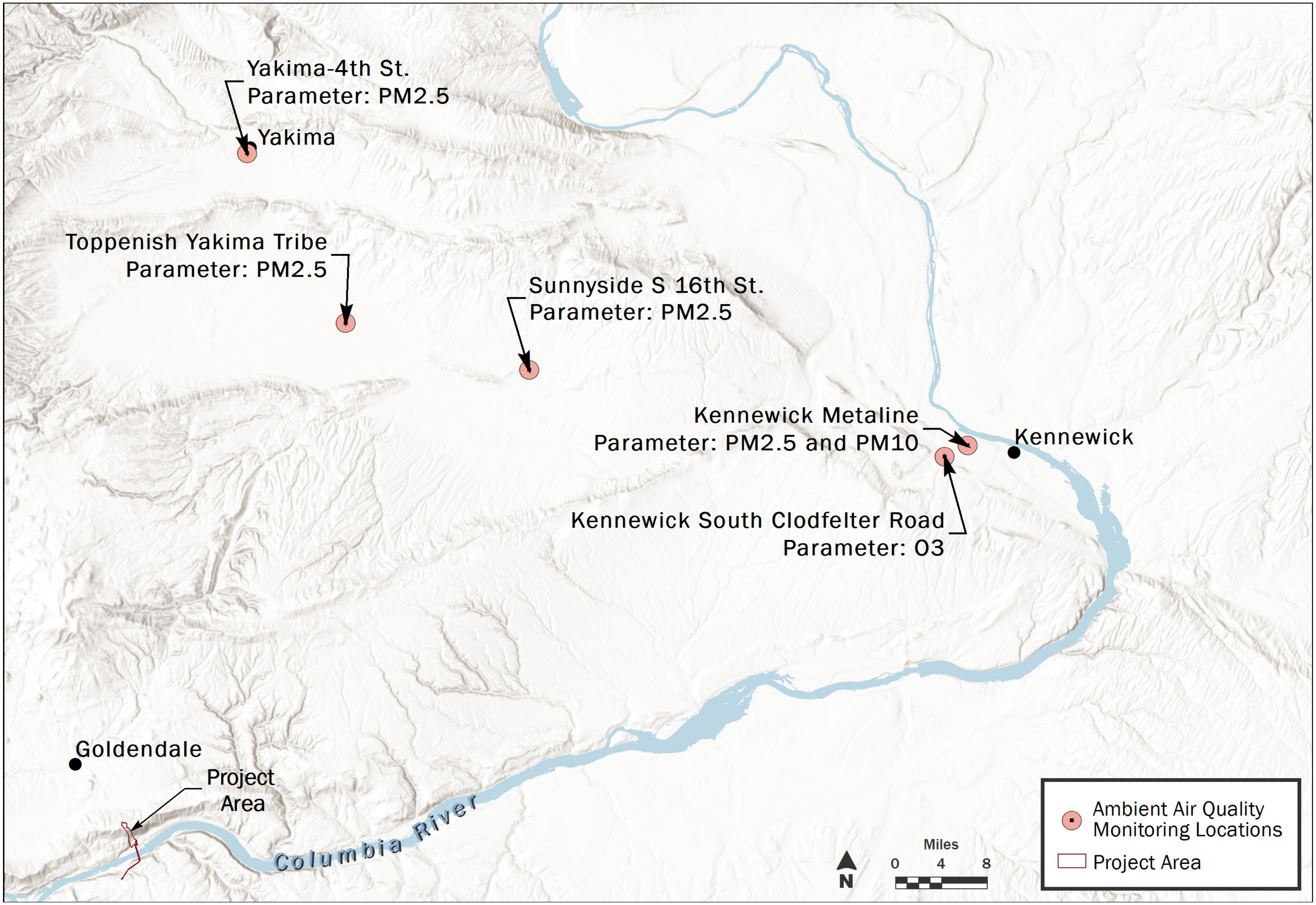
Regional air quality is affected by the combination of all atmospheric emission sources and can vary dramatically over geography and time. The primary anthropogenic emission sources in the study area include vehicle combustion, regional home and building heating, electrical generation, and industrial operations. The primary drivers of these emissions are fossil fuel combustion and particulate generation from both combustion and material disturbance.

The main pollutants of concern related to this analysis include criteria pollutants and GHGs. Criteria pollutants include carbon monoxide, nitrogen dioxide, sulfur dioxide, PM_{10}, and $PM_{2.5}$. These pollutants are regulated on both the state and federal level. Additionally, ozone is a criteria pollutant; however, unlike the other criteria pollutants, ozone is primarily formed by photochemical reactions of precursor chemicals known as VOCs and oxides of nitrogen in the presence of sunlight in the atmosphere. This section describes the main pollutants of concern and their potential to affect human health and the environment. Because the primary source of atmospheric lead has historically been vehicle emissions using leaded fuel, with the prohibition of leaded gasoline, this pollutant is not a current concern and is not detailed further.

The current State of Washington monitoring network locations for each of these main pollutants of concern are detailed in Sections 3.2.3.1 through 3.2.3.5. Monitoring locations outside of the State of Washington were not included in this analysis.

The appropriateness of each nearest monitoring site was reviewed for applicability in describing the air quality conditions within the study area. The nearest State of Washington monitoring sites for each pollutant are presented in Figure 1 (Ecology 2019b). Due to the distance from each monitoring site, it was determined that monitoring data should be combined with regional modeling data to more accurately assess the conditions that would occur in the study area. These refined estimates are presented in Section 3.2.3.6.

Figure 1
Nearest Monitoring Sites to the Study Area for Pollutants of Concern



Source: Ecology 2021a

3.2.3.1 Carbon Monoxide

Carbon monoxide is an odorless, colorless gas usually formed as the result of the incomplete combustion of fuels. Carbon monoxide has the potential to displace oxygen and result in physical maladies to those exposed to high concentrations. The nearest State of Washington carbon monoxide monitor to the study area is in the Seattle metropolitan area. The usefulness of these data for the study area is limited; however, the federal carbon monoxide standards have not been exceeded in the Southcentral Washington region and the study area is defined as in attainment with the carbon monoxide NAAQS.

3.2.3.2 Oxides of Nitrogen

Emissions of oxides of nitrogen are produced by the combustion of fossil fuels (primarily in mobile equipment and electrical generators for the proposed action). The federal NAAQS is defined for a subset of the oxides of nitrogen (nitrogen dioxide). Total oxides of nitrogen associated with the proposed action are estimated because they are a precursor to ozone formation and also assessed relative to their potential impact on ozone concentrations. The nearest State of Washington nitrogen dioxide monitor to the study area is in the Tacoma metropolitan area. The usefulness of these data for the study area is limited; however, the federal nitrogen dioxide standards have not been exceeded in the Southcentral Washington region and the study area is defined as in attainment with the nitrogen dioxide NAAQS.

3.2.3.3 Sulfur Dioxide

Sulfur dioxide is produced by the combustion of sulfur-containing fuels, such as oil, coal, and diesel. Historically, Washington has measured very low levels of sulfur dioxide. Because the levels were so low, monitoring was reduced. The nearest State of Washington sulfur dioxide monitor to the project site is in the Wenatchee metropolitan area. The usefulness of these data for the project study area is limited; however, the federal sulfur dioxide standards have not been exceeded in the Southcentral Washington region and the study area is defined as in attainment with the sulfur dioxide NAAQS.

3.2.3.4 Particulate Matter

Atmospheric PM is a group of pollutants that is composed of varying size ranges of both filterable and condensable particulates. Particulates are regulated for two size categories: PM_{10} and $PM_{2.5}$. Atmospheric particulates, particularly those that fall within the $PM_{2.5}$ category, have the capacity for respirability and associated negative health impacts including heart and lung disease, cognitive impairment, and other chronic exposure impacts.

PM_{10} refers to particles that have a diameter of less than 10 micrometers.

$PM_{2.5}$ refers to particles that have a diameter of less than 2.5 micrometers.

The nearest State of Washington PM_{10} monitor to the project site is in the Kennewick metropolitan area and the nearest $PM_{2.5}$ site is in Toppenish. Although Klickitat County is classified as in attainment, several nearby monitors have shown exceedances of the NAAQS levels. As of 2020, the Kennewick monitor has violated the PM_{10} NAAQS (due primarily to wildfires and high-wind dust events) and the Toppenish and Yakima monitors have violated the 24-hour PM2.5 NAAQS (due primarily to wildfires). The region surrounding those monitors has been defined as a region of concern for particulate pollution by Ecology. The extent of the region of concern does not currently extend to the study area.

3.2.3.5 Ozone

Ground-level ozone is a secondary air pollutant produced in the atmosphere through a series of photochemical reactions involving ultraviolet light and the precursor chemicals of oxides of nitrogen and VOCs. The main sources of VOCs and oxides of nitrogen are fossil fuel combustion and industrial use of solvents of light hydrocarbons.

