San Luis Low Point Improvement Project Environmental Impact Statement / Environmental Impact Report

Appendix P: Detailed Greenhouse Gas Emissions Calculations

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Appendix P
Detailed Greenhouse Gas Emissions Calculations

P.1 Assessment Methods

P.1.1 Greenhouse Gas Emissions

Construction emissions are described as temporary or "short term" in duration. These temporary and short-term emissions have the potential to represent a significant impact to greenhouse gas (GHG) emissions and climate change. GHG emissions are caused by on- and off-road vehicle exhaust.

The emissions estimation method (i.e., specific emission calculation equations) was based on the California Emission Estimator Model (CalEEMod), Version 2016.3.2 (California Air Pollution Control Officers Association [CAPCOA] 2017), although the calculations were performed outside of the model for flexibility. The CalEEMod is "inflexible" because it is difficult to analyze projects with multiple phases or alternatives because nuanced assumptions cannot always be included in the calculations. Construction-related emissions were estimated using multiple sources as described below.

- OFFROAD2017 Off-Road Emissions Inventory Model (California Air Resources Board [CARB] 2017a)
- EMFAC2014 Web Database (CARB 2014)
- The Climate Registry 2018 Default Emission Factors (The Climate Registry 2018)
- CalEEMod User's Guide, Appendix D: Default Data Tables (CAPCOA 2017)
- Rulemaking documentation related to diesel engines on commercial harbor craft (CARB 2004 and CARB 2007)

Each GHG contributes to climate change differently, as expressed by its global warming potential (GWP). GHG emissions are discussed in terms of carbon dioxide (CO_2) equivalent (CO_2e) emissions, which express, for a given mixture of GHG, the amount of CO_2 that would have the same GWP over a specific timescale. CO_2e is determined by multiplying the mass of each GHG by its GWP.

This analysis uses the GWP from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (Forster et al. 2007) for a 100-year time period to estimate CO_2e. This approach is consistent with the federal GHG Reporting Rule (40 Code of Federal Regulations [CFR] 98), as effective on January 1, 2014 (78 FR 71904) and California's 2000-2015 GHG Inventory Report (CARB 2017b). The GWPs used in this analysis are 25 for methane (CH_4) and 298 for nitrous oxide (N_2O).

The following sections provide additional discussion of emission estimation methodologies used for each source group. Detailed emission calculations are provided in Attachment A.

P.1.1.1 On-Site Construction Equipment Engine Emissions

Emission factors were developed using CARB's OFFROAD2017 model. Emission factors were developed for Merced and Santa Clara Counties for calendar years 2020 to 2026. The OFFROAD2017 model does not estimate emissions of CH_4 and N_2O; therefore, it was necessary to estimate these emissions separately. The Climate Registry's 2018 Default Emission Factors were used to estimate emissions. Emission factors for "Construction/Mining Equipment" were used to estimate CH_4 and N_2O emissions for all off-road construction equipment.

The average power rating (horsepower [hp]) for the equipment was weighted from the equipment population and hp bins contained in the models. The average hp is consistent with those developed for Chapter 10, Air Quality.

The emission factors that were developed for each piece of equipment are multiplied by the number of pieces of each equipment type that would be used during each phase of construction for each alternative. Annual emissions were calculated based on the emission factors and data provided by the design engineers. Table P-1 summarizes the maximum daily equipment counts for each alternative. The maximum daily equipment count was assumed to operate continually during each construction phase.

The construction schedule is based on a 10-hour workday for the Lower San Felipe Intake Alternative, the San Luis Reservoir Enlargement Alternative, and the Pacheco Reservoir Expansion Alternative; the latter two alternatives will operate for two shifts per day. For the Lower San Felipe Intake Alternative, it was assumed that tunneling operations would assume 24 hours per day; therefore, 12 employees would work in the tunnel each day (assumes four workers per 8-hour shift). The construction schedule for the Treatment Alternative is based on an 8-hour workday (one shift).

Table P-1. Off-Road Engine Equipment Counts

Equipment Type	Lower San Felipe Intake Alternative – Tunneling Option	Lower San Felipe Intake Alternative – Pipeline Option	Treatment Alternative[1]	San Luis Reservoir Enlargement Alternative	Pacheco Reservoir Expansion Alternative
Aerial Lifts	0	0	0	0	2
Air compressor	0	0	0	1	4
Boom Truck	0	0	0	1	3
Bulldozer	2	2	1	3	6
Cement and Mortar Mixers	0	0	0	0	1
Chipper	0	0	0	0	0
Concrete Pumpers	2	1	2	0	0
Concrete Saw Cutters	0	0	2	2	0
Cranes	4	3	2	4	7
Drill Rig	1	0	0	0	0
Dump Truck	0	0	0	3	10
Excavator	1	1	1	2	1
Flatbed Trucks (on site)	3	3	4	2	3
Forklift	0	0	0	1	0
Fuel and Lube Truck	0	0	0	1	3
Grader	2	2	0	2	2
Loaders	2	2	1	2	12
Mechanic Truck	0	0	0	1	4
Pickup Truck	0	0	0	6	16
Portable Diesel Generators	7	4	0	3	4
Pressure Washers	0	0	0	0	2
Pump	0	0	0	2	5
Roller	0	0	0	0	7
Scraper	1	1	0	2	1
Signal Boards	0	0	0	0	12
Skidders	0	0	0	0	3
Tractor	0	0	0	2	0
Truck Mounted Drill Rig (Wells)	0	0	0	0	4
Vibrating Plate	0	0	0	1	0
Vibratory Soil Compactors	0	0	0	4	0
Water Truck	2	2	2	3	6
Welders	0	0	0	0	4
Wheel Trencher	0	0	2	0	0
Total	**27**	**21**	**17**	**48**	**122**

Notes:

[1] Equipment counts for Treatment Alternative are based on the dissolved air flotation technology and are assumed to be equivalent to the ozonation technology currently proposed for this alternative. Construction assumptions will be confirmed when feasibility level design is completed in July 2018.

P.1.1.2 Off-Site Haul/Delivery Truck and Construction Worker Engine Emissions

Engine exhaust emissions would occur from several on-road vehicles including dump trucks, concrete trucks, delivery trucks, gravel/paving trucks, and soil hauling trucks. Water trucks and flatbed trucks could also operate onsite during construction activities. Furthermore, emissions would also occur from construction workers commuting to the various construction sites. Off-site vehicle trip assumptions are consistent with those used in Chapter 14, Traffic and Transportation.

Haul and delivery truck emission factors were estimated using EMFAC2014 for heavy-duty diesel engines while the water and flatbed trucks were assumed to be medium-duty vehicles. Construction worker commuting emissions were estimated from the specific county's fleet mix for passenger automobiles and light-duty trucks. Both gasoline and diesel engines were assumed to be used by the construction workers.

For the haul/delivery trucks and construction workers, emission factors were estimated from the combined speeds in the various counties (i.e., a "burden" model run), rather than a specific speed. The onsite trucks were assumed to operate at 40 miles per hour.

The EMFAC2014 model does not estimate emissions of CH_4 and N_2O; therefore, it was necessary to estimate these emissions separately. The Climate Registry's 2018 Default Emission Factors were used to estimate emissions. Emission factors for "Diesel Medium and Heavy-Duty Vehicles (Trucks and Busses)" were used to estimate CH_4 and N_2O emissions for all haul and delivery trucks. Construction worker emission factors were estimated based on the county-specific fleet mix of "Gasoline Passenger Cars," "Gasoline Light Trucks (Vans, Pickup Trucks, Sport Utility Vehicles)," "Diesel Passenger Cars," and "Diesel Light Trucks."

P.1.1.3 Marine Emissions (Tugboats, Barges, and Dredges)

Marine emissions would occur from vessels used during construction of either a tunnel or pipeline in the Lower San Felipe Intake Alternative. The tugboats used to move the barges and dredges within the San Luis Reservoir and the crew and supply boats would use both propulsion and auxiliary engines. Emission factors for transport fuels were obtained from The Climate Registry's 2018 Default Emission Factors.

Data on the average number of engines per vessel, the average annual operating hours per vessel type, and the useful life of each vessel were obtained from CARB's *Emissions Estimation Methodology for Commercial Harbor Craft Operating in California* (2007). Information on the quantity and average hp of auxiliary and propulsion engines and the vessel age were estimated from CARB's *Statewide Commercial Harbor Craft Survey* (2004).

Dredges would also operate in the Lower San Felipe Intake Alternative during construction of the pipeline; dredges would not be used during tunnel construction. Emission factors for the auxiliary engines operating on the dredges were obtained from the OFFROAD2017 model.

P.1.2 Climate Change Analysis

The climate change impact assessment characterizes the sensitivity of environmental effects evaluated in this Environmental Impact Statement/Report (EIS/EIR) to uncertainties in potential future socioeconomic and climatic conditions. As previously discussed, Section 15126.2(a) of the California Environmental Quality Act (CEQA) Guidelines require Lead Agencies to consider the effects of placing projects in locations susceptible to hazardous conditions. Because climate change can affect hazards like flooding and wildfire, this section thereby requires the effects of climate change to be analyzed under CEQA.

Appendix Q, Climate Change Analysis, presents the significance determinations made in Chapters 4 through 25, and evaluates how those significance determinations could be changed under future climate change scenarios. This analysis does not identify new impacts that were not already analyzed in the other chapters; it instead describes how those impacts might change with future climate change.

P.2 Significance Criteria

The significance criteria described below were developed consistent with the CEQA Guidelines to determine the significance of potential impacts on air quality. Impacts on GHG emissions would be considered potentially significant if the proposed project or alternatives would:

- Generate GHG emissions, either directly or indirectly, that may have a significant impact on environment.
- Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs.

In addition to the general criteria provided above, individual air districts may also establish significance criteria that would also be applicable. Additional significance criteria by air district are provided below.

P.2.1 San Joaquin Valley Air Pollution Control District (SJVAPCD)

The SJVAPCD publishes a *Guidance for Assessing and Mitigating Air Quality Impacts* (GAMAQI) (SJVAPCD 2015) to assist Lead Agencies with uniform procedures for addressing GHG impacts in environmental documentation. The SJVAPCD does not establish a specific quantitative level of GHG emissions increase above which a project would have a significant impact on the

environment. As a result, the SJVAPCD uses a tiered approach for assessing the significance of a project based on the following criteria (SJVAPCD 2009):

- Projects determined to be exempt from the requirements of CEQA would be determined to have a less than significant individual and cumulative impact for GHG emissions and would not require further environmental review, including analysis of project specific GHG emissions.

- Projects complying with an approved GHG emission reduction plan or GHG mitigation program that avoids or substantially reduces GHG emissions within the geographic area in which the project is located would be determined to have a less than significant individual and cumulative impact for GHG emissions.

- Projects implementing best performance standards (BPS) would not require quantification of project specific emissions. Such projects would be determined to have a less than significant individual and cumulative impact for GHG emissions.

- Projects not implementing BPS would require quantification of project specific GHG emissions and demonstration that project specific GHG emissions would be reduced or mitigated by at least 29 percent compared to business as usual (BAU).

- Notwithstanding any of the above provisions, projects requiring preparation of an EIR for any other reason would require quantification of project specific GHG emissions. Projects implementing BPS or achieving at least a 29 percent GHG emission reduction compared to BAU would be determined to have a less than significant individual and cumulative impact for GHG.

The alternatives do not include the installation of any stationary sources that would be subject to the SJVAPCD's BPS provisions. The BPS classes are generally geared towards stationary source fossil fuel-combustion equipment like boilers, engines, and heaters. In addition, the action alternatives do not consist of "traditional" land use development projects like proposed residential, commercial, industrial, or governmental operations that primarily increase GHG emissions through energy consumption and vehicle miles traveled.

P.2.2 BAAQMD

To evaluate the significance of GHG emissions in the SJVAPCD from non-stationary sources, the quantitative thresholds proposed by the Bay Area Air Quality Management District (BAAQMD) in its CEQA Air Quality Guidelines (2017a) were used. The BAAQMD thresholds are adequate to measure GHG emissions increases above which could hinder implementation of the State's GHG reduction goals, including AB 32.

The BAAQMD publishes CEQA Air Quality Guidelines to assist Lead Agencies with complying with CEQA's requirements. These guidelines were updated in May 2017 to include new and updated significance thresholds.

The 2017 BAAQMD Air Quality CEQA Guidelines do not provide a threshold for construction projects, but they include multiple thresholds for operational emissions, including 1,100 metric tons carbon dioxide equivalent per year ($MTCO_2e$/year) for projects other than stationary sources and 10,000 $MTCO_2e$/year for stationary sources. For construction impacts, the BAAQMD recommends quantifying and disclosing GHG emissions that would occur during construction and to then make a determination of significance in relation to meeting AB 32 reduction goals. Additionally, best management practices should be incorporated to reduce GHG impacts.

P.2.3 Sacramento Metropolitan Air Quality Management District (SMAQMD)

Although the project is not located within the boundaries of the SMAQMD, the significance criteria used by other air districts was evaluated. The SMAQMD uses a significance threshold of 1,100 $MTCO_2e$/year for the construction phase of a proposed project (2015). Because the air quality in the Sacramento Valley is similar to the air quality in the Bay Area and the San Joaquin Valley, and because the threshold is a conservative assessment of GHG impacts for construction-related activities, the threshold was used in this analysis.

P.2.4 Plan Consistency

The action alternatives were compared to various plans, policies, and regulations that were enacted to reduce GHG emissions. If an alternative is found to be consistent with the applicable plans, then impacts associated with construction and operation would be less than significant for the second criterion related to GHG impacts.

P.2.4.1 Initial Scoping Plan

The action alternatives were compared to the Assembly Bill (AB) 32 Initial Scoping Plan (CARB 2008) for consistency. The initial scoping plan contains a variety of strategies that were designed to reduce the State's GHG emissions. Table P-1 summarizes the 18 strategies contained in the initial scoping plan and the alternatives were evaluated for consistency. As shown in the table, emission reduction measures would either not be applicable or the alternatives would be constructed in such a way that they would be compliant.

Table P-1. Initial Scoping Plan Measures Consistency Analysis

Emission Reduction Measure	Project Consistency
1. California Cap-and-Trade Program Linked to Western Climate Initiative Partner Jurisdictions. Implement a broad-based California cap-and-trade program to provide a firm limit on emissions. Link the California cap–and-trade program with other Western Climate Initiative Partner programs to create a regional market system to achieve greater environmental and economic benefits for California. Ensure California's program meets all applicable AB 32 requirements for market-based mechanisms.	**Not Applicable.** The project is a part of an industry that is required to comply with the cap-and-trade regulations.
2. California Light-Duty Vehicle GHG Standards. Implement adopted Pavley standards and planned second phase of the program. Align zero-emission vehicle, alternative and renewable fuel and vehicle technology programs with long-term climate change goals.	**Not Applicable.** This is a statewide measure that is not implemented by a project proponent.
3. Energy Efficiency. Maximize energy efficiency building and appliance standards, and pursue additional efficiency efforts including new technologies, and new policy and implementation mechanisms. Pursue comparable investment in energy efficiency from all retail providers of electricity in California (including both investor-owned and publicly-owned utilities).	**Consistent.** Any new buildings built as part of an action alternative (e.g., new pump station buildings) would be constructed in compliance with the State's energy efficiency regulations for buildings.
4. Renewables Portfolio Standard. Achieve 33 percent renewable energy mix statewide.	**Not Applicable.** This is a statewide measure that is not implemented by a project proponent.
5. Low Carbon Fuel Standard. Develop and adopt the Low Carbon Fuel Standard.	**Not Applicable.** This is a statewide measure that is not implemented by a project proponent.
6. Regional Transportation-Related GHG Targets. Develop regional GHG emissions reduction targets for passenger vehicles.	**Not Applicable.** The regional transportation plans developed for the Bay Area contain provisions required under Senate Bill 375 to reduce GHG emissions from vehicle miles traveled. The regional transportation plans do not have any requirements that apply to the action alternatives.
7. Vehicle Efficiency Measures. Implement light-duty vehicle efficiency measures.	**Not Applicable.** This is a statewide measure that is not implemented by a project proponent.
8. Goods Movement. Implement adopted regulations for the use of shore power for ships at berth. Improve efficiency in goods movement activities.	**Not Applicable.** The project does not propose any changes to goods movement from trucks, ports, and other related facilities.
9. Million Solar Roofs Program. Install 3,000 megawatts of solar-electric capacity under California's existing solar programs.	**Not Applicable.** The project does not impede the ability of the State to install additional solar roofs.
10. Medium/Heavy-Duty Vehicles. Adopt medium and heavy-duty vehicle efficiency measures.	**Not Applicable.** This is a statewide measure that is not implemented by a project proponent.
11. Industrial Emissions. Require assessment of large industrial sources to determine whether individual sources within a facility can cost-effectively reduce GHG emissions and provide other pollution reduction co-benefits. Reduce GHG emissions from fugitive emissions from oil and gas extraction and gas transmission. Adopt and implement regulations to control fugitive methane emissions and reduce flaring at refineries.	**Not Applicable.** This measure only applies to major industrial facilities emitting more than 500,000 $MTCO_2e$ per year.
12. High Speed Rail. Support implementation of a high-speed rail system.	**Not Applicable.** This is a statewide measure that is not implemented by a project proponent.
13. Green Building Strategy. Expand the use of green building practices to reduce the carbon footprint of California's new and existing inventory of buildings.	**Consistent.** Any new buildings built as part of an action alternative (e.g., new pump station buildings) would use green building strategies to the extent possible.

Emission Reduction Measure	Project Consistency
14. High Global Warming Potential Gases. Adopt measure to reduce high global warming potential gases.	**Not Applicable.** This project does not include air conditioning or refrigeration.
15. Recycling and Waste. Reduce methane emissions at landfills. Increase waste diversion, composting and other beneficial uses of organic materials, and mandate commercial recycling. Move toward zero-waste.	**Not Applicable.** Project operations would not result in the generation of waste.
16. Sustainable Forests. Preserve forest sequestration and encourage the use of forest biomass for sustainable energy generation.	**Not Applicable.** None of the alternatives under consideration would be in forested areas or areas zoned as forestland.
17. Water. Continue efficiency programs and use cleaner energy sources to move and treat water.	Consistent. Additional electricity use would be required to pump or treat water depending on the alternative. Increasing energy efficiency to move, treat, and use water is a would reduce GHG emissions.
18. Agriculture. In the near-term, encourage investment in manure digesters and at the five-year Scoping Plan update determine if the program should be made mandatory by 2020.	**Not Applicable.** The project site is not designated or in use for agricultural purposes.

Source: CARB 2008
Key:
AB = Assembly Bill; GHG = greenhouse gas; $MTCO_2e$ = metric tons carbon dioxide equivalent

P.2.4.2 2017 Climate Change Scoping Plan Update

California's 2017 Climate Change Scoping Plan (CARB 2017c) contains various emission reduction strategies to help the State to meet the goals of Executive Order B-30-15 and Senate Bill (SB) 32 to achieve a 2030 goal of reducing GHG emissions 40 percent below 2020 levels. The updated scoping plan contains various emission reduction measures that are specific to the water sector. Table P-2 summarizes the various measures and evaluates if the action alternatives would be consistent.

Table P-2. 2017 Updated Scoping Plan Measures Consistency Analysis

Emission Reduction Measure	Project Consistency
1. As directed by Governor Brown's Executive Order B-37-16, DWR and SWRCB will develop and implement new water use targets to generate more statewide water conservation than existing targets (the existing State law requires a 20 percent reduction in urban per capita water use by 2020 [SBx7-7, Steinberg, Chapter 4, Statutes of 2009]). The new water use targets will be based on strengthened standards for indoor use, outdoor irrigation, commercial, industrial, and institutional water use.	**Not Applicable.** The proposed project would not impede DWR's and SWRCB's ability to implement statewide water conservation targets.
2. SWRCB will develop long-term water conservation regulation, and permanently prohibit practices that waste potable water.	**Not Applicable.** The proposed project would not impede SWRCB's ability to implement its recommendations to use water more wisely.
3. DWR and SWRCB will develop and implement actions to minimize water system leaks, and to set performance standards for water loss, as required by SB 555 (Wolk, Chapter 679, Statutes of 2015).	**Not Applicable.** The measure is only applicable to urban retail water suppliers.
4. DWR and CDFA will update existing requirements for agricultural water management plans to increase water system efficiency.	**Not Applicable.** The project site is not designated or in use for agricultural purposes.

Emission Reduction Measure	Project Consistency
5. CEC will certify innovative technologies for water conservation and water loss detection and control.	**Not Applicable.** The measure is only applicable at utility, household, and appliance levels.
6. CEC will continue to update the State's Appliance Efficiency Regulations (California Code of Regulations, Title 20, Sections 1601–1608) for appliances offered for sale in California to establish standards that reduce energy consumption for devices that use electricity, gas, and/or water.	**Not Applicable.** The proposed project would not operation any appliances subject to the emission reduction measure.
7. CalEPA will oversee development of a voluntary registry for GHG emissions resulting from the water-energy nexus, as required by SB 1425 (Pavley, Chapter 596, Statutes of 2016).	**Not Applicable.** The proposed project would not impede the State's ability to develop a GHG emission registry.
8. The SWP has entered long-term contracts to procure renewable electricity from 140 MW solar installations in California.	**Not Applicable.** The proposed project would not interfere with the ability of the SWP to procure renewable electricity.
9. As described in its Climate Action Plan, DWR will continue to increase the use of renewable energy to operate the SWP.	**Not Applicable.** The proposed project would not interfere with the ability of DWR to increase its renewable energy use.

Source: CARB 2017c
Key:
CalEPA = California Environmental Protection Agency; CDFA = California Department of Food and Agriculture; CEC = California Energy Commission; DWR = Department of Water Resources; GHG = greenhouse gas; MW = megawatt; SB = Senate Bill; SWP = State Water Project; SWRCB = State Water Resources Control Board

P.2.4.3 BAAQMD 2017 Clean Air Plan

The 2017 Clean Air Plan, *Spare the Air, Cool the Climate*, contains various control measures to protect public health and to protect the climate. The 2017 Plan identifies methods to reduce Bay Area GHG emissions 40 percent below 1990 levels by 2030 and 80 percent below 1990 levels by 2050 (BAAQMD 2017b). The goals and objectives focus on the following economic sectors: stationary sources, transportation, energy, buildings, agriculture, natural and working lands, waste management, water, and super-GHG pollutants. Table P-3 summarizes the control measures designed to reduce GHG emissions from the water sector.

Table P-3. 2017 Clean Air Plan Consistency Analysis

Number	Name	Description	Consistency Evaluation
WR1	Limit GHGs from POTWs	Initiate a process to better understand and quantify GHG emissions at POTWs. Explore rulemaking to reduce GHGs emitted directly within POTWs. Promote the use of biogas recovery systems at POTWs.	**Not Applicable.** The proposed project would not interfere with the Bay Area's ability to reduce GHGs emitted within POTWs.
WR2	Support water conservation	Develop a list of best practices that reduce water consumption and increase on-site water recycling in new and existing buildings; incorporate into local planning guidance.	**Not Applicable.** No buildings would be built for the proposed project that would increase water usage.

Source: BAAQMD 2017b
Key:
GHG = greenhouse gas; POTWs = publicly owned treatment works

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Appendix P: Attachment A, Detailed Greenhouse Gas Emissions Calculations Tables

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Operation & Maintenance Emissions

Table A-1. Lower San Felipe Intake Alternative (Tunnel Option) - Annual Operational Emissions

Source	Annual Emissions (MTCO2e/year)			
	CO2	CH4	N2O	CO2e
Additional Pumping at Pacheco	229	1	1	231
Air Compressor Operation	48	0	0	48
LOX Delivery Trucks	7	0	0	7
Subtotal with Air Compressor Operation	277	1	1	279
Subtotal with LOX Delivery Trucks	236	1	1	238
Maximum Operational Emissions	**277**	**1**	**1**	**279**
Significance Threshold	n/a	n/a	n/a	10,000
Significant?	n/a	n/a	n/a	No

Table A-2. Lower San Felipe Intake Alternative (Pipeline Option) - Annual Operational Emissions

Source	Annual Emissions (MTCO2e/year)			
	CO2	CH4	N2O	CO2e
Additional Pumping at Pacheco	229	1	1	231
Air Compressor Operation	48	0	0	48
LOX Delivery Trucks	7	0	0	7
Subtotal with Air Compressor Operation	277	1	1	279
Subtotal with LOX Delivery Trucks	236	1	1	238
Maximum Operational Emissions	**277**	**1**	**1**	**279**
Significance Threshold	n/a	n/a	n/a	10,000
Significant?	n/a	n/a	n/a	No

Table A-3. Treatment Alternative - Annual Operational Emissions

Source	Annual Emissions (MTCO2e/year)			
	CO2	CH4	N2O	CO2e
Workers	2	0	0	2
Solid Waste Disposal	1	0	0	1
Total Operational Emissions	**3**	**0**	**0**	**3**
Significance Threshold	n/a	n/a	n/a	10,000
Significant?	n/a	n/a	n/a	No

Table A-4. Enlarged Reservoir and Treatment Retrofit Alternative - Annual Operational Emissions

Source	Annual Emissions (MTCO2e/year)			
	CO2	CH4	N2O	CO2e
Additional Pumping at Gianelli	5,715	16	23	5,754
Additional Pumping at Pacheco	754	2	3	759
Workers	2	0	0	2
Solid Waste Disposal	1	0	0	1
Total Operational Emissions	**6,471**	**18**	**26**	**6,516**
Significance Threshold	n/a	n/a	n/a	10,000
Significant?	n/a	n/a	n/a	No

Lower San Felipe Intake Alternative

Air Compressor Operation	92	days per year	(Assumes 200 HP operating 25% of year)
Air Flow Rate	1,200	scfm	(Mattei Air Compressor, Model MAXIMA 160 X, 200 hp)
	1,728,000	scf per day	
	158,976,000	scf per year	
Delivery Truck Capacity	20	tons per truck	http://www.uigi.com/delivery.html
	483,200	scf/truck	
Equivalent LOX Truck Trips	4	trucks per day	
	330	trucks per year	

Table A-5. LOX Delivery Truck Emissions

Source	CO2	CH4	N2O	Total
Emission Factor (g/mi)	1,589.77	0.01	0.005	n/a
Emissions (metric tons per year)	6.93	0.00002	0.00002	n/a
Emissions (MTCO2e/year)	6.93	0.001	0.01	6.93

Trip Length 6.6 miles

CAPCOA. 2017. CalEEMod User's Guide, Version 2016.3.2, Appendix D: Default Data Tables, Table 4.2, Merced County, Rural C-NW (Commercial-Nonwork)

CalEEMod User's Guide states that C-NW trips include trips made by delivery vehicles of goods associated with the land use.

Table A-6. Purchased Electricity Emissions

Source	Electricity (kWh/year)	Annual Emissions (MT/year)			Annual Emissions (MTCO2e/year)			
		CO2	CH4	N2O	CO2	CH4	N2O	CO2e
Emission Factors (lbs/MWh)	n/a	293.67	0.033	0.004	n/a	n/a	n/a	n/a
Aeration System (Air Compressor)	357,700	47.65	0.01	0.001	47.65	0.13	0.19	47.98
Additional Pumping at Pacheco	1,722,800	229.49	0.03	0.003	229.49	0.64	0.93	231.07

CO2 Emission Factor Source: The Climate Registry. 2018. Utility-Specific Emission Rates, 2016 Emission Rates, Pacific Gas & Electric. Available online at https://www.theclimateregistry.org/our-members/cris-public-reports/ [Accessed on October 23, 2018].

CH4 and N2O Emission Factor Source: The Climate Registry. 2018. 2018 Default Emission Factors, Table 14.1 U.S. Default Factors for Calculating Emissions from Grid Electricity by eGRID Subregion; CAMX. Available online at https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf [Accesssed on October 23, 2018].

Conversions

60	minutes per hour	
24	hours per day	
24,160	scf per ton	(http://www.uigi.com/o2_conv.html)
1,000,000	grams per metric ton	
1,000	kW per MW	
453.6	grams per pound	

GWP

CO2	1
CH4	25
N2O	298

Source: The Climate Registery. 2018. Default Emission Factors. Table B.1, AR4.

Treatment Alternative

Table A-7. Worker Trips

Source	CO2	CH4	N2O	Total
Emission Factor (g/mi)	287.63	0.18	0.02	n/a
Emissions (metric tons per year)	2.27	0.001	0.0002	n/a
Emissions (MTCO2e/year)	2.27	0.04	0.05	2.35

Trip Length Sources:

CAPCOA. 2017. CalEEMod User's Guide, Version 2016.3.2, Appendix D: Default Data Tables, Table 4.2, Santa Clara County, Urban H-W (Home-Work)

Key: FTE = Full Time Equivalent Employees

Full Time Equivalent Employees	1
Trip Length (miles)	10.8

Maintenance Trips

Treatment

Solids Disposal	10%	increase in solids disposal
Santa Teresa	935	additional pounds per day
	171	additional tons per year

Truck Trips	9	trucks per year

Table A-8. Solid Waste Disposal Truck Trips

Source	CO2	CH4	N2O	Total
Emission Factor (g/mi)	4,060.91	0.0051	0.0048	n/a
Emissions (metric tons per year)	0.53	0.000001	0.000001	n/a
Emissions (MTCO2e/year)	0.53	0.00002	0.0002	0.53

Trip Length 7.3 miles

CAPCOA. 2017. CalEEMod User's Guide, Version 2016.3.2, Appendix D: Default Data Tables, Table 4.2, Santa Clara County, Urban C-NW (Commercial-Nonwork).

CalEEMod User's Guide states that C-NW trips include trips made by delivery vehicles of goods associated with the land use.

Conversions

20	tons per truck (CalEEMod User's Guide, Version 2016.3.2
365	days per year
453.6	grams per pound
1,000,000	grams per metric ton
2,000	pounds per ton

GWP

CO2	1
CH4	25
N2O	298

Source: The Climate Registery. 2018. Default Emission Factors. Table B.1, AR4.

Enlarged Reservoir Alternative

Table A-9. Purchased Electricity Emissions

Source	Electricity (kWh/year)	Annual Emissions (MT/year)			Annual Emissions (MTCO2e/year)			
		CO2	CH4	N2O	CO2	CH4	N2O	CO2e
Emission Factors (lbs/MWh)	n/a	293.67	0.033	0.004	n/a	n/a	n/a	n/a
Additional Pumping at Gianelli	42,899,932	5,714.64	0.64	0.078	5,714.64	16.05	23.20	5,753.89
Additional Pumping at Pacheco	5,657,134	753.58	0.08	0.010	753.58	2.12	3.06	758.76

CO2 Emission Factor Source: The Climate Registry. 2018. Utility-Specific Emission Rates, 2016 Emission Rates, Pacific Gas & Electric. Available online at https://www.theclimateregistry.org/our-members/cris-public-reports/ [Accessed on October 23, 2018].