Because ozone's formation is dependent on ultraviolet light, ozone levels typically vary diurnally, peaking in the afternoon. This pattern is also influenced by the seasons with the additional availability of solar light in the summer causing ozone formation to increase.

Due to this seasonal variability, Ecology currently only monitors ozone from May through September in Southeastern Washington. The nearest ozone monitor is in the Kennewick metropolitan area. The monitoring record for the Kennewick monitor has recorded exceedances of the ozone NAAQS threshold and recorded a violation of the threshold in 2018. The monitoring record suggests that the region encompassing the Kennewick-Pasco-Richland Metropolitan Area is an area of concern for ozone NAAQS non-attainment.

3.2.3.6 Northwest AIRQUEST Project Location NAAQS Design Values

Washington State University and its collaborators (universities, USEPA, Ecology, and regional air quality regulatory bodies), developed an analysis of regional air quality monitoring data and regional modeling products to allow for the modeled distribution of pollutant concentration throughout the Pacific Northwest. This project is called the Northwest AIRQUEST consortium.

Regional-scale modeling and monitoring data from July 2014 through June 2017 were used to estimate background concentrations of criteria air pollutant design values for use in air permit engineering and decision making. The Northwest AIRQUEST tool facilitates the retrieval and exploration of the estimated design values at user-specified locations in Washington, Idaho, and Oregon.

Based on a review of the tool's output for the study area, the nearest grid cell was queried to retrieve interpolated ambient design values for all NAAQS pollutants. Table 6 depicts the predicted values for the study area (NW AIRQUEST 2021). The outputs of this tool suggest that although nearby monitors referenced in Sections 3.2.3.1 through 3.2.3.5 have recorded exceedances and violations of their respective NAAQS thresholds, those monitoring records are not representative of the study area. As a result, the AIRQUEST tool provides a more appropriate assessment of current air quality conditions within the study area and the study area is appropriately defined as attaining the NAAQS for all Criteria Pollutants.

Table 6
Northwest AIRQUEST Local NAAQS Design Values

VARIABLE	VALUE/PREDICTED CONCENTRATION
Latitude	45.72
Longitude	-120.68
PM_{10} 24 hour (µg/m^3)	82.1
CO 1 hour (ppm)	1.1
CO 8 hour (ppm)	0.79
NO_2 1 hour (ppb)	15.8
NO_2 annual (ppb)	3.7

VARIABLE	VALUE/PREDICTED CONCENTRATION
O_3 8 hour (ppb)	58
$PM_{2.5}$ 24 hour (μg/m^3)	17.8
$PM_{2.5}$ annual (μg/m^3)	5.2
SO_2 1 hour (ppb)	4.9
SO_2 3 hour (ppb)	6.5
SO_2 24 hour (ppb)	2.3
SO_2 annual (ppb)	0.4

3.2.4 Greenhouse Gases

In additional to the criteria pollutants, USEPA and Ecology review and consider the influence of a category of pollutants that have the capacity to increase radiative heating within the atmosphere. These pollutants, commonly referred to as GHGs, can accumulate in the atmosphere and influence global climate change. The resultant fluctuations in climate can exceed those that would occur in the absence of anthropogenic activities.

According to the Intergovernmental Panel on Climate Change Special Report (IPCC 2018) the following outcomes result from the anthropogenic influence of GHG emissions:

> *Human influence on climate has been the dominant cause of observed warming since the mid-20th century.*
>
> *Temperature rise to date has already resulted in profound alterations to human and natural systems, including increases in droughts, floods, and some other types of extreme weather; sea level rise; and biodiversity loss. These changes are causing unprecedented risks to vulnerable persons and populations.*

While GHGs also occur naturally, since the industrial revolution increases in the concentrations of individual GHG species within the atmosphere have decreased the amount of solar radiation reflected back into space, intensifying the natural greenhouse effect and increasing of global average temperature.

The primary GHGs of concern are carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, perfluorocarbons, and hydrofluorocarbons due to their extended atmospheric residence time and their efficiency in reflecting thermal radiation. Global warming potential is based on the relative impact of each of these species to the same amount of carbon dioxide. For example, methane is 28 times as potent as carbon dioxide at trapping heat, while sulfur hexafluoride is 25,200 times more potent than carbon dioxide on a 100-year time scale (IPCC 2021). In order to provide clarity in reporting, GHG emissions are commonly reported as carbon dioxide equivalents (CO_2e). This is the amount of carbon dioxide that would be equivalent to the amount of each individual species multiplied by its global warming potential and aggregated for single value reporting. Global warming potentials vary based on the time interval of analysis due to chemical decay of GHGs in the atmosphere. Global warming potentials are typically reported on a 20-, 100-, and 500-year time horizon. This analysis references 100-year global warming potentials because this time horizon is most closely aligned with the anticipated lifetime of the pumped hydro energy storage project.

The primary anthropogenic source of GHGs is the combustion of fossil fuels, including for transportation, heating, and electricity generation. Additionally, coal mining, oil and gas development and venting, and some agricultural practices release methane. Other smaller quantities of rarer GHGs such as perfluorocarbons, hydrofluorocarbons, and sulfur hexafluoride are released by industrial and chemical processes. While the quantity of emissions is often small, the high global warming potential of these chemicals can result in significant effects. Changes to global land cover and vegetation can also influence the carbon lifecycle of GHGs. For example, reduced forest or vegetative cover reduces carbon uptake and reduces snow and ice pack, which can affect the global radiative budget by decreasing surface reflectance.

In 2018, Washington produced about 99.57 million gross metric tons of CO_2e (Ecology 2021b). Ecology found that transportation is the largest source, at 44.9% of the state's GHG emissions, followed by residential, commercial, and industrial heating at 23.4%, and electricity consumption (both in-state and out-of-state) at 16.3%. The sources of the remaining 15.4% of emissions are agriculture, waste management, natural gas distribution, and industrial processes (Ecology 2021b).

3.2.5 Hazardous and Toxic Air Pollutants

In addition to criteria pollutants and GHGs, the CAA regulates 188 chemical species that are collectively known as HAPs. These pollutants are known to cause cancer or other serious or fatal health effects. On the federal level these pollutants are regulated by the National Emissions Standard for Hazardous Air Pollutants by either chemical or emissions-generating source.

USEPA further assessed and identified a subset of 21 HAPs emitted by mobile sources, which are set forth in a USEPA final rule, Control of Emissions of Hazardous Air Pollutants from Mobile Sources (Federal Register 40.59, 40.80, 40.85, and 40.86). Among the 21 HAPs, USEPA designated seven priority mobile source air toxics: acrolein, benzene, formaldehyde, diesel particulate matter (DPM)/diesel exhaust organic gases, naphthalene, polycyclic organic matter, and 1,3-butadiene. Exposure to the latter six pollutants for long durations at sufficient concentrations can increase the chances of cancer and other serious health effects, such as immune system dysfunctions and neurological, reproductive, developmental, and respiratory disorders.

Ambient concentrations levels for HAPs are not routinely monitored; however, special studies are often assessed for individual HAP species, particularly in urban or industrialized environments. Provided the low population and industrial development in the study area, there is not an expectation of elevated HAP concentrations. Additionally, the nearest potential sensitive receptors (typically schools and residences) are greater than 5,000 feet from the study area.

3.3 Proposed Project

3.3.1 Impacts from Construction

The largest contributors of pollution related to the construction of the proposed project would be construction equipment, motor vehicles, blasting, concrete production, and non-road construction equipment. As a result, the main pollutants emitted from the construction phase of the project would be carbon monoxide, oxides of nitrogen, PM_{10}/$PM_{2.5}$, GHGs, and HAPs or TAPs. Motor vehicles and diesel-powered construction equipment also emit pollutants that contribute to the formation of ground-level ozone. Sulfur dioxide emissions would not be appreciably generated by construction of the proposed project. The nature of construction earthmoving and construction-related fuel combustion is not expected to generate odors outside the construction footprint based on comparison to similar operations. There will be no releases of substantially odiferous emissions that would cause impacts to people nearby.