CH4 and N2O Emission Factor Source: The Climate Registry. 2018. 2018 Default Emission Factors, Table 14.1 U.S. Default Factors for Calculating Emissions from Grid Electricity by eGRID Subregion; CAMX. Available online at https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf [Accesssed on October 23, 2018].

Conversions

60	minutes per hour	
24	hours per day	
24,160	scf per ton	(http://www.uigi.com/o2_conv.html)
1,000,000	grams per metric ton	
1,000	kW per MW	
453.6	grams per pound	

GWP

CO2	1
CH4	25
N2O	298

Source: The Climate Registery. 2018. Default Emission Factors. Table B.1, AR4.

Gianelli

13	months of additional pumping over 82 year model record
0.16	annual average months per year
114	hours per year

Gianelli Pumping Plant Capacity

Number of Pumps	8	
Rating per Pump	63,000	hp
Total Power Rating	504,000	hp
	375,833	kW

Pacheco

36	months of additional pumping over 82 year model record
0.44	annual average months per year
316	hours per year

Pacheco Pumping Plant Capacity

Number of Pumps	12	
Rating per Pump	2,000	hp
Total Power Rating	24,000	hp
	17,897	kW

Pacheco Reservoir Expansion Alternative

Table A-10. Purchased Electricity Emissions

Source	Electricity (kWh/year)	Annual Emissions (MT/year)			Annual Emissions (MTCO2e/year)			
		CO2	CH4	N2O	CO2	CH4	N2O	CO2e
Emission Factors (lbs/MWh)	n/a	293.67	0.033	0.004	n/a	n/a	n/a	n/a
Additional Pumping at Pacheco	1,960,404	261.14	0.03	0.004	261.14	0.73	1.06	262.94

CO2 Emission Factor Source: The Climate Registry. 2018. Utility-Specific Emission Rates, 2016 Emission Rates, Pacific Gas & Electric. Available online at https://www.theclimateregistry.org/our-members/cris-public-reports/ [Accessed on October 23, 2018].

CH4 and N2O Emission Factor Source: The Climate Registry. 2018. 2018 Default Emission Factors, Table 14.1 U.S. Default Factors for Calculating Emissions from Grid Electricity by eGRID Subregion; CAMX. Available online at https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf [Accesssed on October 23, 2018].

Conversions

60	minutes per hour	
24	hours per day	
24,160	scf per ton	(http://www.uigi.com/o2_conv.html)
1,000,000	grams per metric ton	
1,000	kW per MW	
453.6	grams per pound	
325,851	gallons per acre-foot	
7.48	gallons per cubic foot	

GWP

CO2	1
CH4	25
N2O	298

Source: The Climate Registery. 2018. Default Emission Factors. Table B.1, AR4.

Pacheco Pumping Plant Capacity

Number of Pumps	11	
Rating per Pump	1,250	hp
Total Power Rating	13,750	hp
	10,253	kW

Pump Station Capacity

490	cfs	*(SCVWD Initial Study and Notice of Preparation)*
219,912	gpm	

Average Annual Pump Rate

7,742	acre-feet	(based on 82-year model record)
191	hours per year	

Onroad Motor Vehicle Emission Factors
EMFAC2014

Table A-10. Running Emission Factors (San Francisco Bay Area)

Year	Vehicle Type	(grams per mile)		
		CO2	CH4	N2O
2021	Workers	287.6285	0.1789	0.0197
	Solid Waste Collection Truck	4060.9074	0.0051	0.0048
	Haul Truck	1598.9822	0.0051	0.0048
2022	Workers	276.5057	0.1775	0.0195
	Solid Waste Collection Truck	3998.4441	0.0051	0.0048
	Haul Truck	1577.9571	0.0051	0.0048

Onroad Motor Vehicle Emission Factors
EMFAC2014

Table A-11. Running Emission Factors (San Joaquin Valley)

Year	Vehicle Type	(grams per mile)		
		CO2	CH4	N2O
2021	Workers	297.3278	0.1790	0.0197
	Solid Waste Collection Truck	4319.5118	0.0051	0.0048
	Haul Truck	1589.7741	0.0051	0.0048
2022	Workers	285.9653	0.1776	0.0196
	Solid Waste Collection Truck	4279.4235	0.0051	0.0048
	Haul Truck	1568.9545	0.0051	0.0048

Greenhouse Gas Construction Emissions Summary

Table A-12. Lower San Felipe Intake Alternative (Tunnel Option) - Annual Emissions

Source	Annual Emissions (tons per year)			
	CO2	CH4	N2O	CO2e
	2020			
Off-Road Construction Equipment	8,593	1	0	8,613
On-Road Haul Trucks and Delivery Vehicles	385	0	0	385
Construction Worker Commuting	276	0	0	301
Marine Emissions (Tugboats and Crew/Supply Vessels)	-	-	-	-
Dredge (Auxiliary Engines)	-	-	-	-
2020 Total Emissions	**9,254**	**1**	**0**	**9,299**
	2021			
Off-Road Construction Equipment	12,135	1	0	12,161
On-Road Haul Trucks and Delivery Vehicles	381	0	0	381
Construction Worker Commuting	266	0	0	290
Marine Emissions (Tugboats and Crew/Supply Vessels)	909	0	0	921
Dredge (Auxiliary Engines)	-	-	-	-
2021 Total Emissions	**13,690**	**1**	**0**	**13,753**
	2022			
Off-Road Construction Equipment	9,487	1	0	9,506
On-Road Haul Trucks and Delivery Vehicles	377	0	0	377
Construction Worker Commuting	256	0	0	280
Marine Emissions (Tugboats and Crew/Supply Vessels)	1,558	0	0	1,579
Dredge (Auxiliary Engines)	-	-	-	-
2022 Total Emissions	**11,677**	**1**	**0**	**11,742**
	2023			
Off-Road Construction Equipment	7,719	1	0	7,734
On-Road Haul Trucks and Delivery Vehicles	334	0	0	334
Construction Worker Commuting	246	0	0	270
Marine Emissions (Tugboats and Crew/Supply Vessels)	130	0	0	132
Dredge (Auxiliary Engines)	-	-	-	-
2023 Total Emissions	**8,429**	**1**	**0**	**8,470**
Maximum Annual Emissions	**13,690**	**1**	**0**	**13,753**
Annual Significance Threshold	n/a	n/a	n/a	12,500
Significant?	n/a	n/a	n/a	Yes
Grand Total Emissions	**43,051**	**3**	**0**	**43,265**
Project Significance Threshold	n/a	n/a	n/a	25,000
Significant?	n/a	n/a	n/a	Yes

Table A-13. Lower San Felipe Intake Alternative (Pipeline Option) - Annual Emissions

Source	Annual Emissions (tons per year)			
	CO2	CH4	N2O	CO2e
	2020			
Off-Road Construction Equipment	7,225	1	0	7,243
On-Road Haul Trucks and Delivery Vehicles	133	0	0	134
Construction Worker Commuting	135	0	0	147
Marine Emissions (Tugboats and Crew/Supply Vessels)	-	-	-	-
Dredge (Auxiliary Engines)	-	-	-	-
2020 Total Emissions	**7,493**	**1**	**0**	**7,523**

Source	Annual Emissions (tons per year)			
	CO2	CH4	N2O	CO2e
	2021			
Off-Road Construction Equipment	9,909	1	0	9,932
On-Road Haul Trucks and Delivery Vehicles	132	0	0	132
Construction Worker Commuting	130	0	0	142
Marine Emissions (Tugboats and Crew/Supply Vessels)	13,030	0	1	13,203
Dredge (Auxiliary Engines)	130	0	0	132
2021 Total Emissions	**23,331**	**1**	**1**	**23,541**
	2022			
Off-Road Construction Equipment	2,433	0	0	2,439
On-Road Haul Trucks and Delivery Vehicles	98	0	0	98
Construction Worker Commuting	94	0	0	103
Marine Emissions (Tugboats and Crew/Supply Vessels)	1,185	0	0	1,200
Dredge (Auxiliary Engines)	12	0	0	12
2022 Total Emissions	**3,821**	**0**	**0**	**3,852**
Maximum Annual Emissions	**23,331**	**1**	**1**	**23,541**
Annual Significance Threshold	n/a	n/a	n/a	12,500
Significant?	n/a	n/a	n/a	Yes
Grand Total Emissions	**34,645**	**2**	**1**	**34,916**
Project Significance Threshold	n/a	n/a	n/a	25,000
Significant?	n/a	n/a	n/a	Yes

Table A-14. Treatment Alternative - Annual Emissions

Source	Annual Emissions (tons per year)			
	CO2	CH4	N2O	CO2e
	2020			
Off-Road Construction Equipment	715	0	0	717
On-Road Haul Trucks and Delivery Vehicles	26	0	0	26
Construction Worker Commuting	99	0	0	108
2020 Total Emissions	**840**	**0**	**0**	**851**
	2021			
Off-Road Construction Equipment	640	0	0	642
On-Road Haul Trucks and Delivery Vehicles	26	0	0	26
Construction Worker Commuting	95	0	0	104
2021 Total Emissions	**762**	**0**	**0**	**772**
	2022			
Off-Road Construction Equipment	528	0	0	529
On-Road Haul Trucks and Delivery Vehicles	26	0	0	26
Construction Worker Commuting	91	0	0	100
2022 Total Emissions	**645**	**0**	**0**	**656**
Maximum Annual Emissions	**840**	**0**	**0**	**851**
Annual Significance Threshold	n/a	n/a	n/a	12,500
Significant?	n/a	n/a	n/a	No
Grand Total Emissions	**2,247**	**0**	**0**	**2,279**
Project Significance Threshold	n/a	n/a	n/a	25,000
Significant?	n/a	n/a	n/a	No

Source	Annual Emissions (tons per year)			
	CO2	CH4	N2O	CO2e

Table A-15. CVP Resevoir Expansion Alternative - Annual Emissions

Source	Annual Emissions (tons per year)			
	CO2	CH4	N2O	CO2e
	2020			
Off-Road Construction Equipment	16,972	1	0	17,135
On-Road Haul Trucks and Delivery Vehicles	11,411	0	0	11,422
Construction Worker Commuting	1,958	1	0	2,131
2020 Total Emissions	**30,341**	**3**	**1**	**30,688**
	2021			
Off-Road Construction Equipment	16,973	1	0	17,135
On-Road Haul Trucks and Delivery Vehicles	11,291	0	0	11,302
Construction Worker Commuting	1,884	1	0	2,057
2021 Total Emissions	**30,148**	**3**	**1**	**30,494**
	2022			
Off-Road Construction Equipment	16,968	1	0	17,127
On-Road Haul Trucks and Delivery Vehicles	11,166	0	0	11,177
Construction Worker Commuting	1,812	1	0	1,985
2022 Total Emissions	**29,946**	**3**	**1**	**30,289**
	2023			
Off-Road Construction Equipment	16,961	1	0	17,119
On-Road Haul Trucks and Delivery Vehicles	10,785	0	0	10,796
Construction Worker Commuting	1,741	1	0	1,914
2023 Total Emissions	**29,486**	**2**	**1**	**29,828**
	2024			
Off-Road Construction Equipment	16,928	1	0	17,085
On-Road Haul Trucks and Delivery Vehicles	10,737	0	0	10,748
Construction Worker Commuting	1,671	1	0	1,844
2024 Total Emissions	**29,337**	**2**	**1**	**29,677**
	2025			
Off-Road Construction Equipment	16,931	1	0	17,087
On-Road Haul Trucks and Delivery Vehicles	10,698	0	0	10,709
Construction Worker Commuting	1,603	1	0	1,776
2025 Total Emissions	**29,232**	**2**	**1**	**29,571**
	2026			
Off-Road Construction Equipment	16,925	1	0	17,079
On-Road Haul Trucks and Delivery Vehicles	10,662	0	0	10,673
Construction Worker Commuting	1,545	1	0	1,718
2026 Total Emissions	**29,131**	**2**	**1**	**29,470**
	2027			
Off-Road Construction Equipment	16,911	1	0	17,064
On-Road Haul Trucks and Delivery Vehicles	10,625	0	0	10,636
Construction Worker Commuting	1,491	1	0	1,664
2027 Total Emissions	**29,027**	**2**	**1**	**29,365**
	2028			
Off-Road Construction Equipment	16,901	1	0	17,054
On-Road Haul Trucks and Delivery Vehicles	10,594	0	0	10,605
Construction Worker Commuting	1,444	1	0	1,617
2028 Total Emissions	**28,939**	**2**	**1**	**29,275**
	2029			
Off-Road Construction Equipment	16,890	1	0	17,042
On-Road Haul Trucks and Delivery Vehicles	10,564	0	0	10,575
Construction Worker Commuting	1,402	1	0	1,576
2029 Total Emissions	**28,856**	**2**	**1**	**29,192**

Source	Annual Emissions (tons per year) CO2	CH4	N2O	CO2e
No Shear Key Option				
Maximum Annual Emissions	**30,341**	**3**	**1**	**30,688**
Annual Significance Threshold	n/a	n/a	n/a	12,500
Significant?	n/a	n/a	n/a	Yes
Grand Total Emissions	**236,648**	**20**	**8**	**239,382**
Project Significance Threshold	n/a	n/a	n/a	25,000
Significant?	n/a	n/a	n/a	Yes
Shear Key Option				
Maximum Annual Emissions	**30,341**	**3**	**1**	**30,688**
Annual Significance Threshold	n/a	n/a	n/a	12,500
Significant?	n/a	n/a	n/a	Yes
Grand Total Emissions	**294,443**	**24**	**9**	**297,850**
Project Significance Threshold	n/a	n/a	n/a	25,000
Significant?	n/a	n/a	n/a	Yes

Table A-16. New Pacheco Alternative - Annual Unmitigated Emissions

	6	7	8	9
Source	**Annual Emissions (metric tons per year) CO2**	**CH4**	**N2O**	**CO2e**
	2024			
Off-Road Construction Equipment	21,057	1	0	21,104
On-Road Haul Trucks and Delivery Vehicles	1,621	1	0	1,796
Construction Worker Commuting	2,970	0	0	2,973
Total	**25,648**	**3**	**1**	**25,872**
	2025			
Off-Road Construction Equipment	16,871	1	0	16,910
On-Road Haul Trucks and Delivery Vehicles	1,871	1	1	2,081
Construction Worker Commuting	8,115	0	0	8,123
Total	**26,857**	**3**	**1**	**27,114**
	2026			
Off-Road Construction Equipment	14,624	1	0	14,658
On-Road Haul Trucks and Delivery Vehicles	2,732	2	1	3,051
Construction Worker Commuting	9,571	0	0	9,581
Total	**26,927**	**3**	**1**	**27,290**
	2027			
Off-Road Construction Equipment	11,414	1	0	11,443
On-Road Haul Trucks and Delivery Vehicles	2,801	2	1	3,140
Construction Worker Commuting	8,799	0	0	8,808
Total	**23,014**	**3**	**1**	**23,391**
	2028			
Off-Road Construction Equipment	9,035	1	0	9,057
On-Road Haul Trucks and Delivery Vehicles	2,712	2	1	3,052
Construction Worker Commuting	663	0	0	664
Total	**12,411**	**3**	**1**	**12,773**
	2029			
Off-Road Construction Equipment	3,649	0	0	3,655
On-Road Haul Trucks and Delivery Vehicles	1,214	1	0	1,371
Construction Worker Commuting	276	0	0	276
Total	**5,139**	**1**	**0**	**5,302**
Maximum Annual Emissions	**26,927**	**3**	**1**	**27,290**
Annual Significance Threshold	n/a	n/a	n/a	12,500
Significant?	n/a	n/a	n/a	Yes
Grand Total Emissions	**119,995**	**16**	**5**	**121,742**
Project Significance Threshold	n/a	n/a	n/a	25,000
Significant?	n/a	n/a	n/a	Yes

GHG Emissions Summary
Off-Road Construction Equipment

Table A-17. Summary of Annual Emissions by Alternative

Alternative	Annual Emissions (metric tons per year)			
	CO2	CH4	N2O	CO2e
	2020			
Lower San Felipe Intake Alternative				
Tunnel Option	8,593	0.72	0.01	8,613
Pipeline Option	7,225	0.60	0.01	7,243
Treatment Alternative	715	0.06	0.00	717
	2021			
Lower San Felipe Intake Alternative				
Tunnel Option	12,135	0.91	0.01	12,161
Pipeline Option	9,909	0.79	0.01	9,932
Treatment Alternative	640	0.05	0.00	642
	2022			
Lower San Felipe Intake Alternative				
Tunnel Option	9,487	0.67	0.01	9,506
Pipeline Option	2,433	0.19	0.00	2,439
Treatment Alternative	528	0.04	0.00	529
	2023			
Lower San Felipe Intake Alternative				
Tunnel Option	7,719	0.51	0.01	7,734
Pipeline Option	-	-	-	-
Treatment Alternative	-	-	-	-
	Annual Maximum (metric tons per year)			
Lower San Felipe Intake Alternative				
Tunnel Option	12,135	0.91	0.01	12,161
Pipeline Option	9,909	0.79	0.01	9,932
Treatment Alternative	715	0.06	0.00	717
	Grand Total (metric tons per project)			
Lower San Felipe Intake Alternative				
Tunnel Option	37,934	2.81	0.04	38,014
Pipeline Option	19,567	1.58	0.02	19,614
Treatment Alternative	1,883	0.16	0.00	1,888

Lower San Felipe Intake Alternative - Tunnel Option

Table A-18. Equipment List

Equipment	Quantity	Mobilization	Site Improvements	Construct Vertical Shaft	Set up TBM	Tunneling and Spreading of Soils	Cofferdam and TBM Out	Connect to Existing Intake	Fabricate Inlet	Set Inlet and Flood Tunnel	Construct Aeration Facility	Fab and Set Air Tubing	Final Work and Testing	Demobilization
Bulldozer	2	X	X											
Concrete Pumpers	2			X				X	X		X			
Cranes	4			X	X		X		X	X	X			
Drill Rig	1			X										
Excavator	1		X	X							X			
Flatbed Trucks (on site)	3	X	X	X	X	X	X	X	X	X	X	X	X	X
Grader	2		X			X					X			X
Loaders	2	X	X								X			
Portable Diesel Generators	7	X	X	X	X	X	X	X	X	X	X	X	X	X
Scraper	1		X			X					X			
Water Truck	2	X	X			X					X			X

Source: Equipment Tables_08012012.docx; EngineeringDataNeeds_July30_2012.xlsx

Table A-19. Annual Emissions from Construction Equipment

Phase	Equipment	OFFROAD Description	Quantity	Hours/ Day	Size (HP)	Start Year	Months	Annual Emissions - 2020 (MT/year)				Annual Emissions - 2021 (MT/year)			
								CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e
Mobilization	Bulldozer	ConstMin - Rubber Tired Dozers	2	20	249	2020	6	376.23	0.05	-	377.49	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	-	20	231			-	-	-	-	-	-	-	-
	Drill Rig	ConstMin - Bore/Drill Rigs	-	20	221			-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			171.12	0.00	0.00	171.79	-	-	-	-
	Grader	ConstMin - Graders	-	20	188			-	-	-	-	-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	2	20	202			276.21	0.02	-	276.78	-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	7	20	559			2,177.64	0.18	-	2,182.26	-	-	-	-
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-	-	-	-	-
	Water Truck	N/A - Onroad engine	2	20	n/a			114.08	0.00	0.00	114.53	-	-	-	-
Mobilization Subtotal								**3,115.28**	**0.26**	**0.00**	**3,122.85**	**-**	**-**	**-**	**-**
Site Improvements	Bulldozer	ConstMin - Rubber Tired Dozers	2	20	249	2020	6	376.23	0.05	-	377.49	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	-	20	231			-	-	-	-	-	-	-	-
	Drill Rig	ConstMin - Bore/Drill Rigs	-	20	221			-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	1	20	158			114.74	0.01	-	115.01	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			171.12	0.00	0.00	171.79	-	-	-	-
	Grader	ConstMin - Graders	2	20	188			293.50	0.02	-	294.12	-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	2	20	202			276.21	0.02	-	276.78	-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	7	20	559			2,177.64	0.18	-	2,182.26	-	-	-	-
	Scraper	ConstMin - Scrapers	1	20	367			338.02	0.03	-	338.86	-	-	-	-
	Water Truck	N/A - Onroad engine	2	20	n/a			114.08	0.00	0.00	114.53	-	-	-	-
Site Improvements Subtotal								**3,861.54**	**0.33**	**0.00**	**3,870.83**	**-**	**-**	**-**	**-**
Construct Vertical Shaft	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2020	6	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	2	20	18			27.25	0.00	-	27.33	27.26	0.00	-	27.34
	Cranes	ConstMin - Cranes	4	20	231			252.41	0.02	-	252.99	252.51	0.02	-	253.05
	Drill Rig	ConstMin - Bore/Drill Rigs	1	20	221			104.48	0.00	-	104.58	104.34	0.00	-	104.43
	Excavator	ConstMin - Excavators	1	20	158			57.37	0.01	-	57.50	57.37	0.00	-	57.50
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			85.56	0.00	0.00	85.90	83.40	0.00	0.00	83.74
	Grader	ConstMin - Graders	-	20	188			-	-	-	-	-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-	-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	7	20	559			1,088.82	0.09	-	1,091.13	1,100.69	0.09	-	1,102.83
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-	-	-	-	-
	Water Truck	N/A - Onroad engine	-	20	n/a			-	-	-	-	-	-	-	-
Construct Vertical Shaft Subtotal								**1,615.89**	**0.13**	**0.00**	**1,619.43**	**1,625.57**	**0.12**	**0.00**	**1,628.89**
Set Up TBM	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2021	2	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	4	20	231			-	-	-	-	168.34	0.01	-	168.70
	Drill Rig	ConstMin - Bore/Drill Rigs	-	20	221			-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-	55.60	0.00	0.00	55.83
	Grader	ConstMin - Graders	-	20	188			-	-	-	-	-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-	-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	7	20	559			-	-	-	-	733.79	0.06	-	735.22
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-	-	-	-	-
	Water Truck	N/A - Onroad engine	-	20	n/a			-	-	-	-	-	-	-	-
Set Up TBM Subtotal								**-**	**-**	**-**	**-**	**957.73**	**0.07**	**0.00**	**959.75**

Lower San Felipe Intake Alternative - Tunnel Option

Table A-18. Equipment List

Equipment	Quantity
Bulldozer	2
Concrete Pumpers	2
Cranes	4
Drill Rig	1
Excavator	1
Flatbed Trucks (on site)	3
Grader	2
Loaders	2
Portable Diesel Generators	7
Scraper	1
Water Truck	2

Source: Equipment Tables_08012012.docx; EngineeringDataNeeds_July30_2012.

Table A-19. Annual Emissions from Construction Equipment

Phase	Equipment	Annual Emissions - 2022 (MT/year)				Annual Emissions - 2023 (MT/year)				Grand Total
		CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	(MTCO2e/project)
Mobilization	Bulldozer	-	-	-	-	-	-	-	-	377.49
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	-	-	-	-	-
	Drill Rig	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	-	-	-	-	-	-	-	-	171.79
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	276.78
	Portable Diesel Generators	-	-	-	-	-	-	-	-	2,182.26
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	114.53
		-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3,122.85**
Site Improvements	Bulldozer	-	-	-	-	-	-	-	-	377.49
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	-	-	-	-	-
	Drill Rig	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	115.01
	Flatbed Trucks (on site)	-	-	-	-	-	-	-	-	171.79
	Grader	-	-	-	-	-	-	-	-	294.12
	Loaders	-	-	-	-	-	-	-	-	276.78
	Portable Diesel Generators	-	-	-	-	-	-	-	-	2,182.26
	Scraper	-	-	-	-	-	-	-	-	338.86
	Water Truck	-	-	-	-	-	-	-	-	114.53
		-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3,870.83**
Construct Vertical Shaft	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	54.67
	Cranes	-	-	-	-	-	-	-	-	506.04
	Drill Rig	-	-	-	-	-	-	-	-	209.01
	Excavator	-	-	-	-	-	-	-	-	115.00
	Flatbed Trucks (on site)	-	-	-	-	-	-	-	-	169.64
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	-	-	-	-	-	-	-	-	2,193.95
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	-
		-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3,248.31**
Set Up TBM	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	-	-	-	-	168.70
	Drill Rig	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	-	-	-	-	-	-	-	-	55.83
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	-	-	-	-	-	-	-	-	735.22
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	-
		-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**959.75**

Table A-19. Annual Emissions from Construction Equipment

Phase	Equipment	OFFROAD Description	Quantity	Hours/ Day	Size (HP)	Start Year	Months	Annual Emissions - 2020 (MT/year)				Annual Emissions - 2021 (MT/year)			
								CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e
Tunneling and Spreading of Soils	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2021	20	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	-	20	231			-	-	-	-	-	-	-	-
	Drill Rig	ConstMin - Bore/Drill Rigs	-	20	221			-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-	194.60	0.00	0.00	195.39
	Grader	ConstMin - Graders	2	20	188			-	-	-	-	342.01	0.03	-	342.69
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-	-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	7	20	559			-	-	-	-	2,568.28	0.20	-	2,573.26
	Scraper	ConstMin - Scrapers	1	20	367			-	-	-	-	394.47	0.04	-	395.40
	Water Truck	N/A - Onroad engine	2	20	n/a			-	-	-	-	129.74	0.00	0.00	130.26
Tunneling and Spreading of Soils Subtotal								**-**	**-**	**-**	**-**	**3,629.10**	**0.27**	**0.00**	**3,637.01**
Cofferdam and TBM Out	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2023	3	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	4	20	231			-	-	-	-	-	-	-	-
	Drill Rig	ConstMin - Bore/Drill Rigs	-	20	221			-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-	-	-	-	-
	Grader	ConstMin - Graders	-	20	188			-	-	-	-	-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-	-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	7	20	559			-	-	-	-	-	-	-	-
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-	-	-	-	-
	Water Truck	N/A - Onroad engine	-	20	n/a			-	-	-	-	-	-	-	-
Cofferdam and TBM Out Subtotal								**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Connect to Existing Intake	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2023	3	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	2	20	18			-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	-	20	231			-	-	-	-	-	-	-	-
	Drill Rig	ConstMin - Bore/Drill Rigs	-	20	221			-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-	-	-	-	-
	Grader	ConstMin - Graders	-	20	188			-	-	-	-	-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-	-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	7	20	559			-	-	-	-	-	-	-	-
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-	-	-	-	-
	Water Truck	N/A - Onroad engine	-	20	n/a			-	-	-	-	-	-	-	-
Connect to Existing Intake Subtotal								**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Fabricate Inlet	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2023	3	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	2	20	18			-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	4	20	231			-	-	-	-	-	-	-	-
	Drill Rig	ConstMin - Bore/Drill Rigs	-	20	221			-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-	-	-	-	-
	Grader	ConstMin - Graders	-	20	188			-	-	-	-	-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-	-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	7	20	559			-	-	-	-	-	-	-	-
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-	-	-	-	-
	Water Truck	N/A - Onroad engine	-	20	n/a			-	-	-	-	-	-	-	-
Fabricate Inlet Subtotal								**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table A-19. Annual Emissions from Construction Equipment

Phase	Equipment	Annual Emissions - 2022 (MT/year)				Annual Emissions - 2023 (MT/year)				Grand Total
		CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	(MTCO2e/project)
Tunneling and Spreading of Soils	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	-	-	-	-	-
	Drill Rig	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	324.63	0.00	0.00	325.97	26.28	0.00	0.00	26.39	547.75
	Grader	586.24	0.04	-	587.35	48.54	0.00	-	48.62	978.66
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	4,450.76	0.32	-	4,458.86	374.94	0.03	-	375.58	7,407.70
	Scraper	675.87	0.06	-	677.39	56.32	0.00	-	56.44	1,129.23
	Water Truck	216.42	0.00	0.00	217.32	17.52	0.00	0.00	17.59	365.17
		6,253.92	**0.44**	**0.01**	**6,266.88**	**523.59**	**0.03**	**0.00**	**524.63**	**10,428.52**
Cofferdam and TBM Out	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	252.77	0.02	-	253.26	253.26
	Drill Rig	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	-	-	-	-	78.83	0.00	0.00	79.17	79.17
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	-	-	-	-	1,124.82	0.08	-	1,126.75	1,126.75
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	-
		-	**-**	**-**	**-**	**1,456.42**	**0.10**	**0.00**	**1,459.17**	**1,459.17**
Connect to Existing Intake	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	27.25	0.00	-	27.33	27.33
	Cranes	-	-	-	-	-	-	-	-	-
	Drill Rig	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	-	-	-	-	78.83	0.00	0.00	79.17	79.17
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	-	-	-	-	1,124.82	0.08	-	1,126.75	1,126.75
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	-
		-	**-**	**-**	**-**	**1,230.90**	**0.08**	**0.00**	**1,233.24**	**1,233.24**
Fabricate Inlet	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	27.25	0.00	-	27.33	27.33
	Cranes	-	-	-	-	252.77	0.02	-	253.26	253.26
	Drill Rig	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	-	-	-	-	78.83	0.00	0.00	79.17	79.17
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	-	-	-	-	1,124.82	0.08	-	1,126.75	1,126.75
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	-
		-	**-**	**-**	**-**	**1,483.68**	**0.10**	**0.00**	**1,486.51**	**1,486.51**

Table A-19. Annual Emissions from Construction Equipment

Phase	Equipment	OFFROAD Description	Quantity	Hours/ Day	Size (HP)	Start Year	Months	Annual Emissions - 2020 (MT/year)				Annual Emissions - 2021 (MT/year)			
								CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e
Set Inlet and Flood Tunnel	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2023	1	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	4	20	231			-	-	-	-	-	-	-	-
	Drill Rig	ConstMin - Bore/Drill Rigs	-	20	221			-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-	-	-	-	-
	Grader	ConstMin - Graders	-	20	188			-	-	-	-	-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-	-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	7	20	559			-	-	-	-	-	-	-	-
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-	-	-	-	-
	Water Truck	N/A - Onroad engine	-	20	n/a			-	-	-	-	-	-	-	-
Set Inlet and Flood Tunnel Subtotal								**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Construct Aeration Facility	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2021	10	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	2	20	18			-	-	-	-	63.60	0.01	-	63.80
	Cranes	ConstMin - Cranes	4	20	231			-	-	-	-	589.19	0.05	-	590.46
	Drill Rig	ConstMin - Bore/Drill Rigs	-	20	221			-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	1	20	158			-	-	-	-	133.87	0.01	-	134.16
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-	194.60	0.00	0.00	195.39
	Grader	ConstMin - Graders	2	20	188			-	-	-	-	342.01	0.03	-	342.69
	Loaders	ConstMin - Rubber Tired Loaders	2	20	202			-	-	-	-	322.31	0.03	-	322.94
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	7	20	559			-	-	-	-	2,568.28	0.20	-	2,573.26
	Scraper	ConstMin - Scrapers	1	20	367			-	-	-	-	394.47	0.04	-	395.40
	Water Truck	N/A - Onroad engine	2	20	n/a			-	-	-	-	129.74	0.00	0.00	130.26
Construct Aeration Facility Subtotal								**-**	**-**	**-**	**-**	**4,738.07**	**0.36**	**0.00**	**4,748.36**
Fab and Set Air Tubing	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2021	6	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	-	20	231			-	-	-	-	-	-	-	-
	Drill Rig	ConstMin - Bore/Drill Rigs	-	20	221			-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-	83.40	0.00	0.00	83.74
	Grader	ConstMin - Graders	-	20	188			-	-	-	-	-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-	-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	7	20	559			-	-	-	-	1,100.69	0.09	-	1,102.83
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-	-	-	-	-
	Water Truck	N/A - Onroad engine	-	20	n/a			-	-	-	-	-	-	-	-
Fab and Set Air Tubing Subtotal								**-**	**-**	**-**	**-**	**1,184.09**	**0.09**	**0.00**	**1,186.57**
Final Work and Testing	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2023	4	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	-	20	231			-	-	-	-	-	-	-	-
	Drill Rig	ConstMin - Bore/Drill Rigs	-	20	221			-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-	-	-	-	-
	Grader	ConstMin - Graders	-	20	188			-	-	-	-	-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-	-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	7	20	559			-	-	-	-	-	-	-	-
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-	-	-	-	-
	Water Truck	N/A - Onroad engine	-	20	n/a			-	-	-	-	-	-	-	-
Final Work and Testing Subtotal								**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table A-19. Annual Emissions from Construction Equipment

Phase	Equipment	Annual Emissions - 2022 (MT/year)				Annual Emissions - 2023 (MT/year)				Grand Total
		CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	(MTCO2e/project)
Set Inlet and Flood Tunnel	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	84.26	0.01	-	84.42	84.42
	Drill Rig	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	-	-	-	-	26.28	0.00	0.00	26.39	26.39
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	-	-	-	-	374.94	0.03	-	375.58	375.58
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	-
		-	**-**	**-**	**-**	**485.47**	**0.03**	**0.00**	**486.39**	**486.39**
Construct Aeration Facility	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	27.25	0.00	-	27.33	-	-	-	-	91.13
	Cranes	252.76	0.02	-	253.28	-	-	-	-	843.74
	Drill Rig	-	-	-	-	-	-	-	-	-
	Excavator	57.39	0.00	-	57.50	-	-	-	-	191.66
	Flatbed Trucks (on site)	81.16	0.00	0.00	81.49	-	-	-	-	276.88
	Grader	146.56	0.01	-	146.84	-	-	-	-	489.53
	Loaders	138.20	0.01	-	138.45	-	-	-	-	461.39
	Portable Diesel Generators	1,112.69	0.08	-	1,114.71	-	-	-	-	3,687.98
	Scraper	168.97	0.02	-	169.35	-	-	-	-	564.75
	Water Truck	54.10	0.00	0.00	54.33	-	-	-	-	184.59
		2,039.08	**0.15**	**0.00**	**2,043.29**	**-**	**-**	**-**	**-**	**6,791.65**
Fab and Set Air Tubing	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	-	-	-	-	-
	Drill Rig	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	81.16	0.00	0.00	81.49	-	-	-	-	165.23
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	1,112.69	0.08	-	1,114.71	-	-	-	-	2,217.54
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	-
		1,193.85	**0.08**	**0.00**	**1,196.21**	**-**	**-**	**-**	**-**	**2,382.77**
Final Work and Testing	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	-	-	-	-	-
	Drill Rig	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	-	-	-	-	105.11	0.00	0.00	105.55	105.55
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	-	-	-	-	1,499.76	0.10	-	1,502.33	1,502.33
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	-
		-	**-**	**-**	**-**	**1,604.86**	**0.10**	**0.00**	**1,607.88**	**1,607.88**

Table A-19. Annual Emissions from Construction Equipment

Phase	Equipment	OFFROAD Description	Quantity	Hours/ Day	Size (HP)	Start Year	Months	Annual Emissions - 2020 (MT/year)				Annual Emissions - 2021 (MT/year)			
								CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e
Demobilization	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2023	2	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	-	20	231			-	-	-	-	-	-	-	-
	Drill Rig	ConstMin - Bore/Drill Rigs	-	20	221			-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-	-	-	-	-
	Grader	ConstMin - Graders	2	20	188			-	-	-	-	-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-	-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	7	20	559			-	-	-	-	-	-	-	-
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-	-	-	-	-
	Water Truck	N/A - Onroad engine	2	20	n/a			-	-	-	-	-	-	-	-
Demobilization Subtotal								**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Grand Total (metric tons per year)								**8,592.72**	**0.72**	**0.01**	**8,613.10**	**12,134.57**	**0.91**	**0.01**	**12,160.56**
							Global Warming Potential	1	25	298					

Notes:
Emission factors for onroad engines (spreader, flatbed trucks, and water trucks) shown in units of grams per hour (g/hr). CO2 emission factors from EMFAC2014 for diesel-fueled medium-duty vehicles in San Joaquin Valley Air Basin.
CH4 and N2O emission factors from "2018 Climate Registry Default Emission Factors" for diesel medium and heavy-duty vehicles.

Onroad Vehicle Speed
40 mph

Air Basin
San Joaquin Valley

Conversions
1,000,000 grams per metric ton
7 days per week
30 days per month

GHG Emission Factors

CH4	0.0051	g/mi	0.204 grams per hour
N2O	0.0048	g/mi	0.192 grams per hour

Source: 2018 Climate Registry Default Emissions Factors
Table 13.4 Default CH4 and N2O Emission Factors for Highway Vehicles by Technology Type
Diesel Medium and Heavy-Duty Vehicles (Trucks and Busses), Uncontrolled
https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf

Table A-19. Annual Emissions from Construction Equipment

Phase	Equipment	Annual Emissions - 2022 (MT/year)				Annual Emissions - 2023 (MT/year)				Grand Total
		CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	(MTCO2e/project)
Demobilization	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	-	-	-	-	-
	Drill Rig	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	-	-	-	-	52.55	0.00	0.00	52.78	52.78
	Grader	-	-	-	-	97.07	0.01	-	97.25	97.25
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	-	-	-	-	749.88	0.05	-	751.16	751.16
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	35.04	0.00	0.00	35.18	35.18
		-	**-**	**-**	**-**	**934.54**	**0.06**	**0.00**	**936.37**	**936.37**
		9,486.84	**0.67**	**0.01**	**9,506.38**	**7,719.47**	**0.51**	**0.01**	**7,734.20**	**38,014.24**

Notes:
Emission factors for onroad engines (spreader, flatbed trucks, and water trucks) st
CH4 and N2O emission factors from "2018 Climate Registry Default Emission Fac

Onroad Vehicle Speed

40 mph

Air Basin

San Joaquin Valley

Conversions

1,000,000 grams per metric ton
7 days per week
30 days per month

Lower San Felipe Intake Alternative - Pipeline Option

Table A-20. Equipment List

Equipment	Quantity	Mobilization	Site Improvements	Fabricate Inlet	Build Cofferdam and Set Lower Inlet	Lay Pipe	Connect to Existing Intake	Construct Aeration Facility	Fab and Set Air Tubing	Final Work and Testing	Demobilization
Bulldozer	2	X	X								
Concrete Pumpers	1		X					X			
Cranes	3			X	X	X	X	X			
Excavator	1		X					X			
Flatbed Trucks (on site)	3	X	X	X	X	X	X	X	X	X	X
Grader	2	X	X					X			X
Loaders	2	X	X					X			
Portable Diesel Generators	4	X	X	X	X	X	X	X	X	X	X
Scraper	1		X					X			
Water Truck	2	X	X					X			X

Source: Equipment Tables_08012012.docx; EngineeringDataNeeds_July30_2012.xlsx

Table A-21. Annual Emissions from Construction Equipment

Phase	Equipment	OFFROAD Description	Quantity	Hours/ Day	Size (HP)	Start Year	Months	Annual Emissions - 2020 (MT/year)			
								CO2	CH4	N2O	CO2e
Mobilization	Bulldozer	ConstMin - Rubber Tired Dozers	2	20	249	2020	6	376.23	0.05	-	377.49
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-
	Cranes	ConstMin - Cranes	-	20	231			-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			171.12	0.00	0.00	171.79
	Grader	ConstMin - Graders	2	20	188			293.50	0.02	-	294.12
	Loaders	ConstMin - Rubber Tired Loaders	2	20	202			276.21	0.02	-	276.78
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	4	20	559			1,244.37	0.11	-	1,247.00
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-
	Water Truck	N/A - Onroad engine	2	20	n/a			114.08	0.00	0.00	114.53
							Mobilization Subtotal	**2,475.51**	**0.21**	**0.00**	**2,481.71**
Site Improvements	Bulldozer	ConstMin - Rubber Tired Dozers	2	20	249	2020	6	376.23	0.05	-	377.49
	Concrete Pumpers	OFF - Light Commercial - Pumps	1	20	18			27.25	0.00	-	27.33
	Cranes	ConstMin - Cranes	-	20	231			-	-	-	-
	Excavator	ConstMin - Excavators	1	20	158			114.74	0.01	-	115.01
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			171.12	0.00	0.00	171.79
	Grader	ConstMin - Graders	2	20	188			293.50	0.02	-	294.12
	Loaders	ConstMin - Rubber Tired Loaders	2	20	202			276.21	0.02	-	276.78
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	4	20	559			1,244.37	0.11	-	1,247.00
	Scraper	ConstMin - Scrapers	1	20	367			338.02	0.03	-	338.86
	Water Truck	N/A - Onroad engine	2	20	n/a			114.08	0.00	0.00	114.53
							Site Improvements Subtotal	**2,955.52**	**0.25**	**0.00**	**2,962.91**
Fabricate Inlet	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2020	3	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-
	Cranes	ConstMin - Cranes	3	20	231			189.31	0.02	-	189.74
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			85.56	0.00	0.00	85.90
	Grader	ConstMin - Graders	-	20	188			-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	4	20	559			622.18	0.05	-	623.50
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-
	Water Truck	N/A - Onroad engine	-	20	n/a			-	-	-	-
							Fabricate Inlet Subtotal	**897.05**	**0.07**	**0.00**	**899.14**

Table A-21. Annual Emissions from Construction Equipment

Phase	Equipment	OFFROAD Description	Quantity	Hours/ Day	Size (HP)	Start Year	Months	Annual Emissions - 2020 (MT/year)			
								CO2	CH4	N2O	CO2e
Build Cofferdam and Set Lower Inlet	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2020	4	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-
	Cranes	ConstMin - Cranes	3	20	231			189.31	0.02	-	189.74
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			85.56	0.00	0.00	85.90
	Grader	ConstMin - Graders	-	20	188			-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	4	20	559			622.18	0.05	-	623.50
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-
	Water Truck	N/A - Onroad engine	-	20	n/a			-	-	-	-
Build Cofferdam and Set Lower Inlet Subtotal								**897.05**	**0.07**	**0.00**	**899.14**
Lay Pipe	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2021	12	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-
	Cranes	ConstMin - Cranes	3	20	231			-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-
	Grader	ConstMin - Graders	-	20	188			-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	4	20	559			-	-	-	-
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-
	Water Truck	N/A - Onroad engine	-	20	n/a			-	-	-	-
Lay Pipe Subtotal								**-**	**-**	**-**	**-**
Connect to Existing Intake	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2022	2	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-
	Cranes	ConstMin - Cranes	3	20	231			-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-
	Grader	ConstMin - Graders	-	20	188			-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	4	20	559			-	-	-	-
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-
	Water Truck	N/A - Onroad engine	-	20	n/a			-	-	-	-
Connect to Existing Intake Subtotal								**-**	**-**	**-**	**-**
Construct Aeration Facility	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2021	10	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	1	20	18			-	-	-	-
	Cranes	ConstMin - Cranes	3	20	231			-	-	-	-
	Excavator	ConstMin - Excavators	1	20	158			-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-
	Grader	ConstMin - Graders	2	20	188			-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	2	20	202			-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	4	20	559			-	-	-	-
	Scraper	ConstMin - Scrapers	1	20	367			-	-	-	-
	Water Truck	N/A - Onroad engine	2	20	n/a			-	-	-	-
Construct Aeration Facility Subtotal								**-**	**-**	**-**	**-**
Fab and Set Air Tubing	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2021	6	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-
	Cranes	ConstMin - Cranes	-	20	231			-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-
	Grader	ConstMin - Graders	-	20	188			-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	4	20	559			-	-	-	-
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-
	Water Truck	N/A - Onroad engine	-	20	n/a			-	-	-	-
Fab and Set Air Tubing Subtotal								**-**	**-**	**-**	**-**

Table A-21. Annual Emissions from Construction Equipment

Phase	Equipment	OFFROAD Description	Quantity	Hours/ Day	Size (HP)	Start Year	Months	Annual Emissions - 2020 (MT/year)			
								CO2	CH4	N2O	CO2e
Final Work and Testing	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2022	4	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-
	Cranes	ConstMin - Cranes	-	20	231			-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-
	Grader	ConstMin - Graders	-	20	188			-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	4	20	559			-	-	-	-
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-
	Water Truck	N/A - Onroad engine	-	20	n/a			-	-	-	-
Final Work and Testing Subtotal								**-**	**-**	**-**	**-**
Demobilization	Bulldozer	ConstMin - Rubber Tired Dozers	-	20	249	2022	2	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	20	18			-	-	-	-
	Cranes	ConstMin - Cranes	-	20	231			-	-	-	-
	Excavator	ConstMin - Excavators	-	20	158			-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	3	20	n/a			-	-	-	-
	Grader	ConstMin - Graders	2	20	188			-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	20	202			-	-	-	-
	Portable Diesel Generators	Portable Equipment - Non-Rental Generator	4	20	559			-	-	-	-
	Scraper	ConstMin - Scrapers	-	20	367			-	-	-	-
	Water Truck	N/A - Onroad engine	2	20	n/a			-	-	-	-
Demobilization Subtotal								**-**	**-**	**-**	**-**
Grand Total (metric tons per year)								**7,225.13**	**0.60**	**0.01**	**7,242.89**
							GWP	1	25	298	

Notes:
Emission factors for onroad engines (spreader, flatbed trucks, and water trucks) shown in units of grams per hour (g/hr). CO2 emission factors from EMFAC2014 for diesel-fueled medium-duty vehicles in San Joaquin Valley Air Basin.
CH4 and N2O emission factors from "2018 Climate Registry Default Emission Factors" for diesel medium and heavy-duty vehicles.

Onroad Vehicle Speed

40	mph

Air Basin
San Joaquin Valley

Conversions

1,000,000	grams per metric ton
7	days per week
30	days per month

GHG Emission Factors

CH4	0.0051	g/mi	0.204	grams per hour
N2O	0.0048	g/mi	0.192	grams per hour

Source: 2018 Climate Registry Default Emissions Factors
Table 13.4 Default CH4 and N2O Emission Factors for Highway Vehicles by Technology Type
Diesel Medium and Heavy-Duty Vehicles (Trucks and Busses), Uncontrolled
https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf

Lower San Felipe Intake Alternative - Pipeline Option

Table A-20. Equipment List

Equipment	Quantity
Bulldozer	2
Concrete Pumpers	1
Cranes	3
Excavator	1
Flatbed Trucks (on site)	3
Grader	2
Loaders	2
Portable Diesel Generators	4
Scraper	1
Water Truck	2

Source: Equipment Tables_08012012.docx; EngineeringDataNeeds_July30_2012.xlsx

Table A-21. Annual Emissions from Construction Equipment

Phase	Equipment	Annual Emissions - 2021 (MT/year)				Annual Emissions - 2022 (MT/year)				Grand Total
		CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	(MTCO2e/project)
Mobilization	Bulldozer	-	-	-	-	-	-	-	-	377.49
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	-	-	-	-	-	-	-	-	171.79
	Grader	-	-	-	-	-	-	-	-	294.12
	Loaders	-	-	-	-	-	-	-	-	276.78
	Portable Diesel Generators	-	-	-	-	-	-	-	-	1,247.00
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	114.53
		-	-	-	-	-	-	-	-	**2,481.71**
Site Improvements	Bulldozer	-	-	-	-	-	-	-	-	377.49
	Concrete Pumpers	-	-	-	-	-	-	-	-	27.33
	Cranes	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	115.01
	Flatbed Trucks (on site)	-	-	-	-	-	-	-	-	171.79
	Grader	-	-	-	-	-	-	-	-	294.12
	Loaders	-	-	-	-	-	-	-	-	276.78
	Portable Diesel Generators	-	-	-	-	-	-	-	-	1,247.00
	Scraper	-	-	-	-	-	-	-	-	338.86
	Water Truck	-	-	-	-	-	-	-	-	114.53
		-	-	-	-	-	-	-	-	**2,962.91**
Fabricate Inlet	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	-	-	-	-	189.74
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	-	-	-	-	-	-	-	-	85.90
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	-	-	-	-	-	-	-	-	623.50
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	**899.14**

Table A-21. Annual Emissions from Construction Equipment

Phase	Equipment	Annual Emissions - 2021 (MT/year)				Annual Emissions - 2022 (MT/year)				Grand Total
		CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	(MTCO2e/project)
Build Cofferdam and Set Lower Inlet	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	63.10	0.01	-	63.25	-	-	-	-	252.99
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	27.80	0.00	0.00	27.91	-	-	-	-	113.81
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	207.39	0.02	-	207.83	-	-	-	-	831.34
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	-
		298.30	**0.02**	**0.00**	**298.99**	**-**	**-**	**-**	**-**	**1,198.13**
Lay Pipe	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	694.13	0.06	-	695.71	63.10	0.01	-	63.25	758.96
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	305.81	0.00	0.00	307.04	27.05	0.00	0.00	27.16	334.20
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	2,281.34	0.19	-	2,286.17	207.39	0.02	-	207.83	2,494.01
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	-
		3,281.27	**0.26**	**0.00**	**3,288.93**	**297.55**	**0.02**	**0.00**	**298.25**	**3,587.17**
Connect to Existing Intake	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	126.21	0.01	-	126.49	126.49
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	-	-	-	-	54.10	0.00	0.00	54.33	54.33
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	-	-	-	-	414.79	0.04	-	415.67	415.67
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	-
		-	**-**	**-**	**-**	**595.10**	**0.05**	**0.00**	**596.49**	**596.49**
Construct Aeration Facility	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	45.41	0.01	-	45.55	-	-	-	-	45.55
	Cranes	631.03	0.06	-	632.47	-	-	-	-	632.47
	Excavator	191.24	0.02	-	191.68	-	-	-	-	191.68
	Flatbed Trucks (on site)	278.01	0.00	0.00	279.13	-	-	-	-	279.13
	Grader	489.17	0.04	-	490.19	-	-	-	-	490.19
	Loaders	460.35	0.04	-	461.31	-	-	-	-	461.31
	Portable Diesel Generators	2,073.94	0.18	-	2,078.34	-	-	-	-	2,078.34
	Scraper	563.37	0.06	-	564.76	-	-	-	-	564.76
	Water Truck	185.34	0.00	0.00	186.09	-	-	-	-	186.09
		4,917.85	**0.40**	**0.01**	**4,929.51**	**-**	**-**	**-**	**-**	**4,929.51**
Fab and Set Air Tubing	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	166.80	0.00	0.00	167.48	-	-	-	-	167.48
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	1,244.37	0.11	-	1,247.00	-	-	-	-	1,247.00
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	-
		1,411.17	**0.11**	**0.00**	**1,414.48**	**-**	**-**	**-**	**-**	**1,414.48**

Table A-21. Annual Emissions from Construction Equipment

Phase	Equipment	Annual Emissions - 2021 (MT/year)				Annual Emissions - 2022 (MT/year)				Grand Total
		CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	(MTCO2e/project)
Final Work and Testing	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	-	-	-	-	108.21	0.00	0.00	108.66	108.66
	Grader	-	-	-	-	-	-	-	-	-
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	-	-	-	-	829.58	0.07	-	831.34	831.34
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	-	-	-	-	-
		-	**-**	**-**	**-**	**937.79**	**0.07**	**0.00**	**939.99**	**939.99**
Demobilization	Bulldozer	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	-	-	-	-	-	-	-	-	-
	Cranes	-	-	-	-	-	-	-	-	-
	Excavator	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	-	-	-	-	54.10	0.00	0.00	54.33	54.33
	Grader	-	-	-	-	97.83	0.01	-	98.04	98.04
	Loaders	-	-	-	-	-	-	-	-	-
	Portable Diesel Generators	-	-	-	-	414.79	0.04	-	415.67	415.67
	Scraper	-	-	-	-	-	-	-	-	-
	Water Truck	-	-	-	-	36.07	0.00	0.00	36.22	36.22
		-	**-**	**-**	**-**	**602.80**	**0.04**	**0.00**	**604.25**	**604.25**
		9,908.59	**0.79**	**0.01**	**9,931.91**	**2,433.23**	**0.19**	**0.00**	**2,438.98**	**19,613.78**

Notes:
Emission factors for onroad engines (spreader, flatbed trucks, and water trucks) shown i
CH4 and N2O emission factors from "2018 Climate Registry Default Emission Factors" f

Onroad Vehicle Speed

40 mph

Air Basin
San Joaquin Valley

Conversions

1,000,000 grams per metric ton
7 days per week
30 days per month

Treatment Alternative

Table A-22. Equipment List (Santa Teresa WTP)

Equipment	Quantity	Mobilization and Site Improvements	Retrofit Existing Facilities	Starting and Testing	Demobilization
Bulldozer	1	X			
Concrete Pumpers	2		X		
Concrete Saw Cutters	2		X		
Cranes	2		X		
Excavator	1		X		
Flatbed Trucks (on site)	4	X	X		X
Loaders	1	X	X		
Water Truck	2	X	X		
Wheel Trencher	2		X		

Table A-23. Annual Emissions from Construction Equipment (Santa Teresa WTP)

Phase	Equipment	OFFROAD Description	Quantity	Hours/ Day	Size (HP)	Start Year	Months	Annual Emissions - 2020 (MT/year)				Annual Emissions - 2021 (MT/year)				Annual Emissions - 2022 (MT/year)				Grand Total
								CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	(MTCO2e/project)
Mobilization and Site Improvements	Bulldozer	ConstMin - Rubber Tired Dozers	1	10	249	2020	2	22.85	0.00	-	22.93	-	-	-	-	-	-	-	-	22.93
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	10	18			-	-	-	-	-	-	-	-	-	-	-	-	-
	Concrete Saw Cutters	OFF - ConstMin - Concrete/Industrial Saws	-	10	31			-	-	-	-	-	-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	-	10	231			-	-	-	-	-	-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	-	10	158			-	-	-	-	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	4	10	n/a			20.39	0.00	0.00	20.43	-	-	-	-	-	-	-	-	20.43
	Loaders	ConstMin - Rubber Tired Loaders	1	10	202			16.94	0.00	-	16.97	-	-	-	-	-	-	-	-	16.97
	Water Truck	N/A - Onroad engine	2	10	n/a			10.20	0.00	0.00	10.22	-	-	-	-	-	-	-	-	10.22
	Wheel Trencher	ConstMin - Trenchers	-	10	79			-	-	-	-	-	-	-	-	-	-	-	-	-
Mobilization and Site Improvements Subtotal								**70.37**	**0.00**	**0.00**	**70.54**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**70.54**
Retrofit Existing Facilities (1)	Bulldozer	ConstMin - Rubber Tired Dozers	-	10	249	2020	14	-	-	-	-	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	2	10	18			33.31	0.00	-	33.41	13.32	0.00	-	13.36	-	-	-	-	46.77
	Concrete Saw Cutters	OFF - ConstMin - Concrete/Industrial Saws	2	10	31			56.77	0.01	-	56.95	22.72	0.00	-	22.79	-	-	-	-	79.73
	Cranes	ConstMin - Cranes	2	10	231			154.52	0.01	-	154.87	61.79	0.01	-	61.93	-	-	-	-	216.80
	Excavator	ConstMin - Excavators	1	10	158			70.12	0.01	-	70.28	28.04	0.00	-	28.10	-	-	-	-	98.38
	Flatbed Trucks (on site)	N/A - Onroad engine	4	10	n/a			101.96	0.00	0.00	102.16	39.66	0.00	0.00	39.74	-	-	-	-	141.90
	Loaders	ConstMin - Rubber Tired Loaders	1	10	202			84.68	0.01	-	84.85	33.85	0.00	-	33.92	-	-	-	-	118.77
	Water Truck	N/A - Onroad engine	2	10	n/a			50.98	0.00	0.00	51.08	19.83	0.00	0.00	19.87	-	-	-	-	70.95
	Wheel Trencher	ConstMin - Trenchers	2	10	79			92.35	0.02	-	92.79	36.95	0.01	-	37.12	-	-	-	-	129.90
Retrofit Existing Facilities (1) Subtotal								**644.67**	**0.06**	**0.00**	**646.38**	**256.17**	**0.02**	**0.00**	**256.82**	**-**	**-**	**-**	**-**	**903.20**
Retrofit Existing Facilities (2)	Bulldozer	ConstMin - Rubber Tired Dozers	-	10	249	2021	14	-	-	-	-	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	2	10	18			-	-	-	-	19.98	0.00	-	20.04	26.65	0.00	-	26.72	46.77
	Concrete Saw Cutters	OFF - ConstMin - Concrete/Industrial Saws	2	10	31			-	-	-	-	34.08	0.00	-	34.18	45.39	0.00	-	45.51	79.69
	Cranes	ConstMin - Cranes	2	10	231			-	-	-	-	92.69	0.01	-	92.89	123.53	0.01	-	123.78	216.67
	Excavator	ConstMin - Excavators	1	10	158			-	-	-	-	42.07	0.00	-	42.16	56.07	0.00	-	56.18	98.34
	Flatbed Trucks (on site)	N/A - Onroad engine	4	10	n/a			-	-	-	-	59.49	0.00	0.00	59.61	77.03	0.00	0.00	77.19	136.80
	Loaders	ConstMin - Rubber Tired Loaders	1	10	202			-	-	-	-	50.77	0.00	-	50.87	67.70	0.01	-	67.83	118.70
	Water Truck	N/A - Onroad engine	2	10	n/a			-	-	-	-	29.74	0.00	0.00	29.81	38.51	0.00	0.00	38.60	68.40
	Wheel Trencher	ConstMin - Trenchers	2	10	79			-	-	-	-	55.43	0.01	-	55.67	73.86	0.01	-	74.17	129.84
Retrofit Existing Facilities (2) Subtotal								**-**	**-**	**-**	**-**	**384.26**	**0.03**	**0.00**	**385.23**	**508.74**	**0.04**	**0.00**	**509.98**	**895.21**

Table A-23. Annual Emissions from Construction Equipment (Santa Teresa WTP)

Phase	Equipment	OFFROAD Description	Quantity	Hours/ Day	Size (HP)	Start Year	Months	Annual Emissions - 2020 (MT/year)				Annual Emissions - 2021 (MT/year)				Annual Emissions - 2022 (MT/year)				Grand Total
								CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	(MTCO2e/project)
Starting and Testing (1)	Bulldozer	ConstMin - Rubber Tired Dozers	-	10	249	2021	2	-	-	-	-	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	10	18			-	-	-	-	-	-	-	-	-	-	-	-	-
	Concrete Saw Cutters	OFF - ConstMin - Concrete/Industrial Saws	-	10	31			-	-	-	-	-	-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	-	10	231			-	-	-	-	-	-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	-	10	158			-	-	-	-	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	-	10	n/a			-	-	-	-	-	-	-	-	-	-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	10	202			-	-	-	-	-	-	-	-	-	-	-	-	-
	Water Truck	N/A - Onroad engine	-	10	n/a			-	-	-	-	-	-	-	-	-	-	-	-	-
	Wheel Trencher	ConstMin - Trenchers	-	10	79			-	-	-	-	-	-	-	-	-	-	-	-	-
Starting and Testing (1) Subtotal								**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Starting and Testing (2)	Bulldozer	ConstMin - Rubber Tired Dozers	-	10	249	2022	2	-	-	-	-	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	10	18			-	-	-	-	-	-	-	-	-	-	-	-	-
	Concrete Saw Cutters	OFF - ConstMin - Concrete/Industrial Saws	-	10	31			-	-	-	-	-	-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	-	10	231			-	-	-	-	-	-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	-	10	158			-	-	-	-	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	-	10	n/a			-	-	-	-	-	-	-	-	-	-	-	-	-
	Loaders	ConstMin - Rubber Tired Loaders	-	10	202			-	-	-	-	-	-	-	-	-	-	-	-	-
	Water Truck	N/A - Onroad engine	-	10	n/a			-	-	-	-	-	-	-	-	-	-	-	-	-
	Wheel Trencher	ConstMin - Trenchers	-	10	79			-	-	-	-	-	-	-	-	-	-	-	-	-
Starting and Testing (2) Subtotal								**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Demobilization	Bulldozer	ConstMin - Rubber Tired Dozers	-	10	249	2022	2	-	-	-	-	-	-	-	-	-	-	-	-	-
	Concrete Pumpers	OFF - Light Commercial - Pumps	-	10	18			-	-	-	-	-	-	-	-	-	-	-	-	-
	Concrete Saw Cutters	OFF - ConstMin - Concrete/Industrial Saws	-	10	31			-	-	-	-	-	-	-	-	-	-	-	-	-
	Cranes	ConstMin - Cranes	-	10	231			-	-	-	-	-	-	-	-	-	-	-	-	-
	Excavator	ConstMin - Excavators	-	10	158			-	-	-	-	-	-	-	-	-	-	-	-	-
	Flatbed Trucks (on site)	N/A - Onroad engine	4	10	n/a			-	-	-	-	-	-	-	-	19.26	0.00	0.00	19.30	19.30
	Loaders	ConstMin - Rubber Tired Loaders	-	10	202			-	-	-	-	-	-	-	-	-	-	-	-	-
	Water Truck	N/A - Onroad engine	-	10	n/a			-	-	-	-	-	-	-	-	-	-	-	-	-
	Wheel Trencher	ConstMin - Trenchers	-	10	79			-	-	-	-	-	-	-	-	-	-	-	-	-
Demobilization Subtotal								**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**19.26**	**0.00**	**0.00**	**19.30**	**19.30**
Santa Teresa WTP Total								**715.04**	**0.06**	**0.00**	**716.93**	**640.43**	**0.05**	**0.00**	**642.06**	**528.00**	**0.04**	**0.00**	**529.28**	**1,888.26**

GWP 1 25 298

Notes:
Emission factors for onroad engines (spreader, flatbed trucks, and water trucks) shown in units of grams per hour (g/hr). CO2 emission factors from EMFAC2014 for diesel-fueled medium-duty vehicles in San Francisco Bay Area Air Basin.
CH4 and N2O emission factors from "2018 Climate Registry Default Emission Factors" for diesel medium and heavy-duty vehicles.