3.3.1.1 Direct Impacts

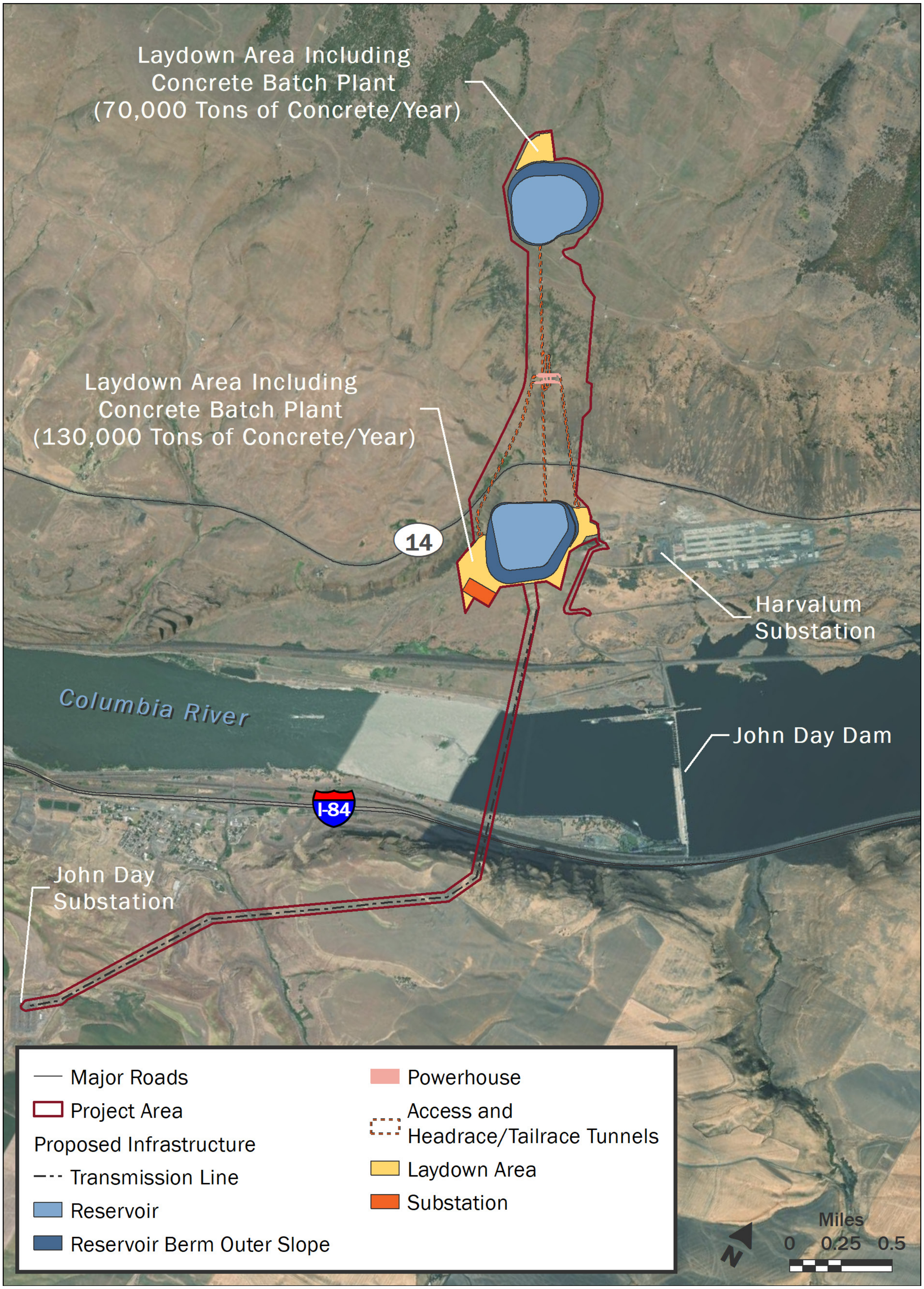
Particulate Emissions from Fugitive Dust

Construction-related fugitive emissions were calculated to capture fugitive dust generation from excavation/fill, material hauling, and general construction support activities. This encompasses dozing, loading and unloading, dirt hauling, grading, drilling, blasting, crushing and screening, and wind-blown dust within the project footprint. Emission calculation methodologies from AP-42 Section 13.2.3 were used to calculate emissions based on the total acreage of disturbance and time span of construction. The total acreage of disturbance was estimated to be 104 acres for the upper reservoir and 140 acres for the lower reservoir. Emissions were calculated for the entire 5-year construction period.

Concrete Batch Plant Emissions

The two on-site concrete batch plants would be sources of particulate emissions related to material handling (Figure 2). The Applicant provided an anticipated capacity of the batch plants as 70,000 tpy for the upper reservoir plant and 130,000 tpy for the lower reservoir plant. Emission calculation methodology detailed in AP-42 Table 11.12-6 was used to estimate batch plant emissions. The concrete batch plants were assumed to be active for only 3 of the 5 years of construction to account for time of excavation and finishing activities before and after active concrete pouring. The location of each concrete batch plant is not specifically known, but it is assumed that each will be located in the laydown areas, within the project boundary, near the reservoir construction areas.

Figure 2
Concrete Batch Plants During Construction



Note: The location of each concrete batch plant is not specifically known, but it is assumed that each will be located in the laydown areas, within the project boundary, near the reservoir construction areas.

Combustion Emissions of Criteria Pollutants and GHGs

Direct air quality impacts would result from construction-related fuel combustion. Emissions were quantified for the following sources using the methodologies as detailed:

- **Concrete, aggregate, and dirt haul trucks.** Haul road distances were estimated based on the proposed project footprint, reservoir locations, existing roads, and assumed locations of each batch plant. Truck capacities and engine power ratings were estimated from typical industry values. Exhaust emission factors were sourced from CFR 40.1039 Appendix I Table 3 for Tier 3 engines for criteria pollutants and CFR 40.98 for GHG emissions. The total amounts of concrete and cut/fill dirt were used to determine the number of haul truck trips required, which is further detailed in calculations in Attachment 1.
- **Non-road mobile construction equipment.** This includes excavators, loaders, dozers, compactors, graders, water trucks, pickup trucks, cranes, and drilling jumbos. Emissions for non-road mobile construction equipment were based on the estimated hours of operation for the equipment, as supplied by the Applicant. These hours of operation were given for the total time span of construction. Therefore, emission calculations use the same time basis. Equipment power ratings were estimated from typical industry values. Exhaust emission factors were sourced from CFR 40.1039 Appendix I Table 3 for Tier 3 engines and AP-42 Table 3.3-1 for criteria pollutants and CFR 40.98 for GHG emissions.
- **Blasting.** Gaseous emissions arise from the combustion of ammonium nitrate and fuel oil. Emission factors from AP-42 Table 13.3-1 were used to estimate emission rates of oxides of nitrogen, sulfur dioxide, and carbon monoxide. General industry knowledge and correlations were used to estimate the total amount of ammonium nitrate and fuel oil needed for blasting in relation to the total cut volume of excavated dirt, which are further detailed in Attachment 1. Particulate emissions from drilling and blasting were assumed to be included in the calculation of construction fugitive particulate described previously.
- **Construction engine-generator sets and various small equipment.** Construction support operations such as lighting, electric-powered tools, pumps, lifts, and other equipment require a portable source of electricity. The source of electricity for these operations will be portable engine-generator sets. The Applicant provided a total of 30,000 hours of operation for these small, portable operations. Emission calculations used a 150-kilowatt average capacity for these small, portable operations, which is equal to the capacity of the non-emergency generator used in the operating phase of the project for maintenance operations. The concrete batch plant and aggregate crushing and screening will be connected to grid electricity and require no additional on-site power generation. A large diesel generator is expected to power tunnel and shaft raise-bore operations. The capacity for this generator was assumed to be 750 kilowatts based on typical commercially available portable diesel generators. The assumption of power capacity for the tunneling generator accounts for the jumbos being assumed to be powered by their own diesel engines, thus not requiring additional electricity generation. The operating hours for the large diesel generator were set assuming three 8-hour shifts for 260 days per year of construction operation for 5 years of construction, as provided by the Applicant. Emission factors from AP-42 Table 3.4-1 were used to quantify criteria pollutant emissions and CFR 40.98 emission factors were used for GHGs.

Table 7 shows the total estimated actual construction phase criteria pollutant and GHG emissions. These emission rates are in average tpy of emissions, calculated by estimating the total emissions across the entire construction phase and dividing by the 5-year construction time span. Emissions are presented in an average ton per year basis to match the basis of the criteria pollutant and GHG impact indicators.

Table 7

Construction Phase Total Emissions: Average Tons Per Year Over 5 Year Construction Period, Direct Impacts

POLLUTANT	CONCRETE BATCH PLANT[1]	CONSTRUCTION FUGITIVE DUST[1]	CONSTRUCTION COMBUSTION	TOTAL	TOTAL 2	NOC THRESHOLD	COMPARISON TO NOC THRESHOLD	TITLE V PERMIT THRESHOLD[3]	PSD MAJOR SOURCE THRESHOLD[4]	COMPARISON TO PSD AND TITLE V THRESHOLD[5]
PM_{10}	1.77	1,075.59	8.83	1,086.20	4.39	0.75	Above	100	250	Below
$PM_{2.5}$	1.77	107.59	8.83	118.17	4.39	0.50	Above	100	250	Below
NO_x	–	–	216.92	216.92	89.79	2.0	Above	100	250	Below
CO	–	–	176.72	176.72	20.58	5.0	Above	100	250	Below
SO_2	–	–	1.56	1.56	0.00	2.0	Below	100	250	Below
VOC	–	–	11.81	11.81	2.64	2.0	Above	100	250	Below
CO_2	–	–	19,318.09	19,318.09	NA	NA	NA	NA	NA	NA
CH_4	–	–	0.78	0.78	NA	NA	NA	NA	NA	NA
N_2O	–	–	0.16	0.16	NA	NA	NA	NA	NA	NA
CO_2e [6, 7]	–	–	19,382.74	19,382.74	NA	NA	NA	NA	NA	NA

Notes:

1. Source categories labeled with a pollutant emission rate of "--" have an estimated emission rate of zero for that pollutant.
2. Stationary emissions include non-fugitive and stationary construction emissions, which are limited to the concrete batch plant and generators.
3. Title V operating permit thresholds codified in CFR 40.40.
4. PSD major source thresholds codified in CFR 40.51.
5. Comparison to both thresholds does not include fugitive emissions or mobile source emissions.
6. CO_2e calculated based on Global Warming Potentials in Table A-1 IPCC AR6 Table 7.SM.7 for 100-year time horizon.
7. GHG emissions relating to the off-site production of cement are considered indirect emissions and are not included in this table. These emissions are discussed separately and quantified in Section 3.3.1.2 to be approximately 59,642 tons of CO_2e total.

NA: not applicable

Criteria Pollutants

Section 2.3.1 discusses the comparison of construction phase emission rates to PSD significance thresholds. While the PSD program does not apply to temporary construction activities, the significance thresholds are used as a relevant comparison to juxtapose the magnitude of impacts. The results of the construction phase emissions analysis show that criteria pollutant average annual emission rates would be well below the significance thresholds for the PSD/Title V programs. Therefore, construction phase criteria pollutant impacts would not result in significant air quality impacts.

Estimated emissions for construction are above NOC permit applicability thresholds, which may require an NOC permit or general order of approval for the construction phase. These state permitting requirements are further detailed in Section 3.3.3.

GHGs

Section 2.3.2 discusses the comparison of construction phase GHG emissions to state GHG regulatory programs to determine alignment. As discussed in Section 2.3.2, the CCA is the most relevant quantitative indicator to compare to estimated emission rates. The CCA would initially apply to sources of emissions greater than 25,000 metric tons of CO_2e annually (equal to 27,558 short tons). The project construction phase is estimated to produce less than 25,000 metric tons of CO_2e annually on average for the 5-year construction period, below the level for which facilities may need to enter into the cap-and-invest program under the CCA. Additionally, the temporary nature of the construction phase would result in the end of construction phase GHG emissions before significant changes to CCA applicability thresholds or compliance requirements would be expected to change.

Reporting of GHG emissions is required for facilities with actual emissions meeting or exceeding 10,000 metrics tons per year of CO_2e. The project construction phase is estimated to produce greater than 10,000 metric tons of CO_2e annually, therefore reporting may be required. Statewide GHG reduction goals are codified in RCW 70A.45 and are relevant to any project with increases in GHG emissions. However, project construction emissions have the potential to influence the rate of progression toward the GHG reduction goals. The construction phase would produce GHG emissions from fuel combustion and would result in approximately 96,913.768 short tons (87,918.61 metric tons) of CO_2e over the 5 years of proposed construction. Although not required, GHG emissions can potentially be addressed through the use of mitigation measures as detailed in Section 3.3.4, which may further enhance alignment of the construction phase GHG impacts with state GHG reduction goals.

Hazardous and Toxic Air Pollutants

The primary sources of HAPs and TAPs for construction are mobile and stationary internal combustion engines. Priority mobile source air toxics include acrolein, benzene, formaldehyde, DPM/diesel exhaust organic gasses, naphthalene, polycyclic organic matter, and 1,3-butadiene. All of these toxics would be generated during the construction phase. Toxic air emissions would likely have a minor effect on the air quality resource based on comparison to other similar projects and would be further evaluated using air dispersion modeling if required as part of an NOC application, which could lead to curtailment of TAPs emissions. Additionally, mitigation measures proposed in Section 3.3.4 to reduce fuel consumption and GHG emissions could also further reduce the potential emissions of air toxics.

3.3.1.2 Indirect Impacts

Vehicle Travel

Indirect impacts from construction include vehicle travel outside the project boundary. This includes material haul trucks and construction employee vehicles driven to nearby locations. These travel-related emissions were accounted for in the on-site construction particulate emissions for unpaved roads and fuel combustion emissions calculations.

Contrary to on-site travel, off-site emissions have a large degree of uncertainty due to variable travel distances to nearby construction material sources or populated areas. For example, the driving distances from the lower reservoir to the nearest populated areas are: 17 miles to Rufus, Oregon; 20 miles to Goldendale, Washington; and 32 miles to The Dalles, Oregon. Construction materials may also be sourced from locations at a greater distance than these examples, which introduces additional uncertainty to quantification of off-site emissions. The uncertainty in off-site travel distances prohibits an accurate analysis of indirect emissions impacts from these sources. Off-site emissions from vehicle travel are considered an indirect impact of the project construction phase although they would not result in significant impacts.

GHGs from Cement Production

The production of cement in calcination kilns makes up a large portion of lifecycle air emissions arising from concrete structure construction. These emissions occur at off-site cement plants and are considered indirect impacts of the project. Off-site cement plants are regulated as entities separate from the project and may be subject to their own air emissions mitigation under such programs such as the CAA, Ecology air regulations in WAC 173.400 and 460, or CCA.

Anticipated CO_2e emissions from the cement production specific to the project were calculated based on the total anticipated concrete needs for the project. A CO_2e emission factor of 400 pounds/yard^3 of concrete was derived from "Life Cycle Inventory of Portland Cement Concrete" (Portland Cement Association 2007), which found that CO_2 emissions from concrete range from 190 pounds/yard^3 to 527 pounds/yard^3 depending on the cement content of the concrete. This resulted in total CO_2e emissions for off-site cement production related to the project to be 59,642 tons. As detailed previously, these emissions are considered indirect impacts and cement plants may be subject to air emissions standards that may require mitigation separate from the project. On-site cement processing in the concrete batch plants for the proposed project will contribute negligible GHG emissions, as the batch plant process is primarily a physical mixing of cement sourced from off-site and other raw materials.

3.3.2 Impacts from Operation

During proposed project operations, the emissions-generating sources would be limited to emergency generator operation, portable generator operation, and vehicle traffic. As a result, the main pollutants emitted from the operations phase of the project would be carbon monoxide, oxides of nitrogen, $PM_{10}/PM_{2.5}$, GHGs, and HAPs and TAPs. Motor vehicles and diesel-powered generators also emit pollutants that contribute to the formation of ground-level ozone. Sulfur dioxide emissions would not be appreciably generated by operation of the proposed project. The nature of the operational fuel combustion is not expected to generate odors outside the project boundary based on comparison to similar operations. There will be no releases of substantially odiferous emissions that would impact people near the project site.

3.3.2.1 Direct Impacts

Engine-Generator Set Combustion Emissions

The operation phase would include two 1,500-kilowatt emergency generators (one near the lower reservoir and one underground at the facility powerhouse) and a 150-kilowatt portable generator for miscellaneous on-site power generation to support maintenance activities. All three generators would combust diesel fuel and emissions were calculated using AP-42 Table 3.4-1 for criteria pollutants and CFR 40.98 for GHGs. The emergency generator emissions were calculated using 100 hours of operation per year per USEPA requirement (CFR 40.63 Subpart ZZZZ). The Applicant estimated 36 hours per year for non-emergency operation, but 100 hours was used for conservatism and to align with regulatory standards. The 150-kilowatt non-emergency generator was estimated to operate half of the time during a normal work week (20 hours per week) for 52 weeks per year due to the purpose of the generator as portable support for maintenance operations.

Table 8 shows the total estimated actual operational phase criteria pollutant and GHG emissions, and comparison to maximum potential NOC and PSD thresholds.

Table 8
Operation Phase Total Emissions: Tons Per Year, Direct Impacts

POLLUTANT	TOTAL OPERATION PHASE	TOTAL STATIONARY AND NOC APPLICABLE[1]	NOC THRESHOLD	COMPARISON TO NOC THRESHOLD	TITLE V PERMIT THRESHOLD[2]	PSD MAJOR SOURCE THRESHOLD[3]	COMPARISON TO TITLE V AND PSD THRESHOLD[4]
PM_{10}	1.07	0.70	0.75	Below	100	250	Below
$PM_{2.5}$	1.07	0.70	0.50	Above	100	250	Below
NO_x	36.69	24.14	2.0	Above	100	250	Below
CO	8.41	5.53	5.0	Above	100	250	Below
SO_2	1.86E-06	1.22E-06	2.0	Below	100	250	Below
VOC	1.08	0.71	2.0	Below	100	250	Below
CO_2	1,773.37	NA	NA	NA	NA	NA	NA
CH_4	7.19E-02	NA	NA	NA	NA	NA	NA
N_2O	1.44E-02	NA	NA	NA	NA	NA	NA
CO_2e[5]	1,779.30	NA	NA	NA	NA	NA	NA

Notes:
1. Per WAC 173.400.110(4)(c)(iv) the 150-kilowatt non-emergency generator is exempt from NOC requirements. The two 1,500-kilowatt emergency generators are above exemptible power rating in WAC 173.400.110(4)(h)(xxxix). Stationary emissions include the two emergency engine-generator sets. The portable 150-kilowatt generator is not stationary.
2. Title V operating permit thresholds codified in CFR 40.40.
3. PSD major source thresholds codified in CFR 40.51.
4. Comparison to both thresholds does not include fugitive emissions or mobile source emissions.
5. CO_2e calculated based on Global Warming Potentials in Table A-1 IPCC AR6 Table 7.SM.7 for 100 year time horizon.