Onroad Vehicle Speed
15 mph

Air Basin
San Francisco Bay Area

Conversions
1,000,000 grams per metric ton
5 days per week
22 days per month

GHG Emission Factors

CH4	0.0051	g/mi	0.0765	grams per hour
N2O	0.0048	g/mi	0.072	grams per hour

Source: 2018 Climate Registry Default Emissions Factors
Table 13.4 Default CH4 and N2O Emission Factors for Highway Vehicles by Technology Type
Diesel Medium and Heavy-Duty Vehicles (Trucks and Busses), Uncontrolled
https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf

Tunnel Option Start Date 1/1/2020
Pipeline Option Start Date 1/1/2020

Table A-24. Lower San Felipe Intake Alternative Schedule

	Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Tunnel Option																																																	
Mobilization	6																																															
Site Improvements	6																																															
Construct Vertical Shaft	6																																														
Set Up TBM	2																																														
Tunneling and Spreading of Soils	20																																														
Cofferdam and TBM Out	3																																														
Connect to Existing Intake	3																																														
Fabricate Inlet	3																																														
Set Inlet and Flood Tunnel	1																																														
Construct Aeration Facility	10																																														
Fab and Set Air Tubing	6																																														
Final Work and Testing	4																																														
Demobilization	2																																														
Pipeline Option																																															
Mobilization	6																																															
Site Improvements	6																																															
Fabricate Inlet	3																																														
Build Cofferdam and Set Lower Inlet	4																																														
Lay Pipe	12																																														
Connect to Existing Intake	2																																														
Construct Aeration Facility	10																																														
Fab and Set Air Tubing	6																																														
Final Work and Testing	4																																														
Demobilization	2																																														

Source: SLLPIP_PD_06082012.pdf

Tunnel Option Start Date 1/1/2020
Pipeline Option Start Date 1/1/2020

Table A-24. Lower San Felipe Intake Alternative S

	Months	Dates		Year		Months by Year				
Tunnel Option		**Start**	**End**	**Start**	**End**	**2020**	**2021**	**2022**	**2023**	**Total**
Mobilization	6	1/1/2020	6/30/2020	2020	2020	6	0	0	0	6
Site Improvements	6	4/1/2020	9/30/2020	2020	2020	6	0	0	0	6
Construct Vertical Shaft	6	10/1/2020	3/31/2021	2020	2021	3	3	0	0	6
Set Up TBM	2	4/1/2021	5/31/2021	2021	2021	0	2	0	0	2
Tunneling and Spreading of Soils	20	6/1/2021	1/31/2023	2021	2023	0	7	12	1	20
Cofferdam and TBM Out	3	2/1/2023	4/30/2023	2023	2023	0	0	0	3	3
Connect to Existing Intake	3	2/1/2023	4/30/2023	2023	2023	0	0	0	3	3
Fabricate Inlet	3	2/1/2023	4/30/2023	2023	2023	0	0	0	3	3
Set Inlet and Flood Tunnel	1	5/1/2023	5/31/2023	2023	2023	0	0	0	1	1
Construct Aeration Facility	10	6/1/2021	3/31/2022	2021	2022	0	7	3	0	10
Fab and Set Air Tubing	6	10/1/2021	3/31/2022	2021	2022	0	3	3	0	6
Final Work and Testing	4	6/1/2023	9/30/2023	2023	2023	0	0	0	4	4
Demobilization	2	10/1/2023	11/30/2023	2023	2023	0	0	0	2	2
Pipeline Option										
Mobilization	6	1/1/2020	6/30/2020	2020	2020	6	0	0	0	6
Site Improvements	6	4/1/2020	9/30/2020	2020	2020	6	0	0	0	6
Fabricate Inlet	3	8/1/2020	10/31/2020	2020	2020	3	0	0	0	3
Build Cofferdam and Set Lower Inlet	4	10/1/2020	1/31/2021	2020	2021	3	1	0	0	4
Lay Pipe	12	2/1/2021	1/31/2022	2021	2022	0	11	1	0	12
Connect to Existing Intake	2	2/1/2022	3/31/2022	2022	2022	0	0	2	0	2
Construct Aeration Facility	10	2/1/2021	11/30/2021	2021	2021	0	10	0	0	10
Fab and Set Air Tubing	6	6/1/2021	11/30/2021	2021	2021	0	6	0	0	6
Final Work and Testing	4	4/1/2022	7/31/2022	2022	2022	0	0	4	0	4
Demobilization	2	8/1/2022	9/30/2022	2022	2022	0	0	2	0	2

Source: SLLPIP_PD_06082012.pdf

Table A-25. Santa Teresa WTP - Construction Schedule

	Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Dates		Year		Months by Year		
																																						Start	End	Start	End	2020	2021	2022
Mobilization and Site Improvements	2																																					1/1/2020	2/29/2020	2020	2020	2	0	0
Retrofit Existing Facilities (1)	14																																					3/1/2020	4/30/2021	2020	2021	10	4	0
Retrofit Existing Facilities (2)	14																																					7/1/2021	8/31/2022	2021	2022	0	6	8
Starting and Testing (1)	2																																					5/1/2021	6/30/2021	2021	2021	0	2	0
Starting and Testing (2)	2																																					9/1/2022	10/31/2022	2022	2022	0	0	2
Demobilization	2																																					11/1/2022	12/31/2022	2022	2022	0	0	2
																																								Total	12	12	12

Source: Equipment Tables_08012012.docx

Note: Construction duration originally estimated to be 15 months; however, schedule updated to 36 months after completion of Feasibility Report. Therefore, current schedule scaled up to reflect 36-month construction schedule.

Emission Factor Summary

Table A-26. In-Use Off-Road Construction Equipment Emission Factors (San Joaquin Valley Air Basin)

Equipment Type	Average HP	Emission Factors - 2020 (g/bhp-hr)			Emission Factors - 2021 (g/bhp-hr)			Emission Factors - 2022 (g/bhp-hr)			Emission Factors - 2023 (g/bhp-hr)			Emission Factors - 2024 (g/bhp-hr)		
		CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O
ConstMin - Bore/Drill Rigs	221	262.652	0.010	-	262.297	0.009	-	261.797	0.009	-	261.761	0.009	-	262.470	0.009	-
ConstMin - Cranes	231	151.762	0.014	-	151.821	0.013	-	151.973	0.012	-	151.980	0.012	-	151.984	0.011	-
ConstMin - Crawler Tractors	212	226.488	0.023	-	226.274	0.022	-	226.059	0.021	-	226.295	0.020	-	226.382	0.019	-
ConstMin - Excavators	158	201.731	0.018	-	201.738	0.017	-	201.784	0.016	-	201.812	0.015	-	201.819	0.014	-
ConstMin - Graders	188	216.830	0.018	-	216.573	0.017	-	216.549	0.016	-	215.145	0.016	-	214.395	0.015	-
ConstMin - Off-Highway Tractors	124	229.411	0.037	-	229.481	0.035	-	229.547	0.033	-	229.589	0.032	-	229.846	0.030	-
ConstMin - Off-Highway Trucks	403	201.177	0.016	-	201.162	0.015	-	201.259	0.014	-	201.274	0.014	-	201.438	0.013	-
ConstMin - Other Construction Equipment	172	220.363	0.016	-	220.262	0.015	-	219.861	0.014	-	219.667	0.013	-	219.635	0.012	-
ConstMin - Pavers	129	219.011	0.030	-	218.918	0.028	-	219.297	0.027	-	219.374	0.025	-	219.534	0.024	-
ConstMin - Paving Equipment	131	187.674	0.025	-	187.767	0.024	-	187.504	0.022	-	187.493	0.021	-	187.715	0.020	-
ConstMin - Rollers	80	197.864	0.028	-	197.839	0.026	-	197.890	0.024	-	197.874	0.022	-	197.903	0.020	-
ConstMin - Rough Terrain Forklifts	100	212.252	0.024	-	212.278	0.023	-	212.186	0.021	-	212.164	0.020	-	212.243	0.019	-
ConstMin - Rubber Tired Dozers	249	209.855	0.028	-	209.931	0.027	-	210.154	0.025	-	210.388	0.024	-	210.383	0.023	-
ConstMin - Rubber Tired Loaders	202	189.914	0.016	-	189.949	0.015	-	190.040	0.014	-	190.253	0.013	-	190.304	0.013	-
ConstMin - Scrapers	367	255.843	0.025	-	255.920	0.024	-	255.779	0.023	-	255.761	0.022	-	255.568	0.021	-
ConstMin - Skid Steer Loaders	65	192.346	0.014	-	191.821	0.014	-	192.907	0.013	-	194.580	0.012	-	192.922	0.012	-
ConstMin - Surfacing Equipment	263	159.048	0.011	-	159.126	0.010	-	159.126	0.010	-	159.149	0.009	-	159.109	0.009	-
ConstMin - Sweepers/Scrubbers	64	240.406	0.026	-	240.398	0.024	-	240.589	0.022	-	240.608	0.021	-	240.627	0.019	-
ConstMin - Tractors/Loaders/Backhoes	98	193.422	0.020	-	193.318	0.019	-	193.492	0.017	-	193.817	0.017	-	193.939	0.016	-
ConstMin - Trenchers	79	264.332	0.050	-	264.739	0.047	-	264.872	0.044	-	264.211	0.042	-	264.720	0.039	-
Industrial - Aerial Lifts	63	162.717	0.016	-	162.730	0.015	-	162.722	0.013	-	162.727	0.013	-	162.729	0.012	-
Industrial - Forklifts	89	106.039	0.011	-	106.040	0.010	-	106.037	0.010	-	106.040	0.009	-	106.032	0.009	-
Industrial - Other General Industrial Equipment	88	180.548	0.026	-	180.572	0.023	-	180.572	0.022	-	180.546	0.021	-	180.551	0.019	-
Industrial - Other Material Handling Equipment	167	208.707	0.023	-	208.711	0.021	-	208.722	0.019	-	208.726	0.018	-	208.723	0.017	-
OFF - ConstMin - Bore/Drill Rigs	15	319.893	0.045	-	319.936	0.045	-	319.561	0.045	-	319.225	0.045	-	319.689	0.045	-
OFF - ConstMin - Cement and Mortar Mixers	10	440.196	0.033	-	446.401	0.033	-	452.604	0.033	-	452.436	0.033	-	446.159	0.033	-
OFF - ConstMin - Concrete/Industrial Saws	31	217.013	0.053	-	217.051	0.048	-	216.251	0.043	-	216.298	0.040	-	217.158	0.037	-
OFF - ConstMin - Dumpers/Tenders	16	323.591	0.024	-	324.405	0.024	-	323.853	0.024	-	325.022	0.024	-	324.287	0.024	-
OFF - ConstMin - Excavators	23	352.585	0.035	-	352.509	0.035	-	352.604	0.035	-	352.494	0.035	-	352.386	0.035	-
OFF - ConstMin - Other Construction Equipment	14	360.435	0.037	-	359.878	0.037	-	360.248	0.037	-	361.516	0.037	-	360.962	0.037	-
OFF - ConstMin - Pavers	24	305.081	0.038	-	303.993	0.038	-	302.079	0.038	-	301.925	0.038	-	302.192	0.038	-
OFF - ConstMin - Paving Equipment	19	244.271	0.033	-	244.297	0.033	-	244.438	0.033	-	244.346	0.033	-	244.445	0.033	-
OFF - ConstMin - Plate Compactors	8	318.146	0.026	-	318.243	0.026	-	318.332	0.026	-	318.427	0.026	-	318.311	0.026	-
OFF - ConstMin - Rollers	12	307.783	0.033	-	309.933	0.033	-	309.896	0.033	-	306.379	0.033	-	307.070	0.033	-
OFF - ConstMin - Rubber Tired Loaders	25	466.020	0.033	-	466.010	0.033	-	466.001	0.033	-	466.012	0.033	-	466.021	0.033	-
OFF - ConstMin - Signal Boards	6	467.378	0.049	-	467.756	0.049	-	476.336	0.049	-	470.484	0.049	-	472.804	0.049	-
OFF - ConstMin - Skid Steer Loaders	20	312.501	0.035	-	312.616	0.035	-	312.583	0.034	-	312.374	0.034	-	312.589	0.034	-
OFF - ConstMin - Tractors/Loaders/Backhoes	23	426.810	0.034	-	426.330	0.034	-	426.618	0.034	-	426.681	0.034	-	427.004	0.034	-
OFF - ConstMin - Trenchers	22	261.415	0.046	-	261.495	0.046	-	261.404	0.046	-	261.245	0.046	-	261.060	0.046	-
OFF - Industrial - Aerial Lifts	17	289.654	0.030	-	289.571	0.029	-	289.648	0.029	-	289.808	0.029	-	289.596	0.029	-
OFF - Industrial - Other General Industrial Equipment	18	388.843	0.032	-	389.170	0.032	-	386.992	0.032	-	387.756	0.032	-	387.359	0.032	-
OFF - Industrial - Sweepers/Scrubbers	18	274.343	0.042	-	274.362	0.042	-	273.291	0.042	-	273.629	0.042	-	273.088	0.042	-
OFF - Light Commercial - Air Compressors	35	420.591	0.045	-	420.595	0.040	-	420.546	0.037	-	420.576	0.034	-	420.564	0.032	-
OFF - Light Commercial - Generator Sets	21	420.527	0.048	-	420.577	0.048	-	420.491	0.047	-	420.508	0.047	-	420.566	0.047	-
OFF - Light Commercial - Pressure Washers	21	170.638	0.020	-	171.199	0.019	-	170.857	0.019	-	169.529	0.019	-	170.596	0.019	-
OFF - Light Commercial - Pumps	18	420.494	0.052	-	420.662	0.051	-	420.591	0.050	-	420.592	0.049	-	420.656	0.048	-
OFF - Light Commercial - Welders	33	403.602	0.040	-	403.536	0.035	-	403.502	0.032	-	403.402	0.030	-	403.469	0.027	-
Portable Equipment - Non-Rental Compressor	210	154.587	0.013	-	156.272	0.012	-	157.976	0.011	-	159.698	0.011	-	161.439	0.010	-
Portable Equipment - Non-Rental Generator	559	154.587	0.013	-	156.272	0.012	-	157.976	0.011	-	159.698	0.011	-	161.439	0.010	-
Portable Equipment - Non-Rental Other Portable Equipment	382	154.587	0.012	-	156.272	0.011	-	157.976	0.010	-	159.698	0.010	-	161.439	0.009	-
Portable Equipment - Non-Rental Pump	593	154.587	0.014	-	156.272	0.013	-	157.976	0.012	-	159.698	0.012	-	161.439	0.011	-
Portable Equipment - Rental Compressor	233	154.587	0.013	-	156.272	0.012	-	157.976	0.011	-	159.698	0.011	-	161.439	0.010	-
Portable Equipment - Rental Generator	232	154.587	0.014	-	156.272	0.013	-	157.976	0.012	-	159.698	0.011	-	161.439	0.011	-
Portable Equipment - Rental Other Portable Equipment	169	154.587	0.016	-	156.272	0.015	-	157.976	0.014	-	159.698	0.013	-	161.439	0.012	-
Portable Equipment - Rental Pump	212	154.587	0.015	-	156.272	0.013	-	157.976	0.013	-	159.698	0.012	-	161.439	0.012	-

Source:
CO2 Emission Factors: California Air Resources Board (CARB). 2017. OFFROAD2017 - ORION Web Database. Available online at https://www.arb.ca.gov/orion/ [Accessesd October 17, 2018].
CH4 and N2O Emission Factors: California Air Resources Board. 2007. OFFROAD2007.
Notes:
1. Horsepower used in modeling is average calculated from OFFROAD2017 (e.g., "Horsepower_Hours_hhpy" divided by "Total_Activity_hpy.")

Table A-27. In-Use Off-Road Construction Equipment Emission Factors (San Francisco Bay Area Air Basin)

Equipment Type	Average HP	Emission Factors - 2020 (g/bhp-hr)			Emission Factors - 2021 (g/bhp-hr)			Emission Factors - 2022 (g/bhp-hr)			Emission Factors - 2023 (g/bhp-hr)			Emission Factors - 2024 (g/bhp-hr)		
		CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O
ConstMin - Bore/Drill Rigs	221	263.425	0.010	-	262.928	0.009	-	262.502	0.009	-	263.106	0.009	-	263.778	0.009	-
ConstMin - Cranes	231	152.030	0.014	-	151.992	0.013	-	151.917	0.012	-	151.961	0.012	-	151.994	0.011	-
ConstMin - Crawler Tractors	212	226.232	0.023	-	226.303	0.022	-	226.169	0.021	-	226.103	0.020	-	226.185	0.019	-
ConstMin - Excavators	158	201.716	0.018	-	201.703	0.017	-	201.646	0.016	-	201.689	0.015	-	201.646	0.014	-
ConstMin - Graders	188	215.884	0.018	-	215.791	0.017	-	215.796	0.016	-	215.935	0.016	-	215.756	0.015	-
ConstMin - Off-Highway Tractors	124	229.814	0.037	-	229.915	0.035	-	229.920	0.033	-	229.754	0.032	-	229.704	0.030	-
ConstMin - Off-Highway Trucks	403	201.408	0.016	-	201.512	0.015	-	201.621	0.014	-	201.864	0.014	-	201.556	0.013	-
ConstMin - Other Construction Equipment	172	218.483	0.016	-	218.490	0.015	-	218.418	0.014	-	218.426	0.013	-	218.448	0.012	-
ConstMin - Pavers	129	219.689	0.030	-	219.565	0.028	-	219.710	0.027	-	219.720	0.025	-	219.677	0.024	-
ConstMin - Paving Equipment	131	187.116	0.025	-	187.076	0.024	-	187.105	0.022	-	187.022	0.021	-	187.154	0.020	-
ConstMin - Rollers	80	198.122	0.028	-	198.170	0.026	-	198.043	0.024	-	198.119	0.022	-	198.149	0.020	-
ConstMin - Rough Terrain Forklifts	100	212.432	0.024	-	212.381	0.023	-	212.337	0.021	-	212.434	0.020	-	212.465	0.019	-
ConstMin - Rubber Tired Dozers	249	208.552	0.028	-	208.834	0.027	-	209.362	0.025	-	209.048	0.024	-	209.022	0.023	-
ConstMin - Rubber Tired Loaders	202	190.541	0.016	-	190.425	0.015	-	190.430	0.014	-	190.492	0.013	-	190.556	0.013	-
ConstMin - Scrapers	367	254.998	0.025	-	254.980	0.024	-	255.037	0.023	-	255.223	0.022	-	255.178	0.021	-
ConstMin - Skid Steer Loaders	65	194.497	0.014	-	194.524	0.014	-	194.538	0.013	-	194.506	0.012	-	194.634	0.012	-
ConstMin - Surfacing Equipment	263	159.194	0.011	-	159.157	0.010	-	159.337	0.010	-	159.398	0.009	-	159.538	0.009	-
ConstMin - Sweepers/Scrubbers	64	241.387	0.025	-	240.737	0.023	-	240.058	0.021	-	239.690	0.020	-	238.843	0.019	-
ConstMin - Tractors/Loaders/Backhoes	98	194.991	0.020	-	195.069	0.019	-	195.218	0.017	-	195.215	0.017	-	195.284	0.016	-
ConstMin - Trenchers	79	265.676	0.050	-	265.766	0.047	-	265.593	0.044	-	265.848	0.042	-	265.793	0.039	-
Industrial - Aerial Lifts	63	162.723	0.015	-	162.700	0.013	-	162.705	0.012	-	162.687	0.012	-	162.686	0.011	-
Industrial - Forklifts	89	105.944	0.011	-	105.948	0.010	-	105.947	0.009	-	105.948	0.009	-	105.937	0.008	-
Industrial - Other General Industrial Equipment	88	180.179	0.024	-	180.697	0.022	-	181.296	0.021	-	181.118	0.019	-	180.767	0.018	-
Industrial - Other Material Handling Equipment	167	208.974	0.021	-	208.946	0.020	-	208.951	0.019	-	208.611	0.017	-	208.613	0.016	-
OFF - ConstMin - Bore/Drill Rigs	16	426.163	0.046	-	426.124	0.046	-	426.962	0.046	-	427.339	0.046	-	426.638	0.046	-
OFF - ConstMin - Cement and Mortar Mixers	10	318.366	0.033	-	318.616	0.033	-	318.857	0.033	-	318.711	0.033	-	318.495	0.033	-
OFF - ConstMin - Concrete/Industrial Saws	31	416.174	0.053	-	416.439	0.048	-	415.984	0.043	-	416.245	0.040	-	416.038	0.037	-
OFF - ConstMin - Dumpers/Tenders	16	215.693	0.024	-	216.319	0.024	-	217.088	0.024	-	216.906	0.024	-	217.498	0.024	-
OFF - ConstMin - Excavators	23	323.955	0.035	-	323.774	0.035	-	323.956	0.035	-	323.780	0.035	-	324.100	0.035	-
OFF - ConstMin - Other Construction Equipment	14	352.350	0.037	-	352.428	0.037	-	352.345	0.037	-	352.346	0.037	-	352.278	0.037	-
OFF - ConstMin - Pavers	24	352.776	0.038	-	352.994	0.038	-	353.867	0.038	-	355.052	0.038	-	352.648	0.038	-
OFF - ConstMin - Paving Equipment	19	301.439	0.033	-	302.037	0.033	-	301.809	0.033	-	300.798	0.033	-	301.378	0.033	-
OFF - ConstMin - Plate Compactors	8	244.393	0.026	-	244.410	0.026	-	244.409	0.026	-	244.368	0.026	-	244.370	0.026	-
OFF - ConstMin - Rollers	12	318.218	0.033	-	318.228	0.033	-	318.254	0.033	-	318.234	0.033	-	318.200	0.033	-
OFF - ConstMin - Rubber Tired Loaders	25	306.838	0.033	-	307.631	0.033	-	307.344	0.033	-	306.288	0.033	-	307.054	0.033	-
OFF - ConstMin - Signal Boards	6	466.012	0.049	-	466.011	0.049	-	466.013	0.049	-	466.023	0.049	-	466.008	0.049	-
OFF - ConstMin - Skid Steer Loaders	20	312.583	0.035	-	312.559	0.035	-	312.567	0.034	-	312.563	0.034	-	312.564	0.034	-
OFF - ConstMin - Tractors/Loaders/Backhoes	23	312.495	0.034	-	312.625	0.034	-	312.588	0.034	-	312.500	0.034	-	312.612	0.034	-
OFF - ConstMin - Trenchers	22	426.250	0.046	-	426.410	0.046	-	425.937	0.046	-	426.076	0.046	-	425.703	0.046	-
OFF - Industrial - Aerial Lifts	17	261.445	0.029	-	261.450	0.029	-	261.461	0.029	-	261.474	0.029	-	261.457	0.029	-
OFF - Industrial - Other General Industrial Equipment	18	289.849	0.032	-	289.813	0.032	-	289.857	0.032	-	289.872	0.032	-	289.840	0.032	-
OFF - Industrial - Sweepers/Scrubbers	18	386.220	0.042	-	386.415	0.042	-	386.278	0.042	-	386.874	0.042	-	386.273	0.042	-
OFF - Light Commercial - Air Compressors	35	272.805	0.040	-	272.772	0.036	-	272.768	0.033	-	272.793	0.031	-	272.800	0.029	-
OFF - Light Commercial - Generator Sets	21	420.551	0.048	-	420.560	0.047	-	420.553	0.047	-	420.543	0.047	-	420.552	0.046	-
OFF - Light Commercial - Pressure Washers	21	171.473	0.019	-	171.839	0.019	-	171.620	0.019	-	170.941	0.019	-	171.212	0.019	-
OFF - Light Commercial - Pumps	18	420.527	0.051	-	420.531	0.050	-	420.569	0.049	-	420.537	0.048	-	420.568	0.048	-
OFF - Light Commercial - Welders	33	255.740	0.035	-	255.746	0.032	-	255.732	0.029	-	255.741	0.027	-	255.728	0.025	-
Portable Equipment - Non-Rental Compressor	167	154.587	0.015	-	156.272	0.014	-	157.976	0.013	-	159.698	0.013	-	161.439	0.012	-
Portable Equipment - Non-Rental Generator	369	154.587	0.012	-	156.272	0.011	-	157.976	0.011	-	159.698	0.010	-	161.439	0.010	-
Portable Equipment - Non-Rental Other Portable Equipment	407	154.587	0.012	-	156.272	0.011	-	157.976	0.010	-	159.698	0.010	-	161.439	0.009	-
Portable Equipment - Non-Rental Pump	197	154.587	0.014	-	156.272	0.013	-	157.976	0.012	-	159.698	0.011	-	161.439	0.011	-
Portable Equipment - Rental Compressor	361	154.587	0.012	-	156.272	0.011	-	157.976	0.011	-	159.698	0.010	-	161.439	0.010	-
Portable Equipment - Rental Generator	406	154.587	0.012	-	156.272	0.011	-	157.976	0.011	-	159.698	0.010	-	161.439	0.010	-
Portable Equipment - Rental Other Portable Equipment	657	154.587	0.012	-	156.272	0.011	-	157.976	0.010	-	159.698	0.010	-	161.439	0.009	-
Portable Equipment - Rental Pump	165	154.587	0.018	-	156.272	0.017	-	157.976	0.016	-	159.698	0.015	-	161.439	0.014	-

Source:
California Air Resources Board (CARB). 2017. OFFROAD2017 - ORION Web Database. Available online at https://www.arb.ca.gov/orion/ [Accessesd October 17, 2018].
Notes:
1. Horsepower used in modeling is average calculated from OFFROAD2017 (e.g., "Horsepower_Hours_hhpy" divided by "Total_Activity_hpy.")

San Luis Low Point Improvement Project
EMFAC2014 Emission Factor Summary

Table A-28. On-Road Medium-Duty Vehicle Diesel CO2 Emission Factors (San Joaquin Valley Air Basin), grams per hour

Speed	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
5	5,339.09	5,204.46	5,064.45	4,919.52	4,771.13	4,621.31	4,492.53	4,368.08	4,255.26	4,157.09	4,069.82
10	9,055.21	8,831.00	8,592.63	8,345.14	8,091.43	7,837.35	7,613.21	7,401.75	7,212.14	7,046.27	6,899.49
15	11,522.17	11,229.84	10,925.87	10,610.17	10,286.04	9,961.67	9,675.04	9,408.38	9,169.59	8,958.80	8,771.96
20	12,773.40	12,448.95	12,114.36	11,766.75	11,415.27	11,058.40	10,747.79	10,447.20	10,180.65	9,946.81	9,738.89
25	13,491.02	13,148.77	12,792.80	12,422.48	12,046.90	11,669.86	11,338.65	11,025.14	10,745.75	10,498.88	10,279.78
30	13,975.52	13,623.34	13,255.46	12,873.33	12,484.04	12,093.16	11,747.76	11,424.76	11,136.57	10,881.32	10,654.30
35	14,810.72	14,435.72	14,046.86	13,643.01	13,231.98	12,818.18	12,452.25	12,107.30	11,799.78	11,528.95	11,288.00
40	15,844.56	15,444.77	15,029.07	14,597.95	14,158.60	13,715.81	13,329.96	12,958.35	12,625.83	12,335.31	12,076.80
45	17,158.81	16,724.96	16,275.47	15,808.19	15,328.81	14,848.96	14,418.97	14,016.45	13,658.41	13,344.05	13,064.87
50	19,143.51	18,657.05	18,153.15	17,629.83	17,100.79	16,564.76	16,102.56	15,652.36	15,252.01	14,900.94	14,589.00
55	22,217.42	21,646.97	21,061.23	20,452.14	19,836.93	19,216.25	18,705.66	18,181.31	17,716.05	17,308.15	16,945.64
60	26,303.61	25,635.63	24,945.79	24,228.98	23,495.26	22,760.95	22,110.77	21,491.16	20,941.22	20,458.17	20,028.32
65	31,911.43	31,109.91	30,272.95	29,402.73	28,515.84	27,627.11	26,833.48	26,095.33	25,439.19	24,857.60	24,339.31
70	36,952.25	36,015.30	35,043.45	34,034.78	33,010.10	31,981.25	31,075.23	30,224.17	29,464.62	28,792.78	28,194.02

Table A-29. On-Road Medium-Duty Vehicle Diesel Emission Factors (San Francisco Bay Area Air Basin), grams per hour

Speed	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
5	5,335.24	5,190.32	5,042.84	4,891.44	4,738.47	4,585.27	4,453.02	4,333.36	4,226.99	4,134.20	4,051.88
10	9,061.54	8,815.38	8,564.04	8,305.84	8,044.73	7,783.39	7,556.62	7,352.88	7,172.74	7,014.92	6,874.88
15	11,585.95	11,266.48	10,941.40	10,607.53	10,270.71	9,933.31	9,640.98	9,377.80	9,143.99	8,939.20	8,757.65
20	12,725.83	12,379.54	12,026.54	11,663.95	11,298.07	10,931.80	10,615.58	10,331.46	10,080.08	9,860.21	9,665.16
25	13,455.78	13,089.96	12,716.94	12,333.81	11,947.09	11,559.93	11,225.43	10,924.85	10,659.01	10,426.39	10,220.02
30	13,938.32	13,559.46	13,173.55	12,777.18	12,377.30	11,976.86	11,631.74	11,320.71	11,045.15	10,804.57	10,591.21
35	14,784.54	14,379.20	13,966.55	13,542.89	13,115.40	12,687.24	12,318.41	11,985.46	11,690.32	11,433.46	11,206.00
40	15,779.91	15,348.81	14,909.89	14,458.98	14,003.72	13,548.11	13,155.84	12,801.57	12,487.59	12,214.53	11,972.77
45	17,063.49	16,603.53	16,134.97	15,653.57	15,168.04	14,681.66	14,262.38	13,884.17	13,548.71	13,255.23	12,994.54
50	19,040.69	18,523.59	17,996.69	17,455.74	16,909.48	16,362.56	15,891.68	15,467.11	15,091.43	14,764.05	14,473.93
55	22,145.35	21,544.69	20,932.70	20,304.08	19,670.03	19,034.75	18,487.21	17,992.60	17,554.13	17,171.58	16,832.19
60	26,111.76	25,403.47	24,681.94	23,941.23	23,194.31	22,446.14	21,801.74	21,222.00	20,708.94	20,260.34	19,862.33
65	31,823.18	30,948.94	30,059.10	29,145.79	28,223.56	27,300.60	26,506.23	25,790.37	25,156.66	24,605.57	24,118.01

San Luis Low Point Improvement Project
Lower San Felipe Intake Alternative - Tunnel Option
Haul Truck and Construction Worker Commuting Emissions

Construction Duration 47 months
3.9 years
Months in Final Year 11

Table A-30. Trip Rate Information

	Round Trips		One-Way Trips		One-Way Distance	VMT		Annual VMT	
Vehicle Type	**Max Day Trips**	**Total Trips**	**Max Day Trips**	**Total Trips**	**(miles)**	**Daily**	**Total**	**2020 - 2022**	**2023**
Dump Truck	6	100	12	200	40	480	8,000	2,043	1,872
Concrete Trucks	15	7,500	30	15,000	40	1,200	600,000	153,191	140,426
Delivery Trucks (non-soil)	5	1,300	10	2,600	40	400	104,000	26,553	24,340
Gravel/paving trucks	3	250	6	500	40	240	20,000	5,106	4,681
Haul trucks (soil)	40	19,420	80	38,840	5	400	194,200	49,583	45,451
Total Truck Trips	69	28,570	138	57,140	165	2,720	926,200	236,476	216,770
Workers	100	43,800	200	87,600	40	8,000	3,504,000	894,638	820,085
Grand Total	**169**	**72,370**	**338**	**144,740**	**205**	**10,720**	**4,430,200**	**1,131,114**	**1,036,855**

Source: EngineeringDataNeeds_July30_2012.xlsx
Note:
Assume earliest alternative could start would be 2020.

Table A-31. Annual Emissions

	Truck Emission Factors (g/mi)		1,628.32	0.0051	0.0048		1,611.17	0.0051	0.0048		1,593.35	0.0051	0.0048		1,538.91	0.0051	0.0048	
	Worker Emission Factors (g/mi)		308.94	0.1838	0.0762		297.33	0.1837	0.0761		285.97	0.1837	0.0761		274.71	0.1836	0.0761	
	Annual VMT (miles/year)		**Annual Emissions - 2020 (metric tons/year)**				**Annual Emissions - 2021 (metric tons/year)**				**Annual Emissions - 2022 (metric tons/year)**				**Annual Emissions - 2023 (metric tons/year)**			
Truck Type	**2020 - 2022**	**2023**	**CO2**	**CH4**	**N2O**	**CO2e**	**CO2**	**CH4**	**N2O**	**CO2e**	**CO2**	**CH4**	**N2O**	**CO2e**	**CO2**	**CH4**	**N2O**	**CO2e**
Dump Truck	2,043	1,872	3.33	0.00	0.00	3.33	3.29	0.00	0.00	3.29	3.26	0.00	0.00	3.26	2.88	0.00	0.00	2.88
Concrete Trucks	153,191	140,426	249.44	0.00	0.00	249.68	246.82	0.00	0.00	247.06	244.09	0.00	0.00	244.32	216.10	0.00	0.00	216.32
Delivery Trucks (non-soil)	26,553	24,340	43.24	0.00	0.00	43.28	42.78	0.00	0.00	42.82	42.31	0.00	0.00	42.35	37.46	0.00	0.00	37.50
Gravel/paving trucks	5,106	4,681	8.31	0.00	0.00	8.32	8.23	0.00	0.00	8.23	8.14	0.00	0.00	8.14	7.20	0.00	0.00	7.21
Haul trucks (soil)	49,583	45,451	80.74	0.00	0.00	80.81	79.89	0.00	0.00	79.96	79.00	0.00	0.00	79.08	69.95	0.00	0.00	70.02
Truck Subtotal	236,476	216,770	385.06	0.00	0.00	385.43	381.00	0.00	0.00	381.37	376.79	0.00	0.00	377.16	333.59	0.00	0.00	333.93
Workers	894,638	820,085	276.39	0.16	0.07	300.82	266.00	0.16	0.07	290.41	255.84	0.16	0.07	280.24	245.76	0.16	0.07	270.17
Grand Total	**1,131,114**	**1,036,855**	**661.45**	**0.17**	**0.07**	**686.25**	**647.00**	**0.17**	**0.07**	**671.78**	**632.62**	**0.17**	**0.07**	**657.40**	**579.35**	**0.17**	**0.07**	**604.10**
		GWP	1	25	298													

Start Year: 2020
Air Basin: San Joaquin Valley

Conversions
1,000,000 grams per metric ton

Lower San Felipe Intake Alternative - Pipeline Option
Haul Truck and Construction Worker Commuting Emissions

Construction Duration	33	months
	2.8	years
Months in Final Year	9	

Table A-32. Trip Rate Information

Vehicle Type	Round Trips		One-Way Trips		One-Way Distance	VMT		Annual VMT	
	Max Day Trips	Total Trips	Max Day Trips	Total Trips	(miles)	Daily	Total	2020 - 2021	2022
Dump Truck	6	100	12	200	40	480	8,000	2,909	2,182
Concrete Trucks	2	5	4	10	40	160	400	145	109
Delivery Trucks (non-soil)	5	1,950	10	3,900	40	400	156,000	56,727	42,545
Gravel/paving trucks	3	250	6	500	40	240	20,000	7,273	5,455
Haul trucks (soil)	2	4,100	4	8,200	5	20	41,000	14,909	11,182
Total Truck Trips	18	6,405	36	12,810	165	1,300	225,400	81,963	61,473
Workers	30	15,000	60	30,000	40	2,400	1,200,000	436,364	327,273
Grand Total	**48**	**21,405**	**96**	**42,810**	**205**	**3,700**	**1,425,400**	**518,327**	**388,746**

Source: EngineeringDataNeeds_July30_2012.xlsx
Note:
Assume earliest alternative could start would be 2020.

Table A-33. Annual Emissions

	Truck Emission Factors (g/mi)		1,628.32	0.0051	0.0048		1,611.17	0.0051	0.0048		1,593.35	0.0051	0.0048	
	Worker Emission Factors (g/mi)		308.94	0.1838	0.0762		297.33	0.1837	0.0761		285.97	0.1837	0.0761	
	Annual VMT (miles/year)		Annual Emissions - 2020 (metric tons/year)				Annual Emissions - 2021 (metric tons/year)				Annual Emissions - 2022 (metric tons/year)			
Truck Type	2020 - 2021	2022	CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e
Dump Truck	2,909	2,182	4.74	0.00	0.00	4.74	4.69	0.00	0.00	4.69	3.48	0.00	0.00	3.48
Concrete Trucks	145	109	0.24	0.00	0.00	0.24	0.23	0.00	0.00	0.23	0.17	0.00	0.00	0.17
Delivery Trucks (non-soil)	56,727	42,545	92.37	0.00	0.00	92.46	91.40	0.00	0.00	91.49	67.79	0.00	0.00	67.86
Gravel/paving trucks	7,273	5,455	11.84	0.00	0.00	11.85	11.72	0.00	0.00	11.73	8.69	0.00	0.00	8.70
Haul trucks (soil)	14,909	11,182	24.28	0.00	0.00	24.30	24.02	0.00	0.00	24.04	17.82	0.00	0.00	17.83
Truck Subtotal	81,963	61,473	133.46	0.00	0.00	133.59	132.06	0.00	0.00	132.18	97.95	0.00	0.00	98.04
Workers	436,364	327,273	134.81	0.08	0.03	146.73	129.74	0.08	0.03	141.65	93.59	0.06	0.02	102.52
Grand Total	**518,327**	**388,746**	**268.27**	**0.08**	**0.03**	**280.32**	**261.80**	**0.08**	**0.03**	**273.83**	**191.54**	**0.06**	**0.03**	**200.56**
		GWP	1	25	298									

Start Year: 2020
Air Basin: San Joaquin Valley

Conversions

1,000,000 grams per metric ton

Treatment Alternative
Haul Truck and Construction Worker Commuting Emissions

Construction Duration

Santa Teresa WTP 36 months
3 years

Table A-34. Trip Rate Information

Vehicle Type	Round Trips		One-Way Trips		One-Way Distance	VMT		Annual VMT
	Max Day Trips	Total Trips	Max Day Trips	Total Trips	(miles)	Daily	Total	2020-2022
Dump Truck	2	302	4	604	10	40	6,040	2,013
Concrete Trucks	2	155	4	310	10	40	3,100	1,033
Delivery Trucks (non-soil)	3	604	6	1,208	25	150	30,200	10,067
Gravel/paving trucks	2	30	4	60	10	40	600	200
Haul trucks (soil)	2	279	4	558	15	60	8,370	2,790
Total Truck Trips	11	1,370	22	2,740	70	330	48,310	16,103
Workers	80	16,538	160	33,076	30	4,800	992,280	330,760
Grand Total	**91**	**17,908**	**182**	**35,816**	**100**	**5,130**	**1,040,590**	**346,863**

Source: EngineeringDataNeeds_July30_2012.xlsx

Note:

Assume earliest alternative could start would be 2020.

Table A-35. Annual Emissions

Truck Emission Factors (g/mi)		1,636.72	0.0051	0.0048		1,619.44	0.0051	0.0048		1,601.47	0.0051	0.0048	
Worker Emission Factors (g/mi)		298.78	0.1837	0.0763		287.63	0.1837	0.0763		276.51	0.1837	0.0763	
	Annual VMT (miles/year)	Annual Emissions - 2020 (metric tons)				Annual Emissions - 2021 (metric tons)				Annual Emissions - 2022 (metric tons)			
Truck Type	2020-2022	CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e
Dump Truck	2,013	3.29	0.00	0.00	3.30	3.26	0.00	0.00	3.26	3.22	0.00	0.00	3.23
Concrete Trucks	1,033	1.69	0.00	0.00	1.69	1.67	0.00	0.00	1.67	1.65	0.00	0.00	1.66
Delivery Trucks (non-soil)	10,067	16.48	0.00	0.00	16.49	16.30	0.00	0.00	16.32	16.12	0.00	0.00	16.14
Gravel/paving trucks	200	0.33	0.00	0.00	0.33	0.32	0.00	0.00	0.32	0.32	0.00	0.00	0.32
Haul trucks (soil)	2,790	4.57	0.00	0.00	4.57	4.52	0.00	0.00	4.52	4.47	0.00	0.00	4.47
Truck Subtotal	16,103	26.36	0.00	0.00	26.38	26.08	0.00	0.00	26.10	25.79	0.00	0.00	25.81
Workers	330,760	98.82	0.06	0.03	107.86	95.14	0.06	0.03	104.17	91.46	0.06	0.03	100.50
Grand Total	**346,863**	**125.18**	**0.06**	**0.03**	**134.24**	**121.21**	**0.06**	**0.03**	**130.28**	**117.25**	**0.06**	**0.03**	**126.31**
		GWP	1	25	298								

Start Year: 2020
Air Basin: San Francisco Bay Area

Conversions

1,000,000 grams per metric ton

Emission Factors - Weighted Average

Table A-36. Emission Factors (grams per mile)

Air Basin	Year	Trucks			Workers		
		CO2	CH4	N2O	CO2	CH4	N2O
San Joaquin Valley	2020	1,628.322	0.0051	0.0048	308.945	0.1838	0.0762
	2021	1,611.170	0.0051	0.0048	297.328	0.1837	0.0761
	2022	1,593.346	0.0051	0.0048	285.965	0.1837	0.0761
	2023	1,538.912	0.0051	0.0048	274.706	0.1836	0.0761
San Francisco Bay Area	2020	1,636.721	0.0051	0.0048	298.775	0.1837	0.0763
	2021	1,619.438	0.0051	0.0048	287.628	0.1837	0.0763
	2022	1,601.474	0.0051	0.0048	276.506	0.1837	0.0763
	2023	1,546.356	0.0051	0.0048	265.441	0.1837	0.0763

CH4 and N2O Emission Factors

Table A-37. San Joaquin Valley Air Basin Emission Factors

Year	Type	Fuel	VMT	CH4 (g/mi)	N2O (g/mi)
2020	LDA	GAS	51,905,504	0.1780	0.0647
		DSL	526,303	0.0006	0.0012
	LDT1	GAS	3,603,221	0.2024	0.1056
		DSL	4,007	0.0011	0.0017
	LDT2	GAS	18,124,513	0.2024	0.1056
		DSL	31,156	0.0011	0.0017
	Weighted Average Emission Factor (2020), grams per mile			**0.1838**	**0.0762**
2021	LDA	GAS	53,113,271	0.1780	0.0647
		DSL	564,773	0.0006	0.0012
	LDT1	GAS	3,581,948	0.2024	0.1056
		DSL	3,767	0.0011	0.0017
	LDT2	GAS	18,596,624	0.2024	0.1056
		DSL	33,720	0.0011	0.0017
	Weighted Average Emission Factor (2021), grams per mile			**0.1837**	**0.0761**
2022	LDA	GAS	54,099,432	0.1780	0.0647
		DSL	599,371	0.0006	0.0012
	LDT1	GAS	3,567,882	0.2024	0.1056
		DSL	3,563	0.0011	0.0017
	LDT2	GAS	19,045,161	0.2024	0.1056
		DSL	35,993	0.0011	0.0017
	Weighted Average Emission Factor (2022), grams per mile			**0.1837**	**0.0761**
2023	LDA	GAS	55,046,389	0.1780	0.0647
		DSL	632,276	0.0006	0.0012
	LDT1	GAS	3,568,656	0.2024	0.1056
		DSL	3,380	0.0011	0.0017
	LDT2	GAS	19,525,102	0.2024	0.1056
		DSL	38,163	0.0011	0.0017
	Weighted Average Emission Factor (2023), grams per mile			**0.1836**	**0.0761**

Table A-38. San Francisco Bay Area Air Basin County Emission Factors

Year	Type	Fuel	VMT	CH4 (g/mi)	N2O (g/mi)
2020	LDA	GAS	93,944,227	0.1780	0.0647
		DSL	1,057,189	0.0006	0.0012
	LDT1	GAS	6,961,771	0.2024	0.1056
		DSL	5,656	0.0011	0.0017
	LDT2	GAS	33,008,227	0.2024	0.1056
		DSL	64,034	0.0011	0.0017
	Weighted Average Emission Factor (2020), grams per mile			**0.1837**	**0.0763**
2021	LDA	GAS	94,103,223	0.1780	0.0647
		DSL	1,091,742	0.0006	0.0012
	LDT1	GAS	6,877,710	0.2024	0.1056
		DSL	5,385	0.0011	0.0017
	LDT2	GAS	33,244,983	0.2024	0.1056
		DSL	66,742	0.0011	0.0017
	Weighted Average Emission Factor (2021), grams per mile			**0.1837**	**0.0763**
2022	LDA	GAS	93,958,360	0.1780	0.0647
		DSL	1,119,674	0.0006	0.0012
	LDT1	GAS	6,799,689	0.2024	0.1056
		DSL	5,169	0.0011	0.0017
	LDT2	GAS	33,430,716	0.2024	0.1056
		DSL	68,832	0.0011	0.0017
	Weighted Average Emission Factor (2022), grams per mile			**0.1837**	**0.0763**
2023	LDA	GAS	93,832,714	0.1780	0.0647
		DSL	1,145,151	0.0006	0.0012
	LDT1	GAS	6,746,772	0.2024	0.1056
		DSL	4,980	0.0011	0.0017
	LDT2	GAS	33,675,803	0.2024	0.1056
		DSL	70,749	0.0011	0.0017
	Weighted Average Emission Factor (2023), grams per mile			**0.1837**	**0.0763**

Table A-39. Emission Factors for Highway Vehicles by Technology Type

Vehicle Type/ Control Technology	CH4 (g/mi)	N2O (g/mi)
Gasoline Passenger Cars		
EPA Tier 2	0.0173	0.0036
Low Emission Vehicles	0.0105	0.0150
EPA Tier 1	0.0271	0.0429
EPA Tier 0	0.0704	0.0647
Oxidation Catalyst	0.1355	0.0504
Non-Catalyst Control	0.1696	0.0197
Uncontrolled	0.1780	0.0197
Gasoline Light Trucks (Vans, Pickup Trucks, SUVs)		
EPA Tier 2	0.0163	0.0066
Low Emission Vehicles	0.0148	0.0157
EPA Tier 1	0.0452	0.0871
EPA Tier 0	0.0776	0.1056
Oxidation Catalyst	0.1516	0.0639
Non-Catalyst Control	0.1908	0.0218
Uncontrolled	0.2024	0.0220
Gasoline Medium and Heavy-Duty Vehicles (Trucks and Busses)		
EPA Tier 2	0.0333	0.0134
Low Emission Vehicles	0.0303	0.0320
EPA Tier 1	0.0655	0.1750
EPA Tier 0	0.2630	0.2135
Oxidation Catalyst	0.2356	0.1317
Non-Catalyst Control	0.4181	0.0473
Uncontrolled	0.4604	0.0497
Diesel Passenger Cars		
Advanced	0.0005	0.0010
Moderate	0.0005	0.0010
Uncontrolled	0.0006	0.0012
Diesel Light Trucks		
Advanced	0.0010	0.0015
Moderate	0.0009	0.0014
Uncontrolled	0.0011	0.0017
Diesel Medium and Heavy-Duty Vehicles (Trucks and Busses)		
Aftertreatment	0.0051	0.0048
Advanced	0.0051	0.0048
Moderate	0.0051	0.0048
Uncontrolled	0.0051	0.0048
Motorcycles		
Non-Catalyst Control	0.0672	0.0069
Uncontrolled	0.0899	0.0087

Source:

2018 Climate Registry Default Emissions Factors

Table 13.4 Default CH4 and N2O Emission Factors for Highway Vehicles by Technology Type

https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.

Lower San Felipe Intake Alternative - Tunnel Option
Marine Emissions

Table A-40. Propulsion Engine Emission Factors

Vessel Type	Average HP	Fuel Consumption (lb/hr)	Fuel Consumption (gal/hr)	Emission Factor (kg/hr) CO2	CH4	N2O
Tug Boats	1,274	517	72	735.27	0.004	0.032
Crew and Supply	439	178	25	253.36	0.001	0.011

Note:
Barges and dredgers are not typically self-propelled and emissions from barge/dredger propulsion engines are not estimated.

Table A-41. Auxiliary Engine Emission Factors

Vessel Type	Average HP	Fuel Consumption (lb/hr)	Fuel Consumption (gal/hr)	Emission Factor (kg/hr) CO2	CH4	N2O
Tug Boats	111	45	6	64.06	0.0004	0.0028
Crew and Supply	79	32	4	45.59	0.0003	0.0020

Construction Start Date 2020

Table A-42. Annual Marine Vessel Emissions

Vessel Type	Quantity	Trips per project	Hours per Trip	No. Propulsion Engines	No. Auxiliary Engines	Propulsion Engine Emissions (MT/project) CO2	CH4	N2O	CO2e	Auxiliary Engine Emissions (MT/project) CO2	CH4	N2O	CO2e	Total Engine Emissions (MT/project) CO2	CH4	N2O	CO2e
Tug Boats	2	270	2	2	2	1,588.19	0.01	0.07	1,609.28	138.37	0.00	0.01	140.21	1,726.56	0.01	0.08	1,749.49
Crew and Supply	2	270	2	3	1	820.90	0.00	0.04	831.80	49.24	0.00	0.00	49.90	870.14	0.01	0.04	881.69
Total	**4**	**540**	**4**	**5**	**3**	**2,409.09**	**0.01**	**0.11**	**2,441.08**	**187.62**	**0.00**	**0.01**	**190.11**	**2,596.70**	**0.02**	**0.11**	**2,631.19**
GWP						1	25	298									

Note:
Hours per trip estimated to assume that marine vessels would be operating 8 hours per day.
"Trips" represent one-day trips and are double the data provided by the engineers.

Table A-43. Annual Marine Vessel Emissions by Year

Vessel Type	Annual Emissions - 2021 (metric tons per year) CO2	CH4	N2O	CO2e	Annual Emissions - 2022 (metric tons per year) CO2	CH4	N2O	CO2e	Annual Emissions - 2023 (metric tons per year) CO2	CH4	N2O	CO2e
Tug Boats	604.30	0.00	0.03	612.32	1,035.94	0.01	0.05	1,049.70	86.33	0.00	0.00	87.47
Crew and Supply	304.55	0.00	0.01	308.59	522.08	0.00	0.02	529.02	43.51	0.00	0.00	44.08
Total	**908.85**	**0.01**	**0.04**	**920.92**	**1,558.02**	**0.01**	**0.07**	**1,578.71**	**129.84**	**0.00**	**0.01**	**131.56**

Conversion Factors

453.6 grams per pound
1,000 kilograms per metric ton
1,000 grams per kilogram

BSFC = 184 g/hp-hr (http://www.arb.ca.gov/regact/2007/chc07/appb.pdf)

Density

0.86 g/mL
7.18 lb/gal

Lower San Felipe Intake Alternative - Pipeline Option
Marine Emissions

Table A-44. Propulsion Engine Emission Factors

Vessel Type	Average HP	Fuel Consumption (lb/hr)	Fuel Consumption (gal/hr)	Emission Factor (kg/hr) CO2	CH4	N2O
Tug Boats	1,274	517	72	735.27	0.004	0.032
Crew and Supply	439	178	25	253.36	0.001	0.011

Note:
Barges and dredgers are not typically self-propelled and emissions from barge/dredger propulsion engines are not estimated.

Table A-45. Auxiliary Engine Emission Factors

Vessel Type	Average HP	Fuel Consumption (lb/hr)	Fuel Consumption (gal/hr)	Emission Factor (kg/hr) CO2	CH4	N2O
Tug Boats	111	45	6	64.06	0.0004	0.0028
Crew and Supply	79	32	4	45.59	0.0003	0.0020

Construction Start Date 2020

Table A-46. Annual Marine Vessel Emissions

Vessel Type	Quantity	Trips per project	Hours per Trip	No. Propulsion	No. Auxiliary	Propulsion Engine Emissions (MT/project) CO2	CH4	N2O	CO2e	Auxiliary Engine Emissions (MT/project) CO2	CH4	N2O	CO2e	Total Engine Emissions (MT/project) CO2	CH4	N2O	CO2e
Tug Boats	4	739	2	2	2	8,693.87	0.05	0.38	8,809.33	757.47	0.00	0.03	767.53	9,451.34	0.06	0.42	9,576.86
Crew and Supply	4	739	2	3	1	4,493.65	0.03	0.20	4,553.33	269.55	0.00	0.01	273.13	4,763.20	0.03	0.21	4,826.46
Total	**8**	**1,478**	**4**	**5**	**3**	**13,187.52**	**0.08**	**0.58**	**13,362.67**	**1,027.02**	**0.01**	**0.05**	**1,040.66**	**14,214.54**	**0.08**	**0.63**	**14,403.33**
					GWP	1	25	298									

Note:
Hours per trip estimated to assume that marine vessels would be operating 8 hours per day.
"Trips" represent one-day trips and are double the data provided by the engineers.

Table A-47. Annual Marine Emissions by Year

Vessel Type	Annual Emissions - 2021 (metric tons per year) CO2	CH4	N2O	CO2e	Annual Emissions - 2022 (metric tons per year) CO2	CH4	N2O	CO2e
Tug Boats	8,663.73	0.05	0.38	8,778.79	787.61	0.00	0.03	798.07
Crew and Supply	4,366.27	0.03	0.19	4,424.26	396.93	0.00	0.02	402.21
Total	**13,030.00**	**0.08**	**0.57**	**13,203.05**	**1,184.55**	**0.01**	**0.05**	**1,200.28**

Conversion Factors
453.6 grams per pound
1,000 kilograms per metric ton
1,000 grams per kilogram

BSFC = 184 g/hp-hr (http://www.arb.ca.gov/regact/2007/chc07/appb.pdf)

Density
0.86 g/mL
7.18 lb/gal

Lower San Felipe Intake Alternative
Data Tables

Table A-48. California Commercial Harbor Craft Engine Profile by Vessel Type

	Propulsion Engine			Auxiliary Engine		
Vessel Type	# of Engines per Vessel	Average Annual Operating Hrs	Useful Life	# of Engines per Vessel	Average Annual Operating Hrs	Useful Life
Commercial Fishing	1.12	1,250	21	0.46	1,633	15
Charter Fishing	1.77	1,622	16	0.75	2,077	15
Ferry/excursion Vessels	2.01	1,843	20	1.23	1,254	20
Crew and Supply	2.5	788	22	1.1	3,036	22
Pilot Vessels	1.7	1,031	19	0.14	994	25
Tug Boats	1.92	2,274	21	1.59	2,486	23
Tow Boats	2.1	1,993	26	1.17	2,965	25
Work Boats	1.46	675	17	0.32	750	23
Others	1.11	779	23	0.46	805	22

Source: California Air Resources Board (CARB). Emissions Estimation Methodology for Commercial Harbor Craft Operating in California, Appendix B [2007 Rulemaking], Available online at: http://www.arb.ca.gov/regact/2007/chc07/appb.pdf [Accessed on: June 15, 2016].

Table A-49. Quantity of Auxiliary Engines and Average Horsepower

Vessel Category	# Auxiliary Engines	Horsepower	
		Range	Average
Commercial Fishing	212	6 - 300	71
Tug Boats	120	7 - 300	111
Ferry/excursion Vessels	98	10 - 400	94
Charter Fishing	82	4 - 185	50
Others	34	10 - 240	56
Work Boats	26	9 - 221	101
Crew and Supply	22	16 - 110	79
Tow Boats	21	18 - 175	79
Pilot Vessels	1	N/A	30

min	max
30	111

Source: CARB. 2004. Statewide Commercial Harbor Craft Survey, Final Report. March. Available online at: http://www.arb.ca.gov/ports/marinevess/documents/hcsurveyrep0304.pdf [Accessed on: June 15, 2016].

Note:

Vessel categories changed from cited document to be consistent with names used in 2007 and 2010 rulemaking documents to assist with VLOOKUP formulas.

Table A-50. Quantity of Propulsion Engines and Average Horsepower

Vessel Category	# Propulsion Engines	Horsepower	
		Range	Average
Commercial Fishing	516	8 – 1,485	230
Charter Fishing	192	80 – 1,400	381
Ferry/excursion Vessels	164	35 – 3,110	733
Tug Boats	144	24 – 3,600	1,274
Work Boats	99	15 – 1,300	239
Others	89	28 - 764	281
Crew and Supply	50	225 - 750	439
Tow Boats	38	24 – 1,500	500
Pilot Vessels	15	230 - 550	408

min	max
230	1274

Source: CARB. 2004. Statewide Commercial Harbor Craft Survey, Final Report. March. Available online at: http://www.arb.ca.gov/ports/marinevess/documents/hcsurveyrep0304.pdf [Accessed on: June 16, 2016].

Note:

Vessel categories changed from cited document to be consistent with names used in 2007 and 2010 rulemaking documents to assist with VLOOKUP formulas.

GHG Emission Factors

Table A-51. US Default CO2 Emission Factors for Transport Fuels

Fuel Type	Carbon Content (Per Unit Energy)	Heat Content	Fraction Oxidized	CO2 Emission Factor (Per Unit Volume)
Fuels Measured in Gallons	**kg C / MMBtu**	**MMBtu / barrel**		**kg CO2 / gallon**
Gasoline	19.2	5.25	1	8.78
Diesel Fuel	20.2	5.80	1	10.21
Aviation Gasoline	18.9	5.04	1	8.31
Jet Fuel (Jet A or A-1)	19.7	5.67	1	9.75
Kerosene	20.5	5.67	1	10.15
Residual Fuel Oil No. 5	19.9	5.88	1	10.21
Residual Fuel Oil No. 6	20.5	6.30	1	11.27
Crude Oil	20.3	5.80	1	10.29
Biodiesel (B100)	20.1	5.38	1	9.45
Ethanol (E100)	18.7	3.53	1	5.75
Methanol	NA	NA	1	4.10
Liquefied Natural Gas (LNG)	NA	NA	1	4.46
Liquefied Petroleum Gas (LPG)	17.2	3.86	1	5.68
Propane (Liquid)	16.8	3.82	1	5.72
Ethane	17.1	2.86	1	4.11
Isobutane	17.7	4.16	1	6.30
Butane	17.8	4.33	1	6.54
Renewable Diesel (R100)	20.2	5.80	1	10.21
Fuels Measured in Standard Cubic Feet	**kg C / MMBtu**	**Btu / Standard cubic foot**		**kg CO2 / Standard cubic foot**
Compressed Natural Gas (CNG)	14.5	1,027	1	0.05444
Propane (Gas)	16.8	2,516	1	0.15
Renewable Diesel (R100)	14.5	1,027	1	0

Source: 2018 Climate Registry Default Emission Factors, Table 13.1
https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.p

Table A-52. US Default CH4 and N2O Emission Factors for Non-Highway Vehicles

Vehicle Type / Fuel Type	CH4 (g / gallon)	N2O (g / gallon)
Ships and Boats		
Residual Fuel Oil	0.11	0.60
Diesel Fuel	0.06	0.45
Gasoline	0.64	0.22
Locomotives		
Diesel Fuel	0.80	0.26
Agricultural Equipment		
Gasoline	1.26	0.22
Diesel Fuel	1.44	0.26
Construction/Mining Equipment		
Gasoline	0.50	0.22
Diesel Fuel	0.58	0.26
Other Non-Highway		
Snowmobiles (Gasoline)	0.50	0.22
Other Recreational (Gasoline)	0.50	0.22
Other Small Utility (Gasoline)	0.50	0.22
Other Large Utility (Gasoline)	0.50	0.22
Other Large Utility (Diesel)	0.58	0.26
Aircraft		
Jet Fuel	0.00	0.31
Aviation Gasoline	7.05	0.11

Source: 2018 Climate Registry Default Emission Factors, Table 13.7
https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.p

Lower San Felipe Intake Alternative - Pipeline Option
Dredge Emissions

Start Year 2021

Table A-53. Auxiliary Engine Emission Factors

Type	Size (hp)	Fuel Consumption		Emission Factor (kg/hr)		
		(lb/hr)	(gal/hr)	CO2	CH4	N2O
Compressor	353	143	20	203.73	0.0012	0.0090
Crane	377	153	21	217.58	0.0013	0.0096
Deck door engine	86	35	5	49.63	0.0003	0.0022
Generator	464	188	26	267.79	0.0016	0.0118
Hoist swing winch	379	154	21	218.74	0.0013	0.0096
Other	390	158	22	225.08	0.0013	0.0099
Pump	518	210	29	298.96	0.0018	0.0132

Table A-54. Annual Emissions

Type	Quantity	Hours/ Day	Total Emissions (metric tons per project)				Annual Emissions - 2021 (tons per year)				Annual Emissions - 2022 (tons per year)			
			CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e
Compressor	12	8	19.56	0.00	0.00	19.82	17.93	0.00	0.00	18.17	1.63	0.00	0.00	1.65
Crane	12	8	20.89	0.00	0.00	21.17	19.15	0.00	0.00	19.40	1.74	0.00	0.00	1.76
Deck door engine	12	8	4.76	0.00	0.00	4.83	4.37	0.00	0.00	4.43	0.40	0.00	0.00	0.40
Generator	12	8	25.71	0.00	0.00	26.05	23.57	0.00	0.00	23.88	2.14	0.00	0.00	2.17
Hoist swing winch	12	8	21.00	0.00	0.00	21.28	19.25	0.00	0.00	19.50	1.75	0.00	0.00	1.77
Other	12	8	21.61	0.00	0.00	21.90	19.81	0.00	0.00	20.07	1.80	0.00	0.00	1.82
Pump	12	8	28.70	0.00	0.00	29.08	26.31	0.00	0.00	26.66	2.39	0.00	0.00	2.42
Total			142.23	0.00	0.01	144.11	**130.37**	**0.00**	**0.01**	**132.10**	**11.85**	**0.00**	**0.00**	**12.01**
		GWP	1	25	298									