NA: not applicable

Criteria Pollutants

Section 2.3.1 discusses the comparison of operation phase emission rates to state NOC applicability and federal PSD significance thresholds. The results of the operation phase emissions analysis show that criteria pollutant average annual emission rates would be above applicable NOC thresholds for oxides of nitrogen, carbon monoxide, and $PM_{2.5}$ thus requiring an NOC permit under the jurisdiction of Ecology. Emission estimates are below the significance thresholds for the PSD/Title V programs. Therefore, operational phase criteria pollutant impacts would not result in significant air quality impacts.

GHGs

Section 2.3.2 discusses the comparison of operational phase GHG emissions to state GHG regulatory programs to determine alignment. As discussed in Section 2.3.2, the CCA is the most relevant quantitative indicator to compare to estimated emission rates. The CCA would initially apply to sources of greater than 25,000 metric tons of CO_2e annually (equal to 27,558 short tons). The project operation phase is estimated to produce less than 25,000 metric tons of CO_2e annually on average, below the level for which facilities may need to enter into the cap-and-invest program under the CCA. Future changes to the CCA applicability thresholds may require additional adaptations from the proposed project to be compliant in the operation phase.

Statewide GHG reduction goals are codified in RCW 70A.45 and are relevant to any project with increases in GHG emissions. However, project operation emissions have the potential to influence the rate of progression toward the GHG reduction goals. Emissions would be minimal and only result from generator use and limited worker and service vehicle trips. Although not required, GHG emissions can potentially be addressed through the use of mitigation measures as detailed in Section 3.3.4, which may further enhance alignment of the operation phase GHG impacts with state GHG reduction goals.

Hazardous and Toxic Air Pollutants

The primary sources of HAPs and TAPs for the operational phase are stationary internal combustion engines (emergency generators, portable non-emergency generator, and worker/service vehicle trips) that generate HAPs and TAPs from diesel burning. Toxic air emissions would likely have a minor effect on the air quality resource based on comparison to other similar projects and would be further evaluated using air dispersion modeling if required as part of an NOC application, which could lead to curtailment of TAPs emissions. Additionally, mitigation measures proposed in Section 3.3.4 to reduce fuel consumption and GHG emissions could also further reduce the potential emissions of air toxics.

3.3.2.2 Indirect Impacts

Vehicle travel outside the project boundary is considered an indirect impact of the operational phase of the proposed project. This includes service vehicles and employee vehicles driven to nearby locations. The operation phase of the project is estimated to have 40 to 60 employees in total. These travel-related emissions are considered insignificant for on-site emissions due to short travel distances within the project footprint and a low magnitude of daily vehicle travel. Off-site impacts may be greater due to substantially longer travel distances to nearby populated areas. Similar to the construction phase, there is a large degree of uncertainty in the actual travel distances that would be experienced by employees and service vehicles. For example, the driving distances from the lower reservoir to the nearest populated areas are 17 to 32 miles (see Section 3.3.1). Service vehicles would likely travel from farther distances if specialized service is required, adding additional uncertainty to travel distances. The uncertainty in off-site travel distances prohibits an accurate analysis of these indirect impacts. Off-site emissions from vehicle travel are, however, considered an indirect impact of the project operation phase although they would not result in significant impacts.

3.3.3 Required Permits

This resource analysis report seeks to inform the potential air permit applicability based on estimated actual emissions. A complete air permit applicability analysis would be based on maximum potential emissions, which may be greater than estimated actual emissions. A complete air permit applicability analysis would be compiled separate from this resource analysis report and contain definitive determinations for required air permits. Additional permits may be required based on the specific development timeline and design at the time of construction/operation.

The following permits related to air quality and GHGs are expected to be required for construction and operation of the proposed project based on estimates of actual emissions. Permit-applicable potential emissions may be higher than estimated actual emissions, but the required air permits are expected to be identical.

- **Construction Phase: Notice of Construction Permit or General Order of Approval per WAC 173.400.560 (Washington Department of Ecology, Central Region):** A facility-wide NOC permit or general order of approval is likely required, resulting from emissions from construction-phase stationary sources. The concrete batch plants alone have estimated actual emissions above NOC exemptible levels in WAC 173.400.110(5), and permit-applicable maximum potential emission rates may be higher than projected actual emissions. The concrete batch plant is not an NOC exempted source type in WAC 173.400.110(4) and is expected to be on site for greater than 1 year, which disqualifies eligibility from portable source permitting via WAC 173.400.036 for portable sources. A general order of approval per WAC 173.400.560 may be used in lieu of a NOC permit. An NOC permit or general order of approval may apply to multiple other sources of air pollutants on site and would likely not be limited to just the concrete batch plant emissions.
- **Operation Phase: Notice of Construction Permit (Washington Department of Ecology, Central Region):** Per the provisions of WACs 173.400.110 and 173.460.040, an air permit would be required for operation phase emergency generator emissions and portable equipment due to estimated emissions and generator capacities above exemptible power ratings.

3.3.4 Proposed Mitigation Measures

Although not required to reduce any significant impacts specified in this resource analysis report, Ecology is proposing mitigation strategies to further reduce potential effects on air quality and GHG emissions from construction and operation of the proposed project. Some of these mitigation measures may also be required as part of air quality permitting.

Ecology-Proposed Mitigation Measures

Ecology-proposed air quality and GHG mitigation measures include:

- **Use of Best Management Practices During Construction.** Projects that require earthwork or otherwise have the potential to create fugitive or windborne dust are required to use best management practices to control dust at the project site. Pursuant to WAC 173.400.040(9)(a): "The owner or operator of a source of fugitive dust shall take reasonable precautions to prevent fugitive dust from becoming airborne and shall maintain and operate the source to minimize emissions." Several subsections of WAC 173.400.040, General Standards for Maximum Emissions, would also apply to the project construction activities. Best management practices that could be used to reduce construction impacts for all construction phases include the following:
  - Complying with applicable dust control policies and plans
  - Spraying dry soil with water to reduce dust

- Minimizing idling of equipment when not in use
- Covering dirt and gravel piles
- Sweeping paved roadways to reduce mud and dust.

Additional strategies can be leveraged that reach beyond the required best management practices. These additional strategies may be used as mitigation in the project to reduce fugitive dust, as appropriate:

- Installation of dust collectors and baghouses to reduce particulate emissions from concrete batch plants and aggregate crushing and screening operations
- Application of dust suppressant surfactant and/or base course to unpaved roads
- Curtailing construction operations during periods of high winds

- **Selection of Efficient Equipment.** For enhanced alignment with GHG reduction goals, preferential selection should be made towards electric powered, hybrid-electric powered, high fuel efficiency, low carbon fuel powered construction equipment, haul trucks, generators, and employee commuting vehicles as practicable. This could mitigate CO_2e emissions in construction and operation phases. The construction phase has larger annual CO_2e emissions estimates compared to the operational phase and therefore could realize a larger magnitude of GHG mitigation impacts from proportional mitigation measures. Effects of mitigation would be of shorter duration in the construction phase and would be more lasting during the operation phase due to the difference in time scale of each phase.

Specific permit conditions and mitigation actions would be confirmed by regulatory agencies during permitting for the proposed project.

3.3.5 Significant and Unavoidable Adverse Impacts

The analysis found the proposed project would have no significant adverse impacts related to air quality and GHG emissions. Mitigation is proposed to facilitate further reduction of potential emissions. Additional measures may be required as part of state air quality permitting. There would be no significant and unavoidable adverse impacts related to air quality and no significant increase in GHG emissions from construction or operation of the proposed project.

3.4 No Action Alternative

Under the No Action Alternative, the proposed project facilities would not be constructed. Investigation of contamination of the Columbia Gorge Aluminum smelter site and development of associated cleanup actions would continue through a separate Model Toxics Control Act (MTCA) cleanup process. In the absence of the proposed project fully removing the West Surface Impoundment (WSI), it is unknown what cleanup action would be required for the WSI through the full site's MTCA cleanup process, which is underway.

For purposes of evaluating the No Action Alternative, it is assumed that the MTCA disproportionate cost analysis conducted as part of the feasibility study would conclude that the incremental cost to fully remove the WSI would be greater than the incremental environmental benefit achieved relative to the continued containment, inspection, and monitoring of the WSI. Therefore, under the No Action Alternative, it is assumed that the WSI would remain intact. However, the WSI would remain within the ongoing MTCA cleanup process for the smelter site and could be subject to additional remedial actions potentially requiring long-term stewardship measures and land-use restrictions for that area.