Conversions

453.6 grams per pound
1,000 kilograms per metric ton
1,000 grams per kilogram

Dredge Trips

1 dredge (1 trip per day)
12 trips per project

BSFC = 184 g/hp-hr (http://www.arb.ca.gov/regact/2007/chc07/appb.pdf)

Density

0.86 g/mL
7.18 lb/gal

Lower San Felipe Intake Alternative - Pipeline Option

Table A-55. Sample Auxiliary Engine Data

VES	MY	Engine_tier	hp	AnnualHrs	SulfurContent
Generator	2001	1	95	890	15
Pump	2001	1	156	991	15
Pump	2001	1	156	1077	15
Pump	2001	1	255	1420	15
Pump	2001	1	255	726	15
Pump	2001	1	371	350	15
Pump	2001	1	371	412	15
Pump	2001	1	371	444	15
Pump	2001	1	371	408	15
Generator	2001	1	95	205	15
Pump	2001	1	156	1276	15
Pump	2001	1	156	571	15
Pump	2001	1	255	851	15
Pump	2001	1	255	932	15
Pump	2001	1	371	510	15
Pump	2001	1	371	79	15
Pump	2001	1	371	87	15
Pump	2001	1	371	546	15
Generator	2001	1	95	1853	15
Pump	2001	1	156	1511	15
Pump	2001	1	156	953	15
Pump	2001	1	255	111	15
Pump	2001	1	255	1362	15
Pump	2001	1	371	583	15
Pump	2001	1	371	213	15
Pump	2001	1	371	207	15
Pump	2001	1	371	764	15
Generator	2001	1	95	273	15
Pump	2001	1	156	1330	15
Pump	2001	1	156	637	15
Pump	2001	1	255	994	15
Pump	2001	1	255	1220	15
Pump	2001	1	371	589	15
Pump	2001	1	371	148	15
Pump	2001	1	371	159	15
Pump	2001	1	371	751	15
Generator	2004	1	95	220	15
Pump	2004	1	1900	1500	15
Pump	2004	1	1900	1500	15
Generator	2006	2	95	250	15
Pump	2006	1	1900	1500	15
Pump	2006	1	1900	1500	15
Generator	2008	3	95	1	15
Pump	2008	2	1900	1	15
Pump	2008	2	1900	1	15
Generator	1976	0	46	1	15
Pump	1976	0	160	1	15
Pump	1976	0	200	1	15
Pump	1976	0	200	1	15
Pump	1976	0	200	1	15
Pump	1990	0	160	1	15
Pump	1990	0	160	1	15
Pump	1990	0	160	1	15

Lower San Felipe Intake Alternative - Pipeline Option

Table A-55. Sample Auxiliary Engine Data

VES	MY	Engine_tier	hp	AnnualHrs	SulfurContent
Pump	1990	0	160	1	15
Pump	1990	0	160	1	15
Pump	1990	0	160	1	15
Generator	1999	1	202	1	15
Compressor	1997	1	80	91	15
Crane	1978	0	287	290	15
Other	1996	0	90	670	15
Hoist swing winch	1960	0	120	8	15
Hoist swing winch	1988	0	185	12	15
Compressor	1969	0	250	17	15
Crane	1966	0	185	450	15
Hoist swing winch	1960	0	45	30	15
Hoist swing winch	1988	0	110	24	15
Hoist swing winch	1974	0	270	0	15
Hoist swing winch	1988	0	291	0	15
Hoist swing winch	1988	0	318	0	15
Compressor	2001	1	71	160	15
Crane	1945	0	316	59	15
Hoist swing winch	1988	0	185	6	15
Hoist swing winch	1969	0	194	5	15
Generator	1998	1	77	55	15
Crane	2005	2	445	1050	15
Hoist swing winch	1988	0	120	26	15
Hoist swing winch	1988	0	210	2	15
Compressor	2007	2	65	360	15
Pump	2008	3	665	800	15
Pump	2008	3	665	1210	15
Pump	2008	3	665	625	15
Pump	2008	3	665	520	15
Pump	2008	3	665	0	15
Pump	2008	3	665	0	15
Other	1999		126	620	15
Hoist swing winch	1988	0	160	90	15
Hoist swing winch	1978	0	100	528	15
Other	1999	1	65	637	15
Other	1999	1	350	445	15
Other	1999	1	350	445	15
Pump	2000	2	409	1497	15
Pump	2000	2	409	562	15
Other	1999	1	65	858	15
Other	1999	1	65	912	15
Other	2002	1	126	1536	15
Other	2002	2	440	193	15
Other	2002	2	440	180	15
Other	2001	1	1100	600	15
Dredger	2006	3	665	0	15
Dredger	2006	3	665	0	15
Dredger	2006	3	665	0	15
Dredger	2003	2	425	0	15
Dredger	2003	2	425	0	15
Dredger	2003	2	425	0	15
Dredger	2003	2	425	0	15
Other	1984	0	265	4284	15

Lower San Felipe Intake Alternative - Pipeline Option

Table A-55. Sample Auxiliary Engine Data

VES	MY	Engine_tier	hp	AnnualHrs	SulfurContent
Other	1984	0	304	257	15
Other	1984	0	375	600	15
Other	1983	0	1000	1390	15
Other	2007	3	765	183	15
Other	2006	3	300	5	15
Other	2007	3	700	183	15
Other	2006	3	540	183	15
Other	2006	3	300	5	15
Other	1999	1	210	150	15
Other	2001	1	2934	1300	15
Other	2003	2	106	1300	15
Other	2006	3	225	213	15
Other	2005	2	440	213	15
Other	2006	3	350	213	15
Other	2006	3	225	15	15
Other	1999	1	180	60	15
Other	1999	1	180	60	15
Hoist swing winch	2007	3	185	24	15
Deck door engine	1970	0	86	1400	15
Generator	1999	1	349	2209	15
Other	2002	2	425	1531	15
Hoist swing winch	1997	1	180	200	15
Pump	1997	0	60	200	15
Hoist swing winch	1997	1	228	200	15
Hoist swing winch	1997	1	180	200	15
Deck door engine	1970	0	86	1400	15
Other	2006	3	375	500	15
Hoist swing winch	1970	0	238	280	15
Generator	2000	1	49	100	15
Pump	2003	2	460	1325	15
Other	1998	1	400	1865	15
Generator	1991	0	685	1825	15
Pump	1966	0	1846	1410	15
Pump	1986	0	1325	0	15
Other	1991	0	390	0	15
Pump	2002	2	425	471	15
Pump	2002	2	425	354	15
Pump	2002	2	425	121	15
Pump	2002	2	425	55	15
Generator	2002	1	190	589	15
Generator	2002	1	190	1319	15
Pump	2002	2	500	388	15
Pump	2002	2	500	415	15
Generator	2002	1	166	589	15
Generator	2002	1	166	1319	15
Pump	2005	2	500	229	15
Pump	2005	2	500	247	15
Compressor	2005	2	500	180	15
Compressor	2005	2	500	169	15
Generator	2005	2	219	1618	15
Generator	2005	2	219	713	15
Pump	2006	3	425	606	15
Pump	2006	3	425	276	15

Lower San Felipe Intake Alternative - Pipeline Option

Table A-55. Sample Auxiliary Engine Data

VES	MY	Engine_tier	hp	AnnualHrs	SulfurContent
Pump	2006	3	425	654	15
Pump	2006	3	425	213	15
Generator	2005	2	219	1798	15
Generator	2005	2	219	628	15
Compressor	2006	3	425	391	15
Compressor	2006	3	425	483	15
Compressor	2003	2	425	346	15
Pump	2006	3	425	189	15
Pump	2006	3	425	195	15
Pump	2006	3	425	546	15
Pump	2006	3	425	535	15
Generator	2007	3	237	628	15
Generator	2007	3	237	1074	15
Compressor	2006	3	500	468	15
Compressor	2006	3	500	451	15
Compressor	2003	2	500	428	15
Pump	2003	2	500	1487	15
Pump	2003	2	500	1464	15
Generator	2004	2	219	1626	15
Generator	2004	2	219	734	15
Other	1997	1	225	520	15
Other	2000	1	210	0	15
Crane	1998	0	650	1	15
Generator	1985	0	38	0.25	15
Hoist swing winch	1999	1	120	0.25	15
Hoist swing winch	1985	0	365	0.25	15
Other	2004	2	72	6710	15
Other	2004	2	72	806	15
Other	2004	2	325	90	15
Other	2004	2	325	266	15
Other	2003	1	5	3500	15
Other	2003	1	15	250	15
Other	2003	1	15	250	15
Other	1983	0	325	468	15
Other	1983	0	325	468	15
Other	1993	0	160	1076	15
Other	1999	1	300	0	15
Other	1999	1	300	0	15
Other	1999	1	276.7857143	0	15
Other	1999	1	276.7857143	0	15
Other	1999	1	276.7857143	0	15
Other	2003	1	72	0	15
Other	2003	1	72	0	15
Other	2003	2	300	0	15
Other	2003	2	300	0	15
Other	1999	0	325	519	15
Other	1999	0	325	519	15
Other	1999	0	90	580	15
Other	2003	1	90	684	15
Other	2003	2	325	80	15
Other	2003	2	325	84	15
Other	1993	0	250	290	15
Other	1993	0	250	290	15

Lower San Felipe Intake Alternative - Pipeline Option

Table A-55. Sample Auxiliary Engine Data

VES	MY	Engine_tier	hp	AnnualHrs	SulfurContent
Other	1993	0	276.7857143	758	15
Other	1993	0	276.7857143	1778	15
Other	1993	0	250	375	15
Other	1992	0	250	504	15
Other	2001	2	325	265	15
Other	2001	2	325	265	15
Other	2006	2	40	280	15
Other	1975	0	210	135	15
Other	1975	0	120	135	15
Other	1975	0	96	322	15
Other	1975	0	120	322	15
Other	1984	0	211	191	15
Other	1984	0	211	191	15
Other	1984	0	211	406	15
Other	1984	0	211	406	15
Other	1980	0	260	103	15
Other	1980	0	260	103	15
Other	1971	0	120	69	15
Other	1971	0	96	69	15
Other	2008	3	225	83	15
Other	2008	3	225	83	15
Other	1975	0	120	200	15
Other	1975	0	120	90	15
Other	1975	0	120	50	15
Other	1975	0	120	50	15
Other	1975	0	96	550	15
Other	1975	0	210	550	15
Pump	2007	3	155	200	15
Pump	2007	3	280	580	15
Pump	2007	3	517.7849462	1300	15
Pump	2003	1	100	185	15
Pump	2003	1	100	190	15
Generator	1999	1	31	375	15
Pump	2007	3	173	130	15
Pump	2007	3	173	400	15
Generator	2006	2	55	500	15
Pump	2000	1	170	500	15
Pump	2000	1	170	500	15
Generator	2006	2	32	300	15
Other	1999	1	100	159	15
Hoist swing winch	1982	0	478	81.775	15
Generator	2002	2	440	748.0431034	15
Other	1999	1	500	771.1818182	15
Other	1999	1	500	771.1818182	15
Pump	1999	0	1500	560.954023	15
Pump	1999	0	1500	560.954023	15
Generator	1999	1	359	748.0431034	15
Generator	1995	0	230	748.0431034	15
Generator	1999	1	359	748.0431034	15
Pump	2001	1	2500	560.954023	15
Hoist swing winch	1980	0	400	81.775	15
Generator	2002	1	335	748.0431034	15
Generator	2002	2	425	748.0431034	15

Lower San Felipe Intake Alternative - Pipeline Option

Table A-55. Sample Auxiliary Engine Data

VES	MY	Engine_tier	hp	AnnualHrs	SulfurContent
Hoist swing winch	2002	2	440	81.775	15
Hoist swing winch	1997	1	290	81.775	15
Hoist swing winch	2004	2	300	81.775	15
Generator	2000	2	550	748.0431034	15
Hoist swing winch	2000	1	211	81.775	15
Generator	1998	0	2600	748.0431034	15
Generator	1998	0	2600	748.0431034	15
Generator	1998	0	2600	748.0431034	15
Generator	1998	1	550	748.0431034	15
Generator	1998	0	2600	748.0431034	15
Generator	1989	1	500	748.0431034	15
Generator	1974	0	245	748.0431034	15
Hoist swing winch	1974	0	243	81.775	15
Hoist swing winch	2000	1	1650	81.775	15
Other	2007	3	174	771.1818182	15
Hoist swing winch	1976	0	182	81.775	15
Hoist swing winch	1969	0	180	81.775	15
Hoist swing winch	1974	0	400	81.775	15
Generator	2007	3	197	748.0431034	15
Generator	1994	0	500	748.0431034	15
Hoist swing winch	2008	3	300	81.775	15
Generator	2000	1	205	748.0431034	15
Hoist swing winch	1997	1	250	81.775	15
Hoist swing winch	1997	1	250	81.775	15
Generator	2005	1	2686	748.0431034	15
Hoist swing winch	2007	3	202	81.775	15
Generator	2004	2	425	748.0431034	15
Generator	2008	3	235	748.0431034	15
Generator	2002	2	440	748.0431034	15
Generator	1979	0	180	748.0431034	15
Generator	1982	0	425	748.0431034	15
Hoist swing winch	1999	1	599	81.775	15
Hoist swing winch	1999	1	599	81.775	15
Generator	2000	2	550	748.0431034	15
Hoist swing winch	2000	1	2935	81.775	15
Hoist swing winch	2000	1	250	81.775	15
Generator	2002	2	440	748.0431034	15
Hoist swing winch	2007	3	173	81.775	15
Hoist swing winch	2007	3	173	81.775	15
Hoist swing winch	2003	2	425	81.775	15
Generator	2008	3	80	748.0431034	15
Hoist swing winch	1956	0	300	81.775	15
Hoist swing winch	2000	1	860	81.775	15
Generator	2000	1	635	748.0431034	15
Generator	2002	1	112	748.0431034	15
Generator	2004	2	275	748.0431034	15
Hoist swing winch	1982	0	239	81.775	15
Hoist swing winch	1982	0	239	81.775	15
Generator	2005	2	500	748.0431034	15
Hoist swing winch	1989	0	1200	81.775	15
Hoist swing winch	2000	1	250	81.775	15
Generator	1995	0	350	748.0431034	15
Generator	2007	2	2206	748.0431034	15

Lower San Felipe Intake Alternative - Pipeline Option

Table A-55. Sample Auxiliary Engine Data

VES	MY	Engine_tier	hp	AnnualHrs	SulfurContent
Generator	2008	3	384	748.0431034	15
Pump	2008	3	630	560.954023	15
Pump	2007	3	630	560.954023	15
Generator	1974	0	180	748.0431034	15
Hoist swing winch	1954	0	400	81.775	15
Hoist swing winch	1970	0	400	81.775	15
Hoist swing winch	1980	0	475	81.775	15
Generator	1963	0	700	748.0431034	15
Other	1982	0	235	1200	15
Other	1982	0	280	1200	15
Other	1982	0	280	1200	15
Other	2006	3	425	1200	15
Other	2006	3	425	1200	15
Other	2006	2	157	1400	15
Other	2006	2	157	1400	15
Other	2006	2	157	1400	15
Other	2006	2	54	360	15
Other	1999	1	49	360	15
Other	1999	1	50	175	15
Other	1999	1	82	162	15
Other	1999	1	300	771.1818182	15
Other	1999	1	300	771.1818182	15
Other	2004	2	276.7857143	771.1818182	15
Other	2000	1	56	771.1818182	15
Other	2001	1	75	771.1818182	15
Other	1999	1	160	771.1818182	15
Other	1999	1	230	771.1818182	15
Other	1999	1	160	771.1818182	15
Other	1999	1	85	771.1818182	15
Other	1999	1	85	771.1818182	15
Pump	1982	0	565	560.954023	15
Pump	1982	0	565	560.954023	15
Other	1982	0	565	771.1818182	15
Other	1982	0	565	771.1818182	15
Other	2007	2	1476	771.1818182	15
Other	2007	2	1476	771.1818182	15
Other	2007	2	1476	771.1818182	15
Other	1999	0	1175	771.1818182	15
Generator	1998	1	400	748.0431034	15
Other	1999	1	400	771.1818182	15
Other	1999	1	280	771.1818182	15
Other	1999	1	460	771.1818182	15
Other	1999	1	460	771.1818182	15
Other	1999	1	180	771.1818182	15
Other	1999	1	565	771.1818182	15
Other	1999	1	565	771.1818182	15
Other	1999	1	565	771.1818182	15
Other	1999	1	565	771.1818182	15
Other	1994	0	89	771.1818182	15
Other	2005	2	90	771.1818182	15
Other	1999	1	245	771.1818182	15
Other	1999	1	385	771.1818182	15
Other	1999	1	385	771.1818182	15

Lower San Felipe Intake Alternative - Pipeline Option

Table A-55. Sample Auxiliary Engine Data

VES	MY	Engine_tier	hp	AnnualHrs	SulfurContent
Other	1999	1	99	771.1818182	15
Hoist swing winch	1988	0	800	81.775	15
Generator	1998	1	147	748.0431034	15
Other	1999	1	380	771.1818182	15
Generator	1998	1	390	748.0431034	15
Hoist swing winch	1988	0	240	81.775	15
Hoist swing winch	1988	0	240	81.775	15
Generator	1998	1	390	748.0431034	15
Other	1999	1	540	771.1818182	15
Other	1999	0	2600	771.1818182	15
Other	1999	0	2600	771.1818182	15
Other	1999	0	2600	771.1818182	15
Other	1999	0	2600	771.1818182	15
Generator	1998	1	550	748.0431034	15
Hoist swing winch	1988	0	379.4	81.775	15
Generator	1998	1	464.3472222	748.0431034	15
Hoist swing winch	1988	0	490	81.775	15
Generator	1998	1	464.3472222	748.0431034	15
Generator	1998	1	249	748.0431034	15
Other	1999	0	930	771.1818182	15
Other	1999	0	930	771.1818182	15
Generator	1998	1	240	748.0431034	15
Generator	1998	1	240	748.0431034	15
Other	1999	1	520	771.1818182	15
Other	1999	1	315	771.1818182	15

Source: CARB. California Barge and Dredge Emissions Inventory Database (Access Database). "View Sample Auxiliary Engine Data" input data table. Accessed on: July 27, 2016. Available at: http://www.arb.ca.gov/msei/categories.htm#offroad_motor_vehicles.

Table A-56. Average Engine Data

Type	Average HP	Average Hours	Percentage
Compressor	353	295	7%
Crane	377	370	9%
Deck door engine	86	1400	34%
Dredger	528	0	0%
Generator	464	748	18%
Hoist swing winch	379	82	2%
Other	390	635	16%
Pump	518	561	14%

San Luis Low Point Improvement Project
GHG Emission Factors

Table A-57. US Default CO2 Emission Factors for Transport Fuels

Fuel Type	Carbon Content (Per Unit Energy)	Heat Content	Fraction Oxidized	CO2 Emission Factor (Per Unit Volume)
Fuels Measured in Gallons	**kg C / MMBtu**	**MMBtu / barrel**		**kg CO2 / gallon**
Gasoline	19.2	5.25	1	8.78
Diesel Fuel	20.2	5.80	1	10.21
Aviation Gasoline	18.9	5.04	1	8.31
Jet Fuel (Jet A or A-1)	19.7	5.67	1	9.75
Kerosene	20.5	5.67	1	10.15
Residual Fuel Oil No. 5	19.9	5.88	1	10.21
Residual Fuel Oil No. 6	20.5	6.30	1	11.27
Crude Oil	20.3	5.80	1	10.29
Biodiesel (B100)	20.1	5.38	1	9.45
Ethanol (E100)	18.7	3.53	1	5.75
Methanol	NA	NA	1	4.10
Liquefied Natural Gas (LNG)	NA	NA	1	4.46
Liquefied Petroleum Gas (LPG)	17.2	3.86	1	5.68
Propane (Liquid)	16.8	3.82	1	5.72
Ethane	17.1	2.86	1	4.11
Isobutane	17.7	4.16	1	6.30
Butane	17.8	4.33	1	6.54
Renewable Diesel (R100)	20.2	5.80	1	10.21
Fuels Measured in Standard Cubic Feet	**kg C / MMBtu**	**Btu / Standard cubic foot**		**kg CO2 / Standard cubic foot**
Compressed Natural Gas (CNG)	14.5	1,027	1	0.05444
Propane (Gas)	16.8	2,516	1	0.15
Renewable Diesel (R100)	14.5	1,027	1	0

Source: 2018 Climate Registry Default Emission Factors, Table 13.1
https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pd

Table A-58. US Default CH4 and N2O Emission Factors for Non-Highway Vehicles

Vehicle Type / Fuel Type	CH4 (g / gallon)	N2O (g / gallon)
Ships and Boats		
Residual Fuel Oil	0.11	0.60
Diesel Fuel	0.06	0.45
Gasoline	0.64	0.22
Locomotives		
Diesel Fuel	0.80	0.26
Agricultural Equipment		
Gasoline	1.26	0.22
Diesel Fuel	1.44	0.26
Construction/Mining Equipment		
Gasoline	0.50	0.22
Diesel Fuel	0.58	0.26
Other Non-Highway		
Snowmobiles (Gasoline)	0.50	0.22
Other Recreational (Gasoline)	0.50	0.22
Other Small Utility (Gasoline)	0.50	0.22
Other Large Utility (Gasoline)	0.50	0.22
Other Large Utility (Diesel)	0.58	0.26
Aircraft		
Jet Fuel	0.00	0.31
Aviation Gasoline	7.05	0.11

Source: 2018 Climate Registry Default Emission Factors, Table 13.7
https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pd

CVP Reservoir Expansion Alternative

Table A-59. Onsite Construction Equipment Emission Factors

Equipment	Quantity	OFFROAD Description	HP	2020			2021			2022			2023		
				CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O
Excavators	3	ConstMin - Excavators	158	201.97	0.0183	0.0051	201.92	0.0171	0.0051	201.81	0.0160	0.0051	201.83	0.0151	0.0051
Bulldozers	4	ConstMin - Rubber Tired Dozers	249	206.92	0.0280	0.0053	208.04	0.0266	0.0053	209.35	0.0253	0.0053	208.78	0.0241	0.0053
Cranes/Lifts	5	ConstMin - Cranes	231	152.24	0.0138	0.0039	152.26	0.0131	0.0039	152.20	0.0124	0.0039	152.22	0.0118	0.0039
Compactors	5	ConstMin - Rollers	80	198.40	0.0280	0.0050	198.50	0.0257	0.0050	198.31	0.0237	0.0050	198.40	0.0219	0.0050
Graders	2	ConstMin - Graders	188	215.08	0.0181	0.0055	214.84	0.0172	0.0055	215.45	0.0163	0.0055	216.38	0.0155	0.0055
Scrapers	2	ConstMin - Scrapers	367	255.60	0.0254	0.0065	255.63	0.0241	0.0065	255.66	0.0230	0.0065	255.86	0.0220	0.0065
Loaders (small)	2	ConstMin - Rubber Tired Loaders	188	190.37	0.0158	0.0049	190.31	0.0149	0.0049	190.37	0.0142	0.0049	190.43	0.0135	0.0049
Loaders (large)	3	ConstMin - Rubber Tired Loaders	541	191.82	0.0153	0.0048	191.38	0.0145	0.0048	191.18	0.0138	0.0048	191.19	0.0132	0.0048
Dump trucks	13	ConstMin - Off-Highway Trucks	403	202.12	0.0160	0.0051	202.37	0.0152	0.0051	202.31	0.0145	0.0051	202.43	0.0138	0.0051
Water Trucks	5		N/A	768.14	0.0051	0.0048	748.66	0.0051	0.0048	728.39	0.0051	0.0048	707.34	0.0051	0.0048

Table A-60. Onsite Construction Equipment Emissions by Pollutant

Equipment	Quantity	OFFROAD Description	HP	2020			2021			2022			2023		
				CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O
Excavators	3	ConstMin - Excavators	158	698.84	0.06	0.02	698.67	0.06	0.02	698.31	0.06	0.02	698.38	0.05	0.02
Bulldozers	4	ConstMin - Rubber Tired Dozers	249	1,504.45	0.20	0.04	1,512.65	0.19	0.04	1,522.13	0.18	0.04	1,518.01	0.18	0.04
Cranes/Lifts	5	ConstMin - Cranes	231	1,283.64	0.12	0.03	1,283.81	0.11	0.03	1,283.28	0.10	0.03	1,283.45	0.10	0.03
Compactors	5	ConstMin - Rollers	80	579.33	0.08	0.01	579.62	0.08	0.01	579.07	0.07	0.01	579.32	0.06	0.01
Graders	2	ConstMin - Graders	188	590.34	0.05	0.02	589.68	0.05	0.02	591.38	0.04	0.02	593.91	0.04	0.02
Scrapers	2	ConstMin - Scrapers	367	1,369.53	0.14	0.03	1,369.72	0.13	0.03	1,369.85	0.12	0.03	1,370.93	0.12	0.03
Loaders (small)	2	ConstMin - Rubber Tired Loaders	188	522.53	0.04	0.01	522.37	0.04	0.01	522.54	0.04	0.01	522.71	0.04	0.01
Loaders (large)	3	ConstMin - Rubber Tired Loaders	541	2,272.65	0.18	0.06	2,267.43	0.17	0.06	2,265.04	0.16	0.06	2,265.25	0.16	0.06
Dump trucks	13	ConstMin - Off-Highway Trucks	403	7,730.06	0.61	0.20	7,739.51	0.58	0.20	7,737.28	0.55	0.20	7,741.75	0.53	0.20
Water Trucks	5		N/A	420.56	0.00	0.00	409.89	0.00	0.00	398.79	0.00	0.00	387.27	0.00	0.00
			Total	**16,971.93**	**1.49**	**0.42**	**16,973.36**	**1.41**	**0.42**	**16,967.67**	**1.34**	**0.42**	**16,960.98**	**1.28**	**0.42**

Table A-61. Summary of Onsite Construction Equipment Emissions

Equipment	Quantity	OFFROAD Description	HP	Annual Emissions (MTCO2e per year)										Project Total	
				2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	No Shear Key	Shear Key
Excavators	3	ConstMin - Excavators	158	706	705	705	705	705	705	704	704	704	704	5,639	7,048
Bulldozers	4	ConstMin - Rubber Tired Dozers	249	1,521	1,529	1,538	1,534	1,534	1,533	1,533	1,531	1,531	1,530	12,253	15,313
Cranes/Lifts	5	ConstMin - Cranes	231	1,296	1,296	1,296	1,296	1,295	1,294	1,294	1,294	1,294	1,294	10,362	12,950
Compactors	5	ConstMin - Rollers	80	586	586	585	585	585	585	585	585	585	585	4,681	5,850
Graders	2	ConstMin - Graders	188	596	595	597	599	599	598	598	599	599	598	4,782	5,980
Scrapers	2	ConstMin - Scrapers	367	1,383	1,383	1,383	1,384	1,383	1,383	1,382	1,380	1,380	1,380	11,062	13,822
Loaders (small)	2	ConstMin - Rubber Tired Loaders	188	528	527	527	528	528	528	528	528	528	528	4,222	5,278
Loaders (large)	3	ConstMin - Rubber Tired Loaders	541	2,294	2,289	2,286	2,286	2,283	2,287	2,285	2,286	2,283	2,279	18,297	22,859
Dump trucks	13	ConstMin - Off-Highway Trucks	403	7,804	7,813	7,810	7,814	7,797	7,810	7,816	7,813	7,814	7,815	62,475	78,104
Water Trucks	5		N/A	421	411	400	388	376	364	354	344	336	328	3,059	3,722
			Total	**17,135**	**17,135**	**17,127**	**17,119**	**17,085**	**17,087**	**17,079**	**17,064**	**17,054**	**17,042**	**136,832**	**170,927**

Notes:
No Shear Key option assumes that construction will occur from 2020 to 2027 (8 years).
Shear Key option assumes that construction will occur from 2020 to 2029 (10 years).

Operating Schedule
8 years without shear key
10 years with shear key
20 hours per day
365 days per year

Global Warming Potential
CO2 1
CH4 25
N2O 298

Conversions
1,000,000 grams per metric ton

Speed Limit
15 miles per hour

CVP Reservoir Expansion Alternative

Table A-59. Onsite Construction Equipment Emission Factors

Equipment	Quantity	OFFROAD Description	Emission Factors (g/hp-hr or g/mi)															
			2024			2025			2026			2027			2028			2029	
			CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O
Excavators	3	ConstMin - Excavators	201.72	0.0142	0.0051	201.74	0.0135	0.0051	201.69	0.0128	0.0051	201.75	0.0123	0.0051	201.78	0.0118	0.0051	201.78	0.0114	0.0051
Bulldozers	4	ConstMin - Rubber Tired Dozers	208.79	0.0230	0.0053	208.70	0.0219	0.0053	208.71	0.0209	0.0053	208.44	0.0201	0.0053	208.45	0.0193	0.0053	208.43	0.0185	0.0053
Cranes/Lifts	5	ConstMin - Cranes	152.20	0.0112	0.0039	152.11	0.0107	0.0039	152.08	0.0102	0.0039	152.08	0.0098	0.0039	152.12	0.0094	0.0039	152.11	0.0090	0.0039
Compactors	5	ConstMin - Rollers	198.34	0.0203	0.0050	198.24	0.0191	0.0050	198.23	0.0180	0.0050	198.27	0.0172	0.0050	198.32	0.0164	0.0051	198.33	0.0157	0.0051
Graders	2	ConstMin - Graders	216.24	0.0148	0.0055	216.01	0.0142	0.0055	215.99	0.0136	0.0055	216.23	0.0131	0.0055	216.15	0.0127	0.0055	216.06	0.0123	0.0055
Scrapers	2	ConstMin - Scrapers	255.68	0.0210	0.0065	255.59	0.0202	0.0065	255.46	0.0194	0.0065	255.24	0.0187	0.0065	255.21	0.0180	0.0065	255.10	0.0174	0.0065
Loaders (small)	2	ConstMin - Rubber Tired Loaders	190.63	0.0128	0.0049	190.55	0.0123	0.0049	190.58	0.0118	0.0049	190.69	0.0113	0.0049	190.71	0.0109	0.0049	190.66	0.0106	0.0049
Loaders (large)	3	ConstMin - Rubber Tired Loaders	190.92	0.0126	0.0048	191.26	0.0121	0.0049	191.16	0.0116	0.0049	191.23	0.0112	0.0049	190.99	0.0108	0.0049	190.69	0.0105	0.0049
Dump trucks	13	ConstMin - Off-Highway Trucks	202.01	0.0132	0.0051	202.36	0.0127	0.0051	202.52	0.0122	0.0051	202.45	0.0119	0.0051	202.49	0.0116	0.0051	202.52	0.0113	0.0052
Water Trucks	5		685.74	0.0051	0.0048	664.11	0.0051	0.0048	645.00	0.0051	0.0048	627.23	0.0051	0.0048	611.31	0.0051	0.0048	597.25	0.0051	0.0048

Table A-60. Onsite Construction Equipment Emissions by Po

Equipment	Quantity	OFFROAD Description	Emission Factors (g/hp-hr or g/mi)															
			2024			2025			2026			2027			2028			2029	
			CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O
Excavators	3	ConstMin - Excavators	697.98	0.05	0.02	698.06	0.05	0.02	697.88	0.04	0.02	698.09	0.04	0.02	698.18	0.04	0.02	698.18	0.04	0.02
Bulldozers	4	ConstMin - Rubber Tired Dozers	1,518.03	0.17	0.04	1,517.42	0.16	0.04	1,517.51	0.15	0.04	1,515.52	0.15	0.04	1,515.56	0.14	0.04	1,515.44	0.13	0.04
Cranes/Lifts	5	ConstMin - Cranes	1,283.29	0.09	0.03	1,282.49	0.09	0.03	1,282.28	0.09	0.03	1,282.28	0.08	0.03	1,282.58	0.08	0.03	1,282.54	0.08	0.03
Compactors	5	ConstMin - Rollers	579.15	0.06	0.01	578.87	0.06	0.01	578.84	0.05	0.01	578.96	0.05	0.01	579.09	0.05	0.01	579.12	0.05	0.01
Graders	2	ConstMin - Graders	593.53	0.04	0.02	592.89	0.04	0.02	592.85	0.04	0.02	593.50	0.04	0.02	593.30	0.03	0.02	593.04	0.03	0.02
Scrapers	2	ConstMin - Scrapers	1,369.98	0.11	0.03	1,369.53	0.11	0.03	1,368.82	0.10	0.03	1,367.61	0.10	0.03	1,367.45	0.10	0.03	1,366.85	0.09	0.03
Loaders (small)	2	ConstMin - Rubber Tired Loaders	523.24	0.04	0.01	523.01	0.03	0.01	523.11	0.03	0.01	523.41	0.03	0.01	523.47	0.03	0.01	523.31	0.03	0.01
Loaders (large)	3	ConstMin - Rubber Tired Loaders	2,261.97	0.15	0.06	2,266.01	0.14	0.06	2,264.82	0.14	0.06	2,265.61	0.13	0.06	2,262.82	0.13	0.06	2,259.24	0.12	0.06
Dump trucks	13	ConstMin - Off-Highway Trucks	7,725.82	0.51	0.20	7,739.20	0.49	0.20	7,745.28	0.47	0.20	7,742.72	0.45	0.20	7,744.08	0.44	0.20	7,745.37	0.43	0.20
Water Trucks	5		375.44	0.00	0.00	363.60	0.00	0.00	353.14	0.00	0.00	343.41	0.00	0.00	334.69	0.00	0.00	327.00	0.00	0.00
			16,928.43	**1.22**	**0.42**	**16,931.08**	**1.16**	**0.42**	**16,924.53**	**1.12**	**0.42**	**16,911.10**	**1.08**	**0.42**	**16,901.23**	**1.04**	**0.42**	**16,890.08**	**1.01**	**0.42**

Table A-61. Summary of Onsite Construction Equipment Emi

Equipment	Quantity	OFFROAD Description
Excavators	3	ConstMin - Excavators
Bulldozers	4	ConstMin - Rubber Tired Dozers
Cranes/Lifts	5	ConstMin - Cranes
Compactors	5	ConstMin - Rollers
Graders	2	ConstMin - Graders
Scrapers	2	ConstMin - Scrapers
Loaders (small)	2	ConstMin - Rubber Tired Loaders
Loaders (large)	3	ConstMin - Rubber Tired Loaders
Dump trucks	13	ConstMin - Off-Highway Trucks
Water Trucks	5	

Notes:
No Shear Key option assumes that construction will occur from 2020 to 2
Shear Key option assumes that construction will occur from 2020 to 202

Operating Schedule

8	years without shear key
10	years with shear key
20	hours per day
365	days per year

CVP Reservoir Expansion Alternative

Table A-62. Offsite Construction Emissions - Construction Worker Commuting

Year	Annual VMT	Emission Factors (g/mi)			Annual Emissions (metric tons per year)			
		CO2	CH4	N2O	CO2	CH4	N2O	CO2e
2020	6,336,400	308.94	0.18	0.08	1,958	1.16	0.48	2,131
2021	6,336,400	297.33	0.18	0.08	1,884	1.16	0.48	2,057
2022	6,336,400	285.97	0.18	0.08	1,812	1.16	0.48	1,985
2023	6,336,400	274.71	0.18	0.08	1,741	1.16	0.48	1,914
2024	6,336,400	263.78	0.18	0.08	1,671	1.16	0.48	1,844
2025	6,336,400	252.94	0.18	0.08	1,603	1.16	0.48	1,776
2026	6,336,400	243.76	0.18	0.08	1,545	1.16	0.48	1,718
2027	6,336,400	235.29	0.18	0.08	1,491	1.16	0.48	1,664
2028	6,336,400	227.85	0.18	0.08	1,444	1.16	0.48	1,617
2029	6,336,400	221.32	0.18	0.08	1,402	1.16	0.48	1,576

Table A-63. Offsite Construction Emissions - Haul Trucks

Year	Annual VMT	Emission Factors (g/mi)			Annual Emissions (metric tons per year)			
		CO2	CH4	N2O	CO2	CH4	N2O	CO2e
2020	7,008,000	1,628.32	0.01	0.00	11,411	0.04	0.03	11,422
2021	7,008,000	1,611.17	0.01	0.00	11,291	0.04	0.03	11,302
2022	7,008,000	1,593.35	0.01	0.00	11,166	0.04	0.03	11,177
2023	7,008,000	1,538.91	0.01	0.00	10,785	0.04	0.03	10,796
2024	7,008,000	1,532.08	0.01	0.00	10,737	0.04	0.03	10,748
2025	7,008,000	1,526.55	0.01	0.00	10,698	0.04	0.03	10,709
2026	7,008,000	1,521.41	0.01	0.00	10,662	0.04	0.03	10,673
2027	7,008,000	1,516.18	0.01	0.00	10,625	0.04	0.03	10,636
2028	7,008,000	1,511.65	0.01	0.00	10,594	0.04	0.03	10,605
2029	7,008,000	1,507.41	0.01	0.00	10,564	0.04	0.03	10,575

Note: CO2 emission factors estimated from EMFAC2014; CH4 and N2O emission factors estimated from The Climate Registry (2016 Default Emission Factors for Highway Vehicles)

One-way trip distance

Workers	40	miles per trip
Trucks	40	miles per trip

Global Warming Potential

CO2	1
CH4	25
N2O	298

Conversions

1,000,000 grams per metric ton

Maximum Daily Workers and Trucks

217 workers per day (130 day time workers and 87 night time workers)

240 trucks per day

Operating Schedule

365 days per year

On-Road Motor Vehicle Emission Factors

Table A-64. Unmitigated Emission Factors for Construction Worker Commutes

	grams per mile		
Year	CO2	CH4	N2O
2020	308.94	0.1838	0.0762
2021	297.33	0.1837	0.0761
2022	285.97	0.1837	0.0761
2023	274.71	0.1836	0.0761
2024	263.78	0.1836	0.0762
2025	252.94	0.1836	0.0762
2026	243.76	0.1836	0.0763
2027	235.29	0.1836	0.0763
2028	227.85	0.1836	0.0764
2029	221.32	0.1836	0.0764

Note:
Vehicle fleet mix includes gasoline, diesel, and electric automobiles (LDA) and light-duty trucks (LDT1 and LDT2).

Table A-65. Unmitigated Emission Factors for Haul and Delivery Trucks

	grams per mile		
Year	CO2	CH4	N2O
2020	1,628.32	0.0051	0.0048
2021	1,611.17	0.0051	0.0048
2022	1,593.35	0.0051	0.0048
2023	1,538.91	0.0051	0.0048
2024	1,532.08	0.0051	0.0048
2025	1,526.55	0.0051	0.0048
2026	1,521.41	0.0051	0.0048
2027	1,516.18	0.0051	0.0048
2028	1,511.65	0.0051	0.0048
2029	1,507.41	0.0051	0.0048

Table A-66. Unmitigated Emission Factors for On-Site Water Trucks (San Joaquin Valley Air Basin)

	CO2, grams per mile									
Speed	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
5	1,067.82	1,040.89	1,012.89	983.90	954.23	924.26	898.51	873.62	851.05	831.42
10	905.52	883.10	859.26	834.51	809.14	783.74	761.32	740.17	721.21	704.63
15	768.14	748.66	728.39	707.34	685.74	664.11	645.00	627.23	611.31	597.25
20	638.67	622.45	605.72	588.34	570.76	552.92	537.39	522.36	509.03	497.34
25	539.64	525.95	511.71	496.90	481.88	466.79	453.55	441.01	429.83	419.96
30	465.85	454.11	441.85	429.11	416.13	403.11	391.59	380.83	371.22	362.71
35	423.16	412.45	401.34	389.80	378.06	366.23	355.78	345.92	337.14	329.40
40	396.11	386.12	375.73	364.95	353.97	342.90	333.25	323.96	315.65	308.38
45	381.31	371.67	361.68	351.29	340.64	329.98	320.42	311.48	303.52	296.53
50	382.87	373.14	363.06	352.60	342.02	331.30	322.05	313.05	305.04	298.02
55	403.95	393.58	382.93	371.86	360.67	349.39	340.10	330.57	322.11	314.69
60	438.39	427.26	415.76	403.82	391.59	379.35	368.51	358.19	349.02	340.97
65	490.95	478.61	465.74	452.35	438.71	425.03	412.82	401.47	391.37	382.42
70	527.89	514.50	500.62	486.21	471.57	456.88	443.93	431.77	420.92	411.33
Aggregated	459.80	447.68	435.61	423.08	410.18	397.37	386.25	375.57	366.06	357.68

CH4 and N2O Emission Factors

Table A-67. San Joaquin Valley Air Basin On-Road Emission Factors

Year	Type	Fuel	VMT	CH4 (g/mi)	N2O (g/mi)
2020	LDA	GAS	51,905,504	0.1780	0.0647
		DSL	526,303	0.0006	0.0012
	LDT1	GAS	3,603,221	0.2024	0.1056
		DSL	4,007	0.0011	0.0017
	LDT2	GAS	18,124,513	0.2024	0.1056
		DSL	31,156	0.0011	0.0017
Weighted Average Emission Factor (2020), grams per mile				**0.1838**	**0.0762**
2021	LDA	GAS	53,113,271	0.1780	0.0647
		DSL	564,773	0.0006	0.0012
	LDT1	GAS	3,581,948	0.2024	0.1056
		DSL	3,767	0.0011	0.0017
	LDT2	GAS	18,596,624	0.2024	0.1056
		DSL	33,720	0.0011	0.0017
Weighted Average Emission Factor (2021), grams per mile				**0.1837**	**0.0761**
2022	LDA	GAS	54,099,432	0.1780	0.0647
		DSL	599,371	0.0006	0.0012
	LDT1	GAS	3,567,882	0.2024	0.1056
		DSL	3,563	0.0011	0.0017
	LDT2	GAS	19,045,161	0.2024	0.1056
		DSL	35,993	0.0011	0.0017
Weighted Average Emission Factor (2022), grams per mile				**0.1837**	**0.0761**
2023	LDA	GAS	55,046,389	0.1780	0.0647
		DSL	632,276	0.0006	0.0012
	LDT1	GAS	3,568,656	0.2024	0.1056
		DSL	3,380	0.0011	0.0017
	LDT2	GAS	19,525,102	0.2024	0.1056
		DSL	38,163	0.0011	0.0017
Weighted Average Emission Factor (2023), grams per mile				**0.1836**	**0.0761**
2024	LDA	GAS	55,886,650	0.1780	0.0647
		DSL	662,231	0.0006	0.0012
	LDT1	GAS	3,578,540	0.2024	0.1056
		DSL	3,217	0.0011	0.0017
	LDT2	GAS	20,004,793	0.2024	0.1056
		DSL	40,154	0.0011	0.0017
Weighted Average Emission Factor (2024), grams per mile				**0.1836**	**0.0762**
2025	LDA	GAS	56,636,618	0.1780	0.0647
		DSL	689,781	0.0006	0.0012
	LDT1	GAS	3,596,711	0.2024	0.1056
		DSL	3,033	0.0011	0.0017
	LDT2	GAS	20,482,570	0.2024	0.1056
		DSL	41,985	0.0011	0.0017
Weighted Average Emission Factor (2025), grams per mile				**0.1836**	**0.0762**
2026	LDA	GAS	57,234,421	0.1780	0.0647
		DSL	712,741	0.0006	0.0012
	LDT1	GAS	3,613,533	0.2024	0.1056
		DSL	2,869	0.0011	0.0017
	LDT2	GAS	20,899,655	0.2024	0.1056
		DSL	43,509	0.0011	0.0017
Weighted Average Emission Factor (2026), grams per mile				**0.1836**	**0.0763**

Table A-67. San Joaquin Valley Air Basin On-Road Emission Factors

Year	Type	Fuel	VMT	CH4 (g/mi)	N2O (g/mi)
2027	LDA	GAS	57,968,341	0.1780	0.0647
		DSL	735,400	0.0006	0.0012
	LDT1	GAS	3,644,805	0.2024	0.1056
		DSL	2,553	0.0011	0.0017
	LDT2	GAS	21,355,536	0.2024	0.1056
		DSL	44,981	0.0011	0.0017
Weighted Average Emission Factor (2027), grams per mile				**0.1836**	**0.0763**
2028	LDA	GAS	58,703,958	0.1780	0.0647
		DSL	756,268	0.0006	0.0012
	LDT1	GAS	3,682,046	0.2024	0.1056
		DSL	2,371	0.0011	0.0017
	LDT2	GAS	21,803,176	0.2024	0.1056
		DSL	46,345	0.0011	0.0017
Weighted Average Emission Factor (2028), grams per mile				**0.1836**	**0.0764**
2029	LDA	GAS	59,445,637	0.1780	0.0647
		DSL	775,919	0.0006	0.0012
	LDT1	GAS	3,723,593	0.2024	0.1056
		DSL	2,252	0.0011	0.0017
	LDT2	GAS	22,242,150	0.2024	0.1056
		DSL	47,604	0.0011	0.0017
Weighted Average Emission Factor (2029), grams per mile				**0.1836**	**0.0764**

Table A-68. Emission Factors for Highway Vehicles by Technology Type

Vehicle Type/ Control Technology	CH4 (g/mi)	N2O (g/mi)
Gasoline Passenger Cars		
EPA Tier 2	0.0173	0.0036
Low Emission Vehicles	0.0105	0.0150
EPA Tier 1	0.0271	0.0429
EPA Tier 0	0.0704	0.0647
Oxidation Catalyst	0.1355	0.0504
Non-Catalyst Control	0.1696	0.0197
Uncontrolled	0.1780	0.0197
Gasoline Light Trucks (Vans, Pickup Trucks, SUVs)		
EPA Tier 2	0.0163	0.0066
Low Emission Vehicles	0.0148	0.0157
EPA Tier 1	0.0452	0.0871
EPA Tier 0	0.0776	0.1056
Oxidation Catalyst	0.1516	0.0639
Non-Catalyst Control	0.1908	0.0218
Uncontrolled	0.2024	0.0220
Gasoline Medium and Heavy-Duty Vehicles (Trucks and Busses)		
EPA Tier 2	0.0333	0.0134
Low Emission Vehicles	0.0303	0.0320
EPA Tier 1	0.0655	0.1750
EPA Tier 0	0.2630	0.2135
Oxidation Catalyst	0.2356	0.1317
Non-Catalyst Control	0.4181	0.0473
Uncontrolled	0.4604	0.0497
Diesel Passenger Cars		
Advanced	0.0005	0.0010
Moderate	0.0005	0.0010
Uncontrolled	0.0006	0.0012

Table A-68. Emission Factors for Highway Vehicles by Technology Type

Vehicle Type/ Control Technology	CH4 (g/mi)	N2O (g/mi)
Diesel Light Trucks		
Advanced	0.0010	0.0015
Moderate	0.0009	0.0014
Uncontrolled	0.0011	0.0017
Diesel Medium and Heavy-Duty Vehicles (Trucks and Busses)		
Aftertreatment	0.0051	0.0048
Advanced	0.0051	0.0048
Moderate	0.0051	0.0048
Uncontrolled	0.0051	0.0048
Motorcycles		
Non-Catalyst Control	0.0672	0.0069
Uncontrolled	0.0899	0.0087

Source:
2018 Climate Registry Default Emissions Factors
Table 13.4 Default CH4 and N2O Emission Factors for Highway Vehicles by Technology Type
https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.

Table A-69. Off-Road Equipment N2O Emission Factors

Vehicle Class	HP Bin	N2O Emission Factor (g/hp-hr)									
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
ConstMin - Bore/Drill Rigs	25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ConstMin - Bore/Drill Rigs	50	0.0077	0.0077	0.0077	0.0077	0.0077	0.0077	0.0077	0.0077	0.0076	0.0076
ConstMin - Bore/Drill Rigs	75	0.0067	0.0067	0.0066	0.0066	0.0066	0.0064	0.0065	0.0067	0.0067	0.0067
ConstMin - Bore/Drill Rigs	100	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067
ConstMin - Bore/Drill Rigs	175	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068
ConstMin - Bore/Drill Rigs	300	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067
ConstMin - Bore/Drill Rigs	600	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067
ConstMin - Bore/Drill Rigs	750	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068
ConstMin - Bore/Drill Rigs	9999	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067
ConstMin - Cranes	25	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043
ConstMin - Cranes	50	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043
ConstMin - Cranes	75	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039
ConstMin - Cranes	100	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039
ConstMin - Cranes	175	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039
ConstMin - Cranes	300	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039
ConstMin - Cranes	600	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039
ConstMin - Cranes	750	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039
ConstMin - Cranes	9999	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039
ConstMin - Crawler Tractors	25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ConstMin - Crawler Tractors	50	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064
ConstMin - Crawler Tractors	75	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0059	0.0059	0.0059	0.0059
ConstMin - Crawler Tractors	100	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058
ConstMin - Crawler Tractors	175	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058
ConstMin - Crawler Tractors	300	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058
ConstMin - Crawler Tractors	600	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058
ConstMin - Crawler Tractors	750	0.0058	0.0058	0.0057	0.0057	0.0057	0.0057	0.0057	0.0058	0.0057	0.0058
ConstMin - Crawler Tractors	9999	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058
ConstMin - Excavators	25	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057
ConstMin - Excavators	50	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057
ConstMin - Excavators	75	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0052	0.0052	0.0052	0.0051
ConstMin - Excavators	100	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051
ConstMin - Excavators	175	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051
ConstMin - Excavators	300	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051
ConstMin - Excavators	600	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051
ConstMin - Excavators	750	0.0051	0.0052	0.0052	0.0052	0.0052	0.0052	0.0052	0.0052	0.0051	0.0052
ConstMin - Excavators	9999	0.0051	0.0051	0.0051	0.0051	0.0052	0.0052	0.0052	0.0052	0.0052	0.0051
ConstMin - Graders	25	0.0000	0.0061	0.0061	0.0061	0.0061	0.0061	0.0000	0.0061	0.0061	0.0061
ConstMin - Graders	50	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061
ConstMin - Graders	75	0.0055	0.0055	0.0056	0.0057	0.0057	0.0057	0.0059	0.0057	0.0057	0.0055
ConstMin - Graders	100	0.0054	0.0054	0.0054	0.0054	0.0055	0.0054	0.0055	0.0055	0.0055	0.0055
ConstMin - Graders	175	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
ConstMin - Graders	300	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
ConstMin - Graders	600	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0054	0.0054	0.0055
ConstMin - Graders	9999	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
ConstMin - Off-Highway Tractors	25	0.0000	0.0065	0.0000	0.0065	0.0065	0.0065	0.0000	0.0065	0.0065	0.0065
ConstMin - Off-Highway Tractors	50	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065
ConstMin - Off-Highway Tractors	75	0.0059	0.0059	0.0059	0.0059	0.0059	0.0058	0.0058	0.0058	0.0058	0.0058
ConstMin - Off-Highway Tractors	100	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059
ConstMin - Off-Highway Tractors	175	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059
ConstMin - Off-Highway Tractors	300	0.0058	0.0058	0.0058	0.0058	0.0059	0.0059	0.0059	0.0059	0.0059	0.0058
ConstMin - Off-Highway Tractors	600	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0059	0.0059	0.0059
ConstMin - Off-Highway Tractors	750	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0058	0.0059
ConstMin - Off-Highway Tractors	9999	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059
ConstMin - Off-Highway Trucks	25	0.0057	0.0057	0.0057	0.0000	0.0057	0.0000	0.0057	0.0000	0.0057	0.0057
ConstMin - Off-Highway Trucks	50	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057	0.0057
ConstMin - Off-Highway Trucks	75	0.0051	0.0051	0.0051	0.0052	0.0052	0.0051	0.0052	0.0052	0.0052	0.0052

Table A-69. Off-Road Equipment N2O Emission Factors

Vehicle Class	HP Bin	N2O Emission Factor (g/hp-hr)									
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
ConstMin - Off-Highway Trucks	100	0.0051	0.0051	0.0051	0.0051	0.0051	0.0052	0.0051	0.0051	0.0051	0.0051
ConstMin - Off-Highway Trucks	175	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051
ConstMin - Off-Highway Trucks	300	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051
ConstMin - Off-Highway Trucks	600	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0052
ConstMin - Off-Highway Trucks	750	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051
ConstMin - Off-Highway Trucks	9999	0.0052	0.0051	0.0052	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051
ConstMin - Other Construction Equipment	25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ConstMin - Other Construction Equipment	50	0.0062	0.0062	0.0062	0.0062	0.0062	0.0063	0.0062	0.0062	0.0062	0.0062
ConstMin - Other Construction Equipment	75	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0056	0.0056
ConstMin - Other Construction Equipment	100	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056
ConstMin - Other Construction Equipment	175	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056
ConstMin - Other Construction Equipment	300	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056
ConstMin - Other Construction Equipment	600	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056
ConstMin - Other Construction Equipment	750	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056
ConstMin - Other Construction Equipment	9999	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056
ConstMin - Pavers	25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ConstMin - Pavers	50	0.0062	0.0062	0.0062	0.0062	0.0062	0.0062	0.0062	0.0062	0.0062	0.0062
ConstMin - Pavers	75	0.0056	0.0056	0.0055	0.0055	0.0055	0.0056	0.0056	0.0056	0.0056	0.0056
ConstMin - Pavers	100	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056
ConstMin - Pavers	175	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056
ConstMin - Pavers	300	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056
ConstMin - Pavers	600	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056
ConstMin - Pavers	750	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0000
ConstMin - Pavers	9999	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0056
ConstMin - Paving Equipment	25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0053	0.0053	0.0053	0.0053
ConstMin - Paving Equipment	50	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
ConstMin - Paving Equipment	75	0.0048	0.0048	0.0048	0.0048	0.0048	0.0047	0.0048	0.0048	0.0048	0.0048
ConstMin - Paving Equipment	100	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048
ConstMin - Paving Equipment	175	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048
ConstMin - Paving Equipment	300	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048
ConstMin - Paving Equipment	600	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048
ConstMin - Paving Equipment	750	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048
ConstMin - Paving Equipment	9999	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048
ConstMin - Rollers	25	0.0056	0.0056	0.0000	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056
ConstMin - Rollers	50	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056
ConstMin - Rollers	75	0.0051	0.0051	0.0051	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
ConstMin - Rollers	100	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0051	0.0051
ConstMin - Rollers	175	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
ConstMin - Rollers	300	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
ConstMin - Rollers	600	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051
ConstMin - Rough Terrain Forklifts	25	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060
ConstMin - Rough Terrain Forklifts	50	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060
ConstMin - Rough Terrain Forklifts	75	0.0058	0.0054	0.0054	0.0054	0.0058	0.0054	0.0054	0.0054	0.0054	0.0054
ConstMin - Rough Terrain Forklifts	100	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054
ConstMin - Rough Terrain Forklifts	175	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054
ConstMin - Rough Terrain Forklifts	300	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054
ConstMin - Rough Terrain Forklifts	600	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054
ConstMin - Rough Terrain Forklifts	750	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054
ConstMin - Rubber Tired Dozers	25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ConstMin - Rubber Tired Dozers	50	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059
ConstMin - Rubber Tired Dozers	75	0.0054	0.0054	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
ConstMin - Rubber Tired Dozers	100	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054
ConstMin - Rubber Tired Dozers	175	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
ConstMin - Rubber Tired Dozers	300	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
ConstMin - Rubber Tired Dozers	600	0.0053	0.0053	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054
ConstMin - Rubber Tired Dozers	750	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053

Table A-69. Off-Road Equipment N2O Emission Factors

Vehicle Class	HP Bin	N2O Emission Factor (g/hp-hr)									
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
ConstMin - Rubber Tired Loaders	25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0054	0.0054
ConstMin - Rubber Tired Loaders	50	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054
ConstMin - Rubber Tired Loaders	75	0.0000	0.0000	0.0000	0.0049	0.0048	0.0049	0.0049	0.0049	0.0049	0.0049
ConstMin - Rubber Tired Loaders	100	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048
ConstMin - Rubber Tired Loaders	175	0.0049	0.0049	0.0049	0.0049	0.0049	0.0048	0.0049	0.0049	0.0049	0.0049
ConstMin - Rubber Tired Loaders	300	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049
ConstMin - Rubber Tired Loaders	600	0.0048	0.0048	0.0048	0.0048	0.0048	0.0049	0.0049	0.0049	0.0049	0.0049
ConstMin - Rubber Tired Loaders	750	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	0.0049	0.0049	0.0048	0.0048
ConstMin - Rubber Tired Loaders	9999	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049
ConstMin - Scrapers	25	0.0072	0.0000	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
ConstMin - Scrapers	50	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071
ConstMin - Scrapers	75	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065
ConstMin - Scrapers	100	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065
ConstMin - Scrapers	175	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065
ConstMin - Scrapers	300	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065
ConstMin - Scrapers	600	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065
ConstMin - Scrapers	750	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065
ConstMin - Scrapers	9999	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065
ConstMin - Skid Steer Loaders	25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ConstMin - Skid Steer Loaders	50	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
ConstMin - Skid Steer Loaders	75	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
ConstMin - Skid Steer Loaders	100	0.0049	0.0049	0.0049	0.0050	0.0049	0.0050	0.0050	0.0050	0.0050	0.0049
ConstMin - Skid Steer Loaders	175	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0050	0.0050	0.0050	0.0050
ConstMin - Skid Steer Loaders	300	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
ConstMin - Skid Steer Loaders	600	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
ConstMin - Skid Steer Loaders	9999	0.0049	0.0050	0.0049	0.0050	0.0050	0.0049	0.0049	0.0050	0.0050	0.0049
ConstMin - Surfacing Equipment	25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0045	0.0045
ConstMin - Surfacing Equipment	50	0.0046	0.0046	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045	0.0045
ConstMin - Surfacing Equipment	75	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041
ConstMin - Surfacing Equipment	100	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041
ConstMin - Surfacing Equipment	175	0.0040	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0040	0.0040
ConstMin - Surfacing Equipment	300	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041
ConstMin - Surfacing Equipment	600	0.0041	0.0041	0.0041	0.0041	0.0041	0.0040	0.0041	0.0040	0.0041	0.0040
ConstMin - Surfacing Equipment	750	0.0041	0.0040	0.0041	0.0040	0.0041	0.0041	0.0040	0.0040	0.0040	0.0041
ConstMin - Surfacing Equipment	9999	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041
ConstMin - Sweepers/Scrubbers	25	0.0068	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0068
ConstMin - Sweepers/Scrubbers	50	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068
ConstMin - Sweepers/Scrubbers	75	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061
ConstMin - Sweepers/Scrubbers	100	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061
ConstMin - Sweepers/Scrubbers	175	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061
ConstMin - Sweepers/Scrubbers	300	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061
ConstMin - Sweepers/Scrubbers	600	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061
ConstMin - Sweepers/Scrubbers	9999	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061
ConstMin - Tractors/Loaders/Backhoes	25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ConstMin - Tractors/Loaders/Backhoes	50	0.0055	0.0055	0.0055	0.0055	0.0055	0.0054	0.0054	0.0054	0.0054	0.0054
ConstMin - Tractors/Loaders/Backhoes	75	0.0050	0.0049	0.0050	0.0050	0.0050	0.0049	0.0050	0.0050	0.0050	0.0050
ConstMin - Tractors/Loaders/Backhoes	100	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
ConstMin - Tractors/Loaders/Backhoes	175	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049
ConstMin - Tractors/Loaders/Backhoes	300	0.0049	0.0050	0.0049	0.0049	0.0049	0.0049	0.0050	0.0049	0.0049	0.0049
ConstMin - Tractors/Loaders/Backhoes	600	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0049	0.0050	0.0050	0.0050
ConstMin - Tractors/Loaders/Backhoes	750	0.0049	0.0049	0.0048	0.0049	0.0049	0.0047	0.0048	0.0049	0.0049	0.0049
ConstMin - Tractors/Loaders/Backhoes	9999	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
ConstMin - Trenchers	25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ConstMin - Trenchers	50	0.0075	0.0075	0.0075	0.0075	0.0075	0.0075	0.0075	0.0075	0.0075	0.0075
ConstMin - Trenchers	75	0.0068	0.0068	0.0068	0.0068	0.0068	0.0067	0.0067	0.0067	0.0067	0.0067
ConstMin - Trenchers	100	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068