This could result in a minor increase in emissions of criteria pollutants, HAP/TAP, and GHGs; however, the magnitude of emissions under the No Action Alternative is not precisely estimated due to uncertainties in the extent of cleanup work required. Under the No Action Alternative, there will be no significant adverse impacts with respect to air quality and GHGs.

4 References

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Attachment 1
Emissions Inventory

Table 1-1
Goldendale Energy Storage Project EIS Information Inputs for Air and GHG Resource Analysis

PROJECT PHASE	PARAMETER	VALUE	UNIT	DATA SOURCE
Construction	Excavators engine power rating	162	horsepower	Based on example of CAT 320
Construction	Total excavators hours of operation	20,000	hours	Applicant
Construction	Loaders engine power rating	973	horsepower	Based on example of CAT 993K
Construction	Total loaders hours of operation	70,000	hours	Applicant
Construction	Dozers engine power rating	247	horsepower	Based on example of CAT D7R
Construction	Total dozers hours of operation	30,000	hours	Applicant
Construction	Compactors engine power rating	142	horsepower	Based on example of CAT CB13
Construction	Total compactors hours of operation	15,000	hours	Applicant
Construction	Graders engine power rating	183	horsepower	Based on example of CAT 140M
Construction	Total graders hours of operation	15,000	hours	Applicant
Construction	Water trucks engine power rating	300	horsepower	Based on example Freightliner LW 4000: M2 106
Construction	Total water trucks hours of operation	17,000	hours	Applicant
Construction	Pickup trucks engine power rating	370	horsepower	Based on example 2021 Dodge RAM 2500 Cummins
Construction	Total pickup trucks hours of operation	57,000	hours	Applicant
Construction	Cranes engine power rating	282	horsepower	Based on example Hitachi SCX 1000A-3
Construction	Total cranes hours of operation	14,000	hours	Applicant

Table 1-1
Goldendale Energy Storage Project EIS Information Inputs for Air and GHG Resource Analysis

PROJECT PHASE	PARAMETER	VALUE	UNIT	DATA SOURCE
Construction	Jumbos engine power rating	275	horsepower	Based on example Sandvik DT912D
Construction	Total jumbos hours of operation	20,000	hours	Applicant
Construction	Concrete truck engine power rating	550	horsepower	Estimation based on range of readily available industry trucks
Construction	Upper reservoir batch plant annual concrete throughput capacity	70,000	tons per year	Applicant
Construction	Lower reservoir batch plant annual concrete throughput capacity	130,000	tons per year	Applicant
Construction	Years of operation for concrete batch plants and earthmoving equipment	3	years	Assumption based on concrete pouring and earthmoving only taking a portion of the total construction time
Construction	Concrete density	4,024	pounds per cubic yard	AP-42 Table 11.12-6 footnote a
Construction	Concrete and aggregate/soil & rock haul trucks average on-site speed	15	miles per hour	Assumption based on industry knowledge
Construction	Concrete and aggregate/soil & rock haul trucks average fuel economy	5	miles per gallon	Assumption based on industry knowledge
Construction	Upper reservoir road distance from site boundary to batch plant	0.3	miles	Assume use of existing unpaved road approaching from the southeast
Construction	Upper reservoir road distance from batch plant to reservoir	0.4	miles	Assumption of average travel distance to various points of reservoir
Construction	Lower reservoir road distance from site boundary to batch plant	0.1	miles	Assume use of existing unpaved road approaching from the southwest

Table 1-1
Goldendale Energy Storage Project EIS Information Inputs for Air and GHG Resource Analysis

PROJECT PHASE	PARAMETER	VALUE	UNIT	DATA SOURCE
Construction	Lower reservoir road distance from batch plant to reservoir	0.5	miles	Assumption of average travel distance to various points of reservoir
Construction	Concrete truck capacity	20.1	tons	Based on example of typical industry equipment
Construction	Upper reservoir road distance from site boundary to reservoir	0.63	miles	Assumption based on distance from southeast existing unpaved road at project boundary to center of reservoir
Construction	Lower reservoir road distance from site boundary to reservoir	0.41	miles	Assumption based on distance from southwest existing unpaved road at project boundary to center of reservoir
Construction	Soil & rock/aggregate haul truck capacity	20.0	tons	Based on example of typical industry equipment: 10 cubic yard truck. Larger capacity trucks are available but 10 cubic yards is conservative.
Construction	Soil & rock/aggregate haul engine power rating	400	horsepower	Estimation based on range of readily available industry trucks
Construction	Blasting mass of ANFO used per blast	26	tons	Estimation based typical industry data
Construction	Total number of blasts required for site-wide construction	272	blasts	Estimation based on typical industry value of 45,000 cubic feet per blast and total excavation volume.
Construction	Electricity generating capacity of diesel-burning generator for construction tunneling operations	750	kilowatts	Assumption based on general industry knowledge

Table 1-1
Goldendale Energy Storage Project EIS Information Inputs for Air and GHG Resource Analysis

PROJECT PHASE	PARAMETER	VALUE	UNIT	DATA SOURCE
Construction	Average power capacity of diesel-burning portable various small equipment	150	kilowatts	Set equal to operation phase maintenance portable generator
Construction	Total hours of construction portable various small equipment	30,000	hours	Applicant
Construction	Construction hours per day	11	hours	*EIS Draft Objectives and Project Description* Section 1.1.4.1
Construction	Construction days per year	260	days	*EIS Draft Objectives and Project Description* Section 1.1.4.1
Construction	Construction total years	5	years	*EIS Draft Objectives and Project Description* Section 1.1.4.1
Construction	Construction tunneling operations total hours	31,200	hours	Applicant: tunnel construction will be three 8-hour shifts
Construction	Powerhouse cavern excavation volume	200,000	cubic yards	*EIS Draft Objectives and Project Description* Section 1.1.4.3
Construction	Step-up transformer cavern excavation volume	46,700	cubic yards	*EIS Draft Objectives and Project Description* Section 1.1.4.3
Construction	Lower reservoir embankment cut volume	4,000,000	cubic yards	*EIS Draft Objectives and Project Description* Section 1.1.4.3
Construction	Lower reservoir embankment fill volume	7,000,000	cubic yards	*EIS Draft Objectives and Project Description* Section 1.1.4.3
Construction	Upper reservoir embankment cut volume	8,000,000	cubic yards	*EIS Draft Objectives and Project Description* Section 1.1.4.3
Construction	Upper reservoir embankment fill volume	5,000,000	cubic yards	*EIS Draft Objectives and Project Description* Section 1.1.4.3
Construction	Density of soil & rock for excavation, cut, fill	4,000	pounds per cubic yard	AP-42 Table 11.9-6 density of overburden; assume most similar to mine I due to similar conditions of moderate sagebrush, moderately steep

Table 1-1
Goldendale Energy Storage Project EIS Information Inputs for Air and GHG Resource Analysis

PROJECT PHASE	PARAMETER	VALUE	UNIT	DATA SOURCE
Construction	Upper reservoir horizontal area of disturbed ground during construction	104	acres	Project site plans inclusive of reservoir and laydown area
Construction	Lower reservoir horizontal area of disturbed ground during construction	140	acres	Project site plans inclusive of reservoir and laydown area
Operation	Total capacity of non-emergency generators on site	150	kilowatts	Applicant
Operation	Annual operating hours of non-emergency generator on site	1040	hours	Assumption based on 20 hours per week and 52 weeks per year
Operation	Annual operating hours of emergency generator on site	100	hours	NSPS IIII limitation
Operation	Total capacity of emergency generators on site	3000	kilowatts	Applicant: two 1,500 kilowatt emergency generators in separate locations

Table 1-2.a

Construction Phase Total Emissions: Average Tons Per Year Over 5-Year Construction Period

POLLUTANT	CONCRETE BATCH PLANT	CONSTRUCTION FUGITIVE DUST	CONSTRUCTION COMBUSTION	TOTAL	TOTAL STATIONARY AND NOC APPLICABLE	NOC THRESHOLD	COMPARISON TO NOC THRESHOLD	TITLE V PERMIT THRESHOLD	PSD MAJOR SOURCE THRESHOLD	COMPARISON TO TITLE V AND PSD THRESHOLD
PM_{10}	1.77	1,075.59	8.83	1,086.20	4.39	0.75	Above	100	250	Below
$PM_{2.5}$	1.77	107.56	8.83	118.17	4.39	0.50	Above	100	250	Below
NO_x	--	--	216.92	216.92	89.79	2.0	Above	100	250	Below
CO	--	--	176.72	176.72	20.58	5.0	Above	100	250	Below
SO_2	--	--	1.56	1.56	0.00	2.0	Below	100	250	Below
VOC	--	--	11.81	11.81	2.64	2.0	Above	100	250	Below
CO_2	--	--	19,318.09	19,318.09	4,340.08	NA	NA	NA	NA	NA
CH_4	--	--	0.78	0.78	0.18	NA	NA	NA	NA	NA
N_2O	--	--	0.16	0.16	0.04	NA	NA	NA	NA	NA
CO_2e	--	--	19,382.74	19,382.74	--	NA	NA	NA	NA	NA

Notes:

Stationary emissions include non-fugitive and stationary construction emissions, which are limited to the concrete batch plant and generators.

Title V operating permit thresholds codified in CFR 40.40. PSD major source thresholds codified in Code of Federal Regulations (CFR) 40.51. Comparison to both thresholds does not include fugitive emissions or mobile source emissions.

CO_2e calculated based on Global Warming Potentials in IPCC AR6 Table 7.SM.7 for 100 year time horizon

Source categories labeled with a pollutant emission rate of "--" have an estimated emisison rate of zero for that pollutant.

NA: not applicable

PSD: Prevention of Significant Deterioration

Table 1-2.b

Operation Phase Total Emissions: Tons Per Year

POLLUTANT	TOTAL OPERATION PHASE	TOTAL STATIONARY AND NOC APPLICABLE	NOC THRESHOLD	COMPARISON TO NOC THRESHOLD	TOTAL STATIONARY AND NOC APPLICABLE	TITLE V PERMIT THRESHOLD	PSD MAJOR SOURCE THRESHOLD	COMPARISON TO TITLE V AND PSD THRESHOLD
PM_{10}	1.07	0.70	0.75	Below	0.70	100	250	Below
$PM_{2.5}$	1.07	0.70	0.50	Above	0.70	100	250	Below
NO_x	36.69	24.14	2.0	Above	24.14	100	250	Below
CO	8.41	5.53	5.0	Above	5.53	100	250	Below
SO_2	1.86E-06	1.22E-06	2.0	Below	1.22E-06	100	250	Below
VOC	1.08	0.71	2.0	Below	0.71	100	250	Below
CO_2	1,773.37	1,166.69	NA	NA	1,166.69	NA	NA	NA
CH_4	7.19E-02	4.73E-02	NA	NA	4.73E-02	NA	NA	NA
N_2O	1.44E-02	9.46E-03	NA	NA	9.46E-03	NA	NA	NA
CO_2e	1,779.30	1,170.59	NA	NA	1,779.30	NA	NA	NA

Notes:

Per Washington Administrative Code (WAC) 173.400.110(4)(c)(iv) the 150 kilowatt non-emergency generator is exempt from NOC requirements. The two 1,500 kilowatt emergency generators are above exemptible power rating in WAC 173.400.110(4)(h)(xxxix).

Per WAC 173.400.110 Table 5 exemption levels

Stationary emissions include the two emergency engine-generator sets. The portable 150 kilowatt generator is not stationary.

Title V operating permit thresholds codified in CFR 40.40. PSD major source thresholds codified in Code of Federal Regulations (CFR) 40.51. Comparison to both thresholds does not include fugitive emissions or mobile source emissions.

CO_2e calculated based on Global Warming Potentials in IPCC AR6 Table 7.SM.7 for 100 year time horizon

NA: not applicable

NOC: Notice of Construction

PSD: Prevention of Significant Deterioration

Table 1-3.a
Emissions from On-Site Concrete Batch Plants

PROCESS STEP	EMISSION FACTOR (pounds/yard^3)			TOTAL CONSTRUCTION EMISSIONS (tons)		
	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Aggregate delivery to ground storage	0.0064	0.0031	0.0031	0.95	0.46	0.46
Sand delivery to ground storage	0.0015	0.0007	0.0007	0.22	0.10	0.10
Aggregate transfer to conveyor	0.0064	0.0031	0.0031	0.95	0.46	0.46
Sand transfer to conveyor	0.0015	0.0007	0.0007	0.22	0.10	0.10
Aggregate transfer to elevated storage	0.0064	0.0031	0.0031	0.95	0.46	0.46
Sand transfer to elevated storage	0.0015	0.0007	0.0007	0.22	0.10	0.10
Cement delivery to silo	0.0002	0.0001	0.0001	0.03	0.01	0.01
Cement supplement delivery to silo	0.0003	0.0002	0.0002	0.04	0.03	0.03
Weigh hopper loading	0.0079	0.0038	0.0038	1.18	0.57	0.57
Central mix loading	0.1613	0.0440	0.0440	24.05	6.56	6.56
			Total	**28.8**	**8.9**	**8.9**

Notes:

Process steps and emission factors from AP-42 Table 11.12-6 (June 2006). PM2.5 emission factor conservatively set equal to PM10 factor. Conservatively assumed uncontrolled emissions. Central mix loading incorporates AP-42 Table 11.12-2 factor.

Emissions estimates based on the following inputs:

Annual mass concrete production, upper reservoir	70,000	tons
Annual mass concrete production, lower reservoir	130,000	tons
Concrete density	4,024	pounds/yard
Years of operation for concrete batch plant	3	years
Total volumetric concrete production	298,211	yards^3

PM: particulate matter

Table 1-3.b
GHG Emissions from Off-Site Cement Production

PROCESS STEP	CO_2e EMISSION FACTOR (pounds/yard^3)	TOTAL CONCRETE USAGE (yard^3)	TOTAL CO_2e EMISSIONS (tons)
Off-site cement production	400	298,211	59,642

Notes:

CO_2e emission factor of 400 lbs/yard^3 derived from "Life Cycle Inventory of Portland Cement Concrete" (Portland Cement Association, 2007), which found that CO_2 emissions from concrete range from 190 lb/cy to 527 lb/cy depending on the cement content of the concrete.

Total conrete usage calcuated in Table A-3.a

Table 1-4
Particulate Emissions from Construction

PROCESS STEP	TOTAL ACRES[1]	EMISSION FACTOR[2] (tons/acre/month)			TOTAL CONSTRUCTION EMISSIONS[3] (tons)		
		PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Upper reservoir	104	1.2	0.37	0.037	7,488	2,292	229
Lower reservoir	140	1.2	0.37	0.037	10,080	3,086	309
				Total:	**17,568**	**5,378**	**538**

1. Acreage of each reservoir based on footprint of reservoirs and laydown areas
2. PM emission factor from AP-42 13.2.3.3 (1/95). Particle size multipliers from AP-42 Table 13.2.2-2 (11/06) for industrial roads

PM	4.9
PM_{10}	1.5
$PM_{2.5}$	0.15

3. Total construction emissions based on full length of construction (5 years)

PM: particulate matter

Table 1-5.a
Mobile Vehicle Fuel Combustion Emission Factor Basis

POLLUTANT	EMISSION FACTOR	EMISSION FACTOR UNIT	EMISSION FACTOR METHODOLOGY
PM_{10}	0.2	g/kW-hr	From 40 CFR Part 1039 Appendix I Table 3 - Tier 3 emission standards for non-road compression ignition engines. PM10 and PM2.5 set equal to PM factor.
$PM_{2.5}$	0.2	g/kW-hr	From 40 CFR Part 1039 Appendix I Table 3 - Tier 3 emission standards for non-road compression ignition engines. PM10 and PM2.5 set equal to PM factor.
NO_x	3.7	g/kW-hr	From 40 CFR Part 1039 Appendix I Table 3 - Tier 3 emission standards for non-road compression ignition engines. Proportion of NO_x vs. VOC optained from AP-42 Table 3.3-1 (10/96)
CO	3.5	g/kW-hr	From 40 CFR Part 1039 Appendix I Table 3 - Tier 3 emission standards for non-road compression ignition engines.
SO_2	2.12E-04	lb/gal	Based on 15 ppm ultra-low sulfur diesel fuel standard and diesel density of 7.05 lb/gallon per AP-42 Appendix A pg. A-7 (9/85)
VOC	0.3	g/kW-hr	From 40 CFR Part 1039 Appendix I Table 3 - Tier 3 emission standards for non-road compression ignition engines. Proportion of NOx vs. VOC optained from AP-42 Table 3.3-1 (10/96)
CO_2	10.2	kg/gal	From 40 CFR Part 98 Table C-1 and Table C-2
CH_4	4.14E-04	kg/gal	From 40 CFR Part 98 Table C-1 and Table C-2
N_2O	8.28E-05	kg/gal	From 40 CFR Part 98 Table C-1 and Table C-2

Notes:

CFR: Code of Federal Regulations

g/kW-hr: grams per kilowatt per hour

kg/gal: kilograms per gallon

lb/gal: pounds per gallon

PM: particulate matter

VOC: volatile organic compounds

Table 1-5.b

Concrete and Dirt Hauling Fuel Combustion Emissions

POLLUTANT	EMISSION FACTOR	EMISSION FACTOR UNIT	CONSTRUCTION EMISSIONS (tons)			
			Concrete Trucks	Aggregate Trucks	Soil & Rock Trucks	Total
PM_{10}	0.2	g/kW-hr	0.17	0.04	11.25	11.46
$PM_{2.5}$	0.2	g/kW-hr	0.17	0.04	11.25	11.46
NO_x	3.7	g/kW-hr	3.10	0.83	208.35	212.28
CO	3.5	g/kW-hr	2.93	0.78	196.84	200.54
SO_2	2.12E-04	lb/gal	5.9E-04	2.2E-04	5.4E-02	5.5E-02
VOC	0.3	g/kW-hr	0.25	0.07	16.60	16.91
CO_2	10.2	kg/gal	62	23	5,773	5,858
CH_4	4.14E-04	kg/gal	2.53E-03	9.31E-04	2.34E-01	0.24
N_2O	8.28E-05	kg/gal	5.06E-04	1.86E-04	4.68E-02	0.05

Notes:

Emission estimates based on the following inputs:

Concrete truck engine rating	410	kW
Aggregate/soil & rock truck engine rating	298	kW
Upper reservoir road distance from site boundary to batch plant	0.30	miles
Upper reservoir road distance from batch plant to reservoir	0.40	miles
Lower reservoir road distance from site boundary to batch plant	0.10	miles
Lower reservoir road distance from batch plant to reservoir	0.50	miles
Upper reservoir road distance from site boundary to reservoir	0.63	miles
Lower reservoir road distance from site boundary to reservoir	0.41	miles
Years of operation for concrete batch plants and earthmoving	3	years
Concrete truck capacity	20.1	tons
Aggregate/soil & rock truck capacity	20.0	tons
Upper reservoir batch plant annual concrete throughput capacity	70,000	tons per year
Lower reservoir batch plant annual concrete throughput capacity	130,000	tons per year
Upper reservoir soil & rock hauling	26,246,700	total tons
Lower reservoir soil & rock hauling	22,246,700	total tons
Concrete trucks total vehicle miles traveled	27,734	VMT
Aggregate trucks total vehicle miles traveled	10,200	VMT
Soil & rock trucks total vehicle miles traveled	2,565,657	VMT
Concrete and aggregate trucks average on-site travel speed	15	mph
Concrete and aggregate trucks average on-site fuel economy	5	mpg

g/kW-hr: grams per kilowatt per hour

kg/gal: kilograms per gallon

lb/gal: pounds per gallon

PM: particulate matter

Table 1-5.c
Construction Non-Road Mobile Vehicles Fuel Combustion Emissions

POLLUTANT	EMISSION FACTOR	EMISSION FACTOR UNIT	CONSTRUCTION EMISSIONS (tons)									
			Exavators	Loaders	Dozers	Compactors	Graders	Water Trucks	Pickup Trucks	Cranes	Jumbos	Total
PM_{10}	0.2	g/kW-hr	0.53	11.20	1.22	0.35	0.45	0.84	3.47	0.65	0.90	19.61
$PM_{2.5}$	0.2	g/kW-hr	0.53	11.20	1.22	0.35	0.45	0.84	3.47	0.65	0.90	19.61
NO_x	3.7	g/kW-hr	9.87	207.42	22.57	6.49	8.36	15.53	64.23	12.01	16.74	363.20
CO	3.5	g/kW-hr	9.32	195.95	21.32	6.13	7.90	14.67	60.68	11.34	15.82	343.12
SO_2	2.12E-04	lb/gal	0.02	0.37	0.04	0.01	0.01	0.03	0.11	0.02	0.03	0.65
VOC	0.3	g/kW-hr	0.79	16.53	1.80	0.52	0.67	1.24	5.12	0.96	1.33	28.94
CO_2	10.2	kg/gal	1,875	39,422	4,289	1,233	1,589	2,952	12,207	2,282	3,182	69,032
CH_4	4.14E-04	kg/gal	0.08	1.60	0.17	0.05	0.06	0.12	0.50	0.09	0.13	2.80
N_2O	8.28E-05	kg/gal	0.02	0.32	0.03	0.01	0.01	0.02	0.10	0.02	0.03	0.56

Notes:

Emission estimates based on the following inputs:

Excavators engine power rating	121	kW
Total excavators hours of operation	20,000	hours
Loaders engine power rating	726	kW
Total loaders hours of operation	70,000	hours
Dozers engine power rating	184	kW
Total dozers hours of operation	30,000	hours
Compactors engine power rating	106	kW
Total compactors hours of operation	15,000	hours
Graders engine power rating	136	kW
Total graders hours of operation	15,000	hours
Water trucks engine power rating	224	kW
Total water trucks hours of operation	17,000	hours
Pickup trucks engine power rating	276	kW
Total pickup trucks hours of operation	57,000	hours
Cranes engine power rating	210	kW
Total cranes hours of operation	14,000	hours
Jumbos engine power rating	205	kW
Total jumbos hours of operation	20,000	hours
Brake-specific fuel consumption, per AP-42 Table 3.3-1 (10/96)	7000	Btu/hp-hr
Diesel heating value, per AP-42 Table 3.3-1 (10/96)	19,300	Btu/lb
Diesel density, per AP-42 Appendix A Pg A-7 (9/85)	7.05	lb/gal
Calculated fuel consumption rate	0.0690	gal/kW-hr

Btu/hp-hr: British Thermal Units per horsepower per hour

g/kW-hr: grams per kilowatt per hour

kg/gal: kilograms per gallon

lb/gal: pounds per gallon

PM: particulate matter

Table 1-5.d
Blasting Emissions

POLLUTANT[1]	EMISSION FACTOR	EMISSION FACTOR UNIT	CONSTRUCTION EMISSIONS[2] (tons)
NO_x	17	lb/ton	60.1
CO	67	lb/ton	237.0
SO_2	2	lb/ton	7.1

Notes:

1. Emission factors from AP-42 Table 13.3-1 (2/80). Particulate emissions from drilling and blasting assumed to be included in calculation of construction fugitive dust.

2. Estimated 7,076 tons total ANFO usage

lb/ton: pounds per ton

Table 1-5.e
Construction Generator Sets

POLLUTANT	EMISSION FACTOR[1]	EMISSION FACTOR UNIT	TUNNELING GENERATOR EMISSIONS[2] (tons)	VARIOUS PORTABLE EQUIPMENT EMISSIONS[2] (tons)	TOTAL EMISSIONS (tons)
PM_{10}	0.0007	lb/hp-hr	11.0	2.1	13.1
$PM_{2.5}$	0.0007	lb/hp-hr	11.0	2.1	13.1
NO_x	0.024	lb/hp-hr	376.6	72.4	449.0
CO	5.50E-03	lb/hp-hr	86.3	16.6	102.9
SO_2	1.21E-09	lb/hp-hr	1.90E-05	3.66E-06	2.27E-05
VOC	7.05E-04	lb/hp-hr	11.1	2.1	13.2
CO_2	1.16	lb/hp-hr	18,200	3,500	21,700
CH_4	4.71E-05	lb/hp-hr	0.7	0.1	0.9
N_2O	9.41E-06	lb/hp-hr	0.15	0.03	0.18

Note:

1. Emission factors from AP-42 Table 3.4-1 (10/96). PM10 and PM2.5 set equal to PM factor. SO2 based on 15 parts per million ultra-low sulfur diesel (ULSD) standard. CH4 and N2O factors based on Code of Federal Regulations 40.98 Table C-1 and Table C-2 ratio to CO2 factor.

2. Emissions based on the following inputs

Capacity of diesel-burning generator for construction tunneling operations	750	kilowatts
Average power capacity of diesel-burning portable various small equipment	150	kilowatts
Construction tunneling operations total hours	31,200	hours
Total hours of construction portable various small equipment	30,000	hours

lb/hp-hr: pounds per horsepower per hour

Table 1-6
Operation Generator Sets

POLLUTANT	EMISSION FACTOR[1]	EMISSION FACTOR UNIT	CONSTRUCTION EMISSIONS[2] (tons)		
			Non Emergency Generator	Emergency Generators Total	Total
PM_{10}	0.0007	lb/hp-hr	0.4	0.7	1.1
$PM_{2.5}$	0.0007	lb/hp-hr	0.4	0.7	1.1
NO_x	0.024	lb/hp-hr	12.6	24.1	36.7
CO	5.50E-03	lb/hp-hr	2.9	5.5	8.4
SO_2	1.21E-09	lb/hp-hr	0.0	0.0	0.0
VOC	7.05E-04	lb/hp-hr	0.4	0.7	1.1
CO_2	1.16	lb/hp-hr	607	1,167	1,773
CH_4	4.71E-05	lb/hp-hr	0.02	0.05	0.07
N_2O	9.41E-06	lb/hp-hr	0.005	0.009	0.014

Notes:

1. Emission factors from AP-42 Table 3.4-1 (10/96). PM_{10} and $PM_{2.5}$ set equal to PM factor. SO_2 based on 15 parts per million ultra-low sulfur diesel (ULSD) standard. CH_4 and N_2O factors based on Code of Federal Regulations 40.98 Table C-1 and Table C-2 ratio to CO_2 factor.
2. Emissions based on the following inputs:

Non-emergency generator capacity	150	kilowatts
Non-emergency generator hours per year	1040	hours
Total emergency generator capacity	3000	kilowatts
Emergency generator hours per year	100	hours

lb/hp-hr: pounds per horsepower per hour