Table A-69. Off-Road Equipment N2O Emission Factors

Vehicle Class	HP Bin	N2O Emission Factor (g/hp-hr)									
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
ConstMin - Trenchers	175	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067
ConstMin - Trenchers	300	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068
ConstMin - Trenchers	600	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068
ConstMin - Trenchers	750	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068
ConstMin - Trenchers	9999	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068
Industrial - Aerial Lifts	25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Industrial - Aerial Lifts	50	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046
Industrial - Aerial Lifts	75	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041
Industrial - Aerial Lifts	100	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041
Industrial - Aerial Lifts	175	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041
Industrial - Aerial Lifts	300	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041
Industrial - Aerial Lifts	600	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041
Industrial - Forklifts	25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Industrial - Forklifts	50	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030
Industrial - Forklifts	75	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027
Industrial - Forklifts	100	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027
Industrial - Forklifts	175	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027
Industrial - Forklifts	300	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027
Industrial - Forklifts	600	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027
Industrial - Forklifts	9999	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027
Industrial - Other General Industrial Equipment	25	0.0051	0.0051	0.0051	0.0000	0.0051	0.0051	0.0051	0.0051	0.0051	0.0000
Industrial - Other General Industrial Equipment	50	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051
Industrial - Other General Industrial Equipment	75	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046
Industrial - Other General Industrial Equipment	100	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046
Industrial - Other General Industrial Equipment	175	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046
Industrial - Other General Industrial Equipment	300	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046
Industrial - Other General Industrial Equipment	600	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046
Industrial - Other General Industrial Equipment	750	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046
Industrial - Other General Industrial Equipment	9999	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046	0.0046
Industrial - Other Material Handling Equipment	25	0.0059	0.0000	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059
Industrial - Other Material Handling Equipment	50	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059
Industrial - Other Material Handling Equipment	75	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Industrial - Other Material Handling Equipment	100	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Industrial - Other Material Handling Equipment	175	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Industrial - Other Material Handling Equipment	300	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Industrial - Other Material Handling Equipment	600	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Industrial - Other Material Handling Equipment	750	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Industrial - Other Material Handling Equipment	9999	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
OFF - ConstMin - Bore/Drill Rigs	25	0.0111	0.0111	0.0111	0.0110	0.0110	0.0110	0.0111	0.0111	0.0112	0.0111
OFF - ConstMin - Cement and Mortar Mixers	25	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083
OFF - ConstMin - Concrete/Industrial Saws	25	0.0106	0.0108	0.0108	0.0106	0.0103	0.0104	0.0103	0.0103	0.0107	0.0110
OFF - ConstMin - Concrete/Industrial Saws	50	0.0110	0.0110	0.0109	0.0110	0.0109	0.0109	0.0109	0.0110	0.0109	0.0109
OFF - ConstMin - Dumpers/Tenders	25	0.0054	0.0054	0.0054	0.0054	0.0054	0.0055	0.0055	0.0055	0.0056	0.0055
OFF - ConstMin - Excavators	25	0.0085	0.0085	0.0085	0.0085	0.0085	0.0085	0.0085	0.0085	0.0085	0.0085
OFF - ConstMin - Other Construction Equipment	25	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092
OFF - ConstMin - Pavers	25	0.0093	0.0093	0.0093	0.0093	0.0092	0.0092	0.0091	0.0091	0.0091	0.0091
OFF - ConstMin - Paving Equipment	25	0.0079	0.0079	0.0078	0.0078	0.0078	0.0078	0.0078	0.0078	0.0078	0.0079
OFF - ConstMin - Plate Compactors	25	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064	0.0064
OFF - ConstMin - Rollers	25	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083	0.0083
OFF - ConstMin - Rubber Tired Loaders	25	0.0080	0.0081	0.0081	0.0079	0.0079	0.0080	0.0080	0.0080	0.0080	0.0080
OFF - ConstMin - Signal Boards	25	0.0122	0.0122	0.0122	0.0122	0.0122	0.0122	0.0122	0.0122	0.0122	0.0122
OFF - ConstMin - Signal Boards	50	0.0119	0.0120	0.0122	0.0120	0.0121	0.0123	0.0122	0.0122	0.0123	0.0122
OFF - ConstMin - Skid Steer Loaders	25	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082
OFF - ConstMin - Tractors/Loaders/Backhoes	25	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082	0.0082
OFF - ConstMin - Trenchers	25	0.0111	0.0111	0.0111	0.0111	0.0111	0.0111	0.0111	0.0111	0.0111	0.0111
OFF - Industrial - Aerial Lifts	25	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068

Table A-69. Off-Road Equipment N2O Emission Factors

Vehicle Class	HP Bin	N2O Emission Factor (g/hp-hr)									
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
OFF - Industrial - Other General Industrial Equipment	25	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076	0.0076
OFF - Industrial - Sweepers/Scrubbers	25	0.0100	0.0100	0.0100	0.0101	0.0100	0.0100	0.0100	0.0100	0.0101	0.0101
OFF - Light Commercial - Air Compressors	25	0.0071	0.0072	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071	0.0071
OFF - Light Commercial - Air Compressors	50	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
OFF - Light Commercial - Generator Sets	25	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110
OFF - Light Commercial - Generator Sets	50	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110
OFF - Light Commercial - Pressure Washers	25	0.0036	0.0038	0.0038	0.0038	0.0038	0.0038	0.0038	0.0037	0.0038	0.0038
OFF - Light Commercial - Pressure Washers	50	0.0043	0.0043	0.0042	0.0041	0.0040	0.0040	0.0040	0.0041	0.0041	0.0042
OFF - Light Commercial - Pumps	25	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110
OFF - Light Commercial - Pumps	50	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110	0.0110
OFF - Light Commercial - Welders	25	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067
OFF - Light Commercial - Welders	50	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067	0.0067
Portable Equipment - Non-Rental Compressor	50	0.0044	0.0044	0.0045	0.0045	0.0046	0.0046	0.0047	0.0047	0.0048	0.0048
Portable Equipment - Non-Rental Compressor	75	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Compressor	100	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Compressor	175	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Compressor	300	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Compressor	600	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Compressor	750	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Compressor	9999	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Generator	50	0.0044	0.0044	0.0045	0.0045	0.0046	0.0046	0.0047	0.0047	0.0048	0.0048
Portable Equipment - Non-Rental Generator	75	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Generator	100	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Generator	175	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Generator	300	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Generator	600	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Generator	750	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Generator	9999	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Other Portable Equipment	50	0.0044	0.0044	0.0045	0.0045	0.0046	0.0046	0.0047	0.0047	0.0048	0.0048
Portable Equipment - Non-Rental Other Portable Equipment	75	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Other Portable Equipment	100	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Other Portable Equipment	175	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Other Portable Equipment	300	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Other Portable Equipment	600	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Other Portable Equipment	750	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Other Portable Equipment	9999	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Pump	50	0.0044	0.0044	0.0045	0.0045	0.0046	0.0046	0.0047	0.0047	0.0048	0.0048
Portable Equipment - Non-Rental Pump	75	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Pump	100	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Pump	175	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Pump	300	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Pump	600	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Pump	750	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Non-Rental Pump	9999	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Compressor	75	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Compressor	100	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Compressor	175	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Compressor	300	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Compressor	600	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Compressor	750	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Compressor	9999	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Generator	75	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Generator	100	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Generator	175	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Generator	300	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Generator	600	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043

Table A-69. Off-Road Equipment N2O Emission Factors

Vehicle Class	HP Bin	N2O Emission Factor (g/hp-hr)									
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Portable Equipment - Rental Generator	750	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Generator	9999	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Other Portable Equipment	50	0.0044	0.0044	0.0045	0.0045	0.0046	0.0046	0.0047	0.0047	0.0048	0.0048
Portable Equipment - Rental Other Portable Equipment	75	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Other Portable Equipment	100	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Other Portable Equipment	175	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Other Portable Equipment	300	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Other Portable Equipment	600	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Other Portable Equipment	750	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Other Portable Equipment	9999	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Pump	50	0.0044	0.0044	0.0045	0.0045	0.0046	0.0046	0.0047	0.0047	0.0048	0.0048
Portable Equipment - Rental Pump	75	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Pump	100	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Pump	175	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Pump	300	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Pump	600	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Pump	750	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043
Portable Equipment - Rental Pump	9999	0.0039	0.0040	0.0040	0.0041	0.0041	0.0042	0.0042	0.0042	0.0043	0.0043

N2O Emission Factor

0.26 grams per gallon

Source: The Climate Registry. 2018. Default Emission Factors. Table 13.7 U.S. Default Factors for Calculating CH4 and N2O Emissions from Non-Highway Vehicles, Construction/Mining Equipment, Diesel Fuel.

Note:
Calculated fuel consumption factor (gallons per horsepower-hour) calculated from OFFROAD2017 and multiplied by N2O emission factor to convert to grams per horsepower-hour.

Table A-70. Emission Factor Summary by Equipment

Equipment Description	OFFROAD2017 Equipment Category	Fuel	Hours per Project	Size (hp)	Quantity	Unit	Emission Factors - 2024 (g/hp-hr or g/hr)			Emission Factors - 2025 (g/hp-hr or g/hr)		
							CO2	CH4	N2O	CO2	CH4	N2O
Earthmoving Equipment												
110 Hsp Bulldozer (Cat D5)	ConstMin - Rubber Tired Dozers	Diesel	53	110	1	g/hp-hr	208.7387	0.0286	0.0000	208.7713	0.0272	0.0000
170 Hsp Bulldozer (Cat D6)	ConstMin - Rubber Tired Dozers	Diesel	71,036	170	2	g/hp-hr	208.7387	0.0286	0.0000	208.7713	0.0272	0.0000
305 Hsp Bulldozer (Cat D8)	ConstMin - Rubber Tired Dozers	Diesel	110,098	305	3	g/hp-hr	210.3833	0.0217	0.0000	210.3710	0.0208	0.0000
3.5 CY Loader (Cat 950)	ConstMin - Rubber Tired Loaders	Diesel	1,867	202	1	g/hp-hr	190.5561	0.0128	0.0000	190.5542	0.0123	0.0000
6.5 CY Loader (Cat 980)	ConstMin - Rubber Tired Loaders	Diesel	59,824	373	2	g/hp-hr	190.3041	0.0126	0.0000	190.7207	0.0121	0.0000
11.2 CY Loader (Cat 990)	ConstMin - Rubber Tired Loaders	Diesel	9,507	699	1	g/hp-hr	190.3624	0.0126	0.0000	190.3781	0.0121	0.0000
3.0 CY Track Loader (Cat 963)	ConstMin - Crawler Tractors	Diesel	914	193	1	g/hp-hr	226.1851	0.0191	0.0000	226.1049	0.0183	0.0000
1300LB Skid Steer Loader (Bobcat 743)	ConstMin - Skid Steer Loaders	Diesel	138	36	1	g/hp-hr	217.0388	0.0219	0.0000	217.1252	0.0214	0.0000
200 Hsp Grader (Cat 14G)	ConstMin - Graders	Diesel	70,318	200	2	g/hp-hr	215.7561	0.0148	0.0000	215.6772	0.0142	0.0000
1.7 CY Backhoe (JD 790)	ConstMin - Tractors/Loaders/Backhoes	Diesel	914	27	1	g/hp-hr	214.0815	0.0303	0.0000	213.9154	0.0294	0.0000
2.0 CY Backhoe (Cat 330)	ConstMin - Tractors/Loaders/Backhoes	Diesel	11,600	235	1	g/hp-hr	193.8874	0.0109	0.0000	194.1451	0.0104	0.0000
2.0 CY Excavator	ConstMin - Excavators	Diesel	75	235	1	g/hp-hr	201.8187	0.0124	0.0000	201.7514	0.0119	0.0000
2.6 CY Backhoe (Cat 350)	ConstMin - Tractors/Loaders/Backhoes	Diesel	1,063	286	1	g/hp-hr	193.8874	0.0108	0.0000	194.1451	0.0103	0.0000
2.7 CY Backhoe (Cat 345 BL)	ConstMin - Tractors/Loaders/Backhoes	Diesel	5,755	290	1	g/hp-hr	193.8874	0.0108	0.0000	194.1451	0.0103	0.0000
1.7 CY Backhoe Loader (Case680)	ConstMin - Tractors/Loaders/Backhoes	Diesel	24,968	80	1	g/hp-hr	195.2836	0.0159	0.0000	195.2576	0.0153	0.0000
5 Ton Flatbed Truck	n/a - onroad	Diesel	5,457	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
20 Ton (10 CY) Tandem Truck	n/a - onroad	Diesel	83	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
24 Ton (12 CY) Tandem Truck	n/a - onroad	Diesel	5,080	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
35 Ton Articulated Truck (Cat D350)	ConstMin - Off-Highway Trucks	Diesel	256,985	340	6	g/hp-hr	201.5560	0.0132	0.0000	201.8708	0.0127	0.0000
50 Ton Off Hwy Truck 680 Hsp (Cat 773)	ConstMin - Off-Highway Trucks	Diesel	43,944	680	2	g/hp-hr	201.4380	0.0132	0.0000	201.9102	0.0127	0.0000
26 CY Tandem Scraper (Cat 637)	ConstMin - Scrapers	Diesel	12,112	783	1	g/hp-hr	254.5773	0.0211	0.0000	254.5773	0.0202	0.0000
22" Smooth Drum Manual (Bomag 55)	OFF - ConstMin - Plate Compactors	Diesel	2,021	4	1	g/hp-hr	244.3700	0.0257	0.0000	244.3860	0.0257	0.0000
10 Ton Compactor 120 hsp (Dyn CA25)	ConstMin - Rollers	Diesel	50	120	1	g/hp-hr	197.9028	0.0203	0.0000	197.9031	0.0191	0.0000
13 Ton Compactor 72" (Cat 553)	ConstMin - Rollers	Diesel	597	145	1	g/hp-hr	197.9028	0.0156	0.0000	197.9031	0.0147	0.0000
15 Ton Compactor 84" (Cat 563)	ConstMin - Rollers	Diesel	157	145	1	g/hp-hr	197.9028	0.0156	0.0000	197.9031	0.0147	0.0000
15 Ton Compactor 84" (Cat 663)	ConstMin - Rollers	Diesel	5,391	165	1	g/hp-hr	197.9028	0.0156	0.0000	197.9031	0.0147	0.0000
20 Ton Compactor 190 hsp (Bomag 217)	ConstMin - Rollers	Diesel	55	190	1	g/hp-hr	198.1512	0.0129	0.0000	198.1409	0.0123	0.0000
30 Ton Compactor 315 hsp (Cat 825)	ConstMin - Rollers	Diesel	23,482	315	1	g/hp-hr	199.0623	0.0126	0.0000	198.7551	0.0121	0.0000
180 Hsp Wheel Skidder (Cat 535)	OFF - Logging - Skidders	Diesel	2,210	180	1	g/hp-hr	420.4925	0.0000	0.0000	420.4925	0.0000	0.0000
210 Hsp Harvester (Cat 580)	OFF - Logging - Skidders	Diesel	2,210	210	1	g/hp-hr	420.4925	0.0000	0.0000	420.4925	0.0000	0.0000
150 Hsp Grapple (Cat 527)	OFF - Logging - Skidders	Diesel	1,105	150	1	g/hp-hr	420.5488	0.0000	0.0000	420.5069	0.0000	0.0000
Concrete Equipment												
Grout Mixer	OFF - ConstMin - Cement and Mortar Mixers	Diesel	5,334	10	1	g/hp-hr	318.4946	0.0334	0.0000	318.3822	0.0334	0.0000
90 YPH Trailer Mounted Concrete Pump	Portable Equipment - Non-Rental Pump	Diesel	15,182	220	1	g/hp-hr	161.4394	0.0109	0.0000	163.1994	0.0103	0.0000
124 YPH Trailer Mounted Concrete Pump	Portable Equipment - Non-Rental Pump	Diesel	917	330	1	g/hp-hr	161.4394	0.0106	0.0000	163.1994	0.0101	0.0000
Grout Pump	OFF - Light Commercial - Pumps	Diesel	8,685	18	1	g/hp-hr	420.5680	0.0477	0.0000	420.5160	0.0472	0.0000
8 YPH Wet Shotcrete Pump (Swing 750)	Portable Equipment - Non-Rental Pump	Diesel	9,808	100	1	g/hp-hr	161.4394	0.0177	0.0000	163.1994	0.0167	0.0000
Utility Equipment												
10 KW Generator Set (Gas)	OFF - Light Commercial - Generator Sets	Gasoline	34,088	13	1	g/hp-hr	292.0282	0.1790	0.2368	292.0268	0.1786	0.2365
100 KW Diesel Generator Set	Portable Equipment - Non-Rental Generator	Diesel	200	134	1	g/hp-hr	161.4394	0.0127	0.0000	163.1994	0.0118	0.0000
200 KW Diesel Generator Set	Portable Equipment - Non-Rental Generator	Diesel	20,262	268	1	g/hp-hr	161.4394	0.0098	0.0000	163.1994	0.0093	0.0000
320 KW Diesel Generator Set	Portable Equipment - Non-Rental Generator	Diesel	2,843	429	1	g/hp-hr	161.4394	0.0098	0.0000	163.1994	0.0093	0.0000
Tower 4-Lights 12 Hsp	OFF - ConstMin - Signal Boards	Diesel	483,274	12	12	g/hp-hr	466.0080	0.0489	0.0000	466.0129	0.0489	0.0000
3" Gas Water Pump 20,000 gph	OFF - Light Commercial - Pumps	Gasoline	200	18	1	g/hp-hr	296.3187	0.2757	0.2104	296.3256	0.2757	0.2104
150 CFM Diesel Compressor	OFF - Light Commercial - Air Compressors	Diesel	1,060	35	1	g/hp-hr	272.8000	0.0289	0.0000	272.7981	0.0272	0.0000
185 CFM Diesel Compressor	Portable Equipment - Non-Rental Compressor	Diesel	19,943	61	1	g/hp-hr	161.4394	0.0152	0.0000	163.1994	0.0144	0.0000
375 CFM Diesel Compressor	Portable Equipment - Non-Rental Compressor	Diesel	7,171	130	1	g/hp-hr	161.4394	0.0120	0.0000	163.1994	0.0113	0.0000
750 CFM Diesel Compressor	Portable Equipment - Non-Rental Compressor	Diesel	30,483	266	1	g/hp-hr	161.4394	0.0096	0.0000	163.1994	0.0092	0.0000
250 Amp Diesel Welder	OFF - Light Commercial - Welders	Diesel	19,230	19	1	g/hp-hr	255.7471	0.0290	0.0000	255.7515	0.0287	0.0000
350 Amp Diesel Welder	OFF - Light Commercial - Welders	Diesel	38,711	22	1	g/hp-hr	255.7471	0.0290	0.0000	255.7515	0.0287	0.0000
400 Amp Diesel Welder	OFF - Light Commercial - Welders	Diesel	237	24	1	g/hp-hr	255.7471	0.0290	0.0000	255.7515	0.0287	0.0000
Large Dia. Polyethylene Fusion Machine	OFF - Light Commercial - Welders	Diesel	111	33	1	g/hp-hr	255.7284	0.0248	0.0000	255.7439	0.0231	0.0000
2000 PSI Pressure Washer	OFF - Light Commercial - Pressure Washers	Diesel	19,299	21	1	g/hp-hr	171.2121	0.0188	0.0000	171.3677	0.0188	0.0000
10 GPM Pressure Washer	OFF - Light Commercial - Pressure Washers	Diesel	12,675	21	1	g/hp-hr	171.2121	0.0188	0.0000	171.3677	0.0188	0.0000
Hoisting Equipment												
20 Ton Truck Crane	ConstMin - Cranes	Diesel	50	123	1	g/hp-hr	152.2348	0.0134	0.0000	152.3160	0.0127	0.0000
50 Ton Truck Crane (Linkbelt 108)	ConstMin - Cranes	Diesel	148	170	1	g/hp-hr	152.2348	0.0134	0.0000	152.3160	0.0127	0.0000
60 Ton Crawler Crane (Linkbelt118)	ConstMin - Cranes	Diesel	26,245	178	1	g/hp-hr	151.9944	0.0112	0.0000	151.9937	0.0107	0.0000
150 Ton Crawler Crane (American 9260)	ConstMin - Cranes	Diesel	14,545	308	1	g/hp-hr	151.9844	0.0110	0.0000	151.9996	0.0105	0.0000
20 Ton Hydraulic Crane (Grove58)	ConstMin - Cranes	Diesel	6,457	123	1	g/hp-hr	152.2348	0.0134	0.0000	152.3160	0.0127	0.0000
30 Ton Hydraulic Crane (Grove500)	ConstMin - Cranes	Diesel	300	130	1	g/hp-hr	152.2348	0.0134	0.0000	152.3160	0.0127	0.0000
60 Ton Hydraulic Crane (Grove)	ConstMin - Cranes	Diesel	1,050	355	1	g/hp-hr	151.9844	0.0110	0.0000	151.9996	0.0105	0.0000
Motorized Manlift 66 Ft	Industrial - Aerial Lifts	Diesel	375	63	1	g/hp-hr	162.6858	0.0108	0.0000	162.6905	0.0102	0.0000
Drilling & Tunneling Equipment												
Hydraulic Drill 3" (AC1238/Tam400)	ConstMin - Bore/Drill Rigs	Diesel	54,435	221	2	g/hp-hr	263.7776	0.0088	0.0000	264.1227	0.0087	0.0000
2.5" Air Track Rockdrill (IR100)	ConstMin - Bore/Drill Rigs	Diesel	4,319	221	1	g/hp-hr	263.7776	0.0088	0.0000	264.1227	0.0087	0.0000
Core Drill Skid Mounted 44 Hsp	ConstMin - Bore/Drill Rigs	Diesel	338	44	1	g/hp-hr	300.8277	0.0236	0.0000	301.4897	0.0236	0.0000
Tunnel Scissor Truck	Industrial - Aerial Lifts	Diesel	19	63	1	g/hp-hr	162.6858	0.0108	0.0000	162.6905	0.0102	0.0000
1/4 CY Crawler Backhoe	ConstMin - Tractors/Loaders/Backhoes	Diesel	1,585	98	1	g/hp-hr	195.2836	0.0159	0.0000	195.2576	0.0153	0.0000

Table A-70. Emission Factor Summary by Equipment

Equipment Description	OFFROAD2017 Equipment Category	Fuel	Emission Factors - 2026 (g/hp-hr or g/hr)			Emission Factors - 2027 (g/hp-hr or g/hr)			Emission Factors - 2028 (g/hp-hr or g/hr)			Emission Factors - 2029 (g/hp-hr or g/hr)		
			CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O
Earthmoving Equipment														
110 Hsp Bulldozer (Cat D5)	ConstMin - Rubber Tired Dozers	Diesel	208.7348	0.0258	0.0000	208.6262	0.0245	0.0000	208.8690	0.0233	0.0000	208.6620	0.0222	0.0000
170 Hsp Bulldozer (Cat D6)	ConstMin - Rubber Tired Dozers	Diesel	208.7348	0.0258	0.0000	208.6262	0.0245	0.0000	208.8690	0.0233	0.0000	208.6620	0.0222	0.0000
305 Hsp Bulldozer (Cat D8)	ConstMin - Rubber Tired Dozers	Diesel	210.5205	0.0199	0.0000	210.5242	0.0191	0.0000	210.6423	0.0184	0.0000	210.4711	0.0178	0.0000
3.5 CY Loader (Cat 950)	ConstMin - Rubber Tired Loaders	Diesel	190.5246	0.0118	0.0000	190.5502	0.0113	0.0000	190.5905	0.0109	0.0000	190.5592	0.0106	0.0000
6.5 CY Loader (Cat 980)	ConstMin - Rubber Tired Loaders	Diesel	190.7433	0.0116	0.0000	190.9095	0.0112	0.0000	190.7549	0.0108	0.0000	190.5371	0.0105	0.0000
11.2 CY Loader (Cat 990)	ConstMin - Rubber Tired Loaders	Diesel	190.5311	0.0116	0.0000	190.6300	0.0112	0.0000	190.3180	0.0108	0.0000	190.2403	0.0105	0.0000
3.0 CY Track Loader (Cat 963)	ConstMin - Crawler Tractors	Diesel	226.0976	0.0175	0.0000	225.9929	0.0168	0.0000	226.1379	0.0162	0.0000	226.1042	0.0157	0.0000
1300LB Skid Steer Loader (Bobcat 743)	ConstMin - Skid Steer Loaders	Diesel	216.9195	0.0210	0.0000	216.8927	0.0208	0.0000	216.8882	0.0206	0.0000	216.8243	0.0205	0.0000
200 Hsp Grader (Cat 14G)	ConstMin - Graders	Diesel	215.6734	0.0136	0.0000	215.7870	0.0131	0.0000	215.8074	0.0127	0.0000	215.7782	0.0123	0.0000
1.7 CY Backhoe (JD 790)	ConstMin - Tractors/Loaders/Backhoes	Diesel	213.6159	0.0287	0.0000	213.5477	0.0281	0.0000	213.6382	0.0276	0.0000	213.6795	0.0271	0.0000
2.0 CY Backhoe (Cat 330)	ConstMin - Tractors/Loaders/Backhoes	Diesel	194.4190	0.0100	0.0000	194.3012	0.0097	0.0000	194.2654	0.0094	0.0000	194.3088	0.0092	0.0000
2.0 CY Excavator	ConstMin - Excavators	Diesel	201.7146	0.0115	0.0000	201.7091	0.0111	0.0000	201.6957	0.0108	0.0000	201.6771	0.0106	0.0000
2.6 CY Backhoe (Cat 350)	ConstMin - Tractors/Loaders/Backhoes	Diesel	194.4190	0.0100	0.0000	194.3012	0.0096	0.0000	194.2654	0.0094	0.0000	194.3088	0.0092	0.0000
2.7 CY Backhoe (Cat 345 BL)	ConstMin - Tractors/Loaders/Backhoes	Diesel	194.4190	0.0100	0.0000	194.3012	0.0096	0.0000	194.2654	0.0094	0.0000	194.3088	0.0092	0.0000
1.7 CY Backhoe Loader (Case680)	ConstMin - Tractors/Loaders/Backhoes	Diesel	195.2002	0.0148	0.0000	195.1675	0.0144	0.0000	195.1481	0.0140	0.0000	195.0370	0.0138	0.0000
5 Ton Flatbed Truck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
20 Ton (10 CY) Tandem Truck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
24 Ton (12 CY) Tandem Truck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
35 Ton Articulated Truck (Cat D350)	ConstMin - Off-Highway Trucks	Diesel	202.0926	0.0122	0.0000	202.0321	0.0119	0.0000	202.1420	0.0116	0.0000	202.2226	0.0113	0.0000
50 Ton Off Hwy Truck 680 Hsp (Cat 773)	ConstMin - Off-Highway Trucks	Diesel	201.9395	0.0123	0.0000	201.9863	0.0119	0.0000	201.9561	0.0116	0.0000	201.9875	0.0113	0.0000
26 CY Tandem Scraper (Cat 637)	ConstMin - Scrapers	Diesel	254.5773	0.0194	0.0000	254.6479	0.0187	0.0000	254.5067	0.0180	0.0000	254.7150	0.0174	0.0000
22" Smooth Drum Manual (Bomag 55)	OFF - ConstMin - Plate Compactors	Diesel	244.4017	0.0257	0.0000	244.3351	0.0257	0.0000	244.3897	0.0257	0.0000	244.3118	0.0257	0.0000
10 Ton Compactor 120 hsp (Dyn CA25)	ConstMin - Rollers	Diesel	197.8719	0.0180	0.0000	197.8826	0.0172	0.0000	197.8870	0.0164	0.0000	197.9027	0.0157	0.0000
13 Ton Compactor 72" (Cat 553)	ConstMin - Rollers	Diesel	197.8719	0.0139	0.0000	197.8826	0.0132	0.0000	197.8870	0.0125	0.0000	197.9027	0.0119	0.0000
15 Ton Compactor 84" (Cat 563)	ConstMin - Rollers	Diesel	197.8719	0.0139	0.0000	197.8826	0.0132	0.0000	197.8870	0.0125	0.0000	197.9027	0.0119	0.0000
15 Ton Compactor 84" (Cat 663)	ConstMin - Rollers	Diesel	197.8719	0.0139	0.0000	197.8826	0.0132	0.0000	197.8870	0.0125	0.0000	197.9027	0.0119	0.0000
20 Ton Compactor 190 hsp (Bomag 217)	ConstMin - Rollers	Diesel	198.1622	0.0117	0.0000	198.1290	0.0112	0.0000	198.1809	0.0107	0.0000	198.1744	0.0103	0.0000
30 Ton Compactor 315 hsp (Cat 825)	ConstMin - Rollers	Diesel	198.4627	0.0115	0.0000	198.3839	0.0110	0.0000	199.1161	0.0106	0.0000	199.2778	0.0101	0.0000
180 Hsp Wheel Skidder (Cat 535)	OFF - Logging - Skidders	Diesel	420.9484	0.0000	0.0000	420.2649	0.0000	0.0000	420.1512	0.0000	0.0000	421.0626	0.0000	0.0000
210 Hsp Harvester (Cat 580)	OFF - Logging - Skidders	Diesel	420.9484	0.0000	0.0000	420.2649	0.0000	0.0000	420.1512	0.0000	0.0000	421.0626	0.0000	0.0000
150 Hsp Grapple (Cat 527)	OFF - Logging - Skidders	Diesel	420.5069	0.0000	0.0000	420.4231	0.0000	0.0000	420.6745	0.0000	0.0000	420.6326	0.0000	0.0000
Concrete Equipment														
Grout Mixer	OFF - ConstMin - Cement and Mortar Mixers	Diesel	318.5246	0.0334	0.0000	318.6793	0.0334	0.0000	318.6552	0.0334	0.0000	318.3736	0.0334	0.0000
90 YPH Trailer Mounted Concrete Pump	Portable Equipment - Non-Rental Pump	Diesel	164.9786	0.0098	0.0000	166.7772	0.0094	0.0000	168.5953	0.0090	0.0000	170.4333	0.0087	0.0000
124 YPH Trailer Mounted Concrete Pump	Portable Equipment - Non-Rental Pump	Diesel	164.9786	0.0097	0.0000	166.7772	0.0093	0.0000	168.5953	0.0089	0.0000	170.4333	0.0086	0.0000
Grout Pump	OFF - Light Commercial - Pumps	Diesel	420.5444	0.0467	0.0000	420.5388	0.0464	0.0000	420.5336	0.0462	0.0000	420.5497	0.0460	0.0000
8 YPH Wet Shotcrete Pump (Swing 750)	Portable Equipment - Non-Rental Pump	Diesel	164.9786	0.0156	0.0000	166.7772	0.0147	0.0000	168.5953	0.0138	0.0000	170.4333	0.0131	0.0000
Utility Equipment														
10 KW Generator Set (Gas)	OFF - Light Commercial - Generator Sets	Gasoline	292.0261	0.1784	0.2364	292.0286	0.1783	0.2363	292.0281	0.1784	0.2364	292.0282	0.1784	0.2364
100 KW Diesel Generator Set	Portable Equipment - Non-Rental Generator	Diesel	164.9786	0.0110	0.0000	166.7772	0.0103	0.0000	168.5953	0.0096	0.0000	170.4333	0.0090	0.0000
200 KW Diesel Generator Set	Portable Equipment - Non-Rental Generator	Diesel	164.9786	0.0089	0.0000	166.7772	0.0085	0.0000	168.5953	0.0082	0.0000	170.4333	0.0079	0.0000
320 KW Diesel Generator Set	Portable Equipment - Non-Rental Generator	Diesel	164.9786	0.0089	0.0000	166.7772	0.0085	0.0000	168.5953	0.0082	0.0000	170.4333	0.0079	0.0000
Tower 4-Lights 12 Hsp	OFF - ConstMin - Signal Boards	Diesel	466.0080	0.0489	0.0000	466.0127	0.0489	0.0000	466.0237	0.0489	0.0000	466.0165	0.0489	0.0000
3" Gas Water Pump 20,000 gph	OFF - Light Commercial - Pumps	Gasoline	296.3135	0.2756	0.2104	296.3214	0.2757	0.2104	296.3178	0.2757	0.2104	296.3166	0.2757	0.2104
150 CFM Diesel Compressor	OFF - Light Commercial - Air Compressors	Diesel	272.7594	0.0256	0.0000	272.7864	0.0242	0.0000	272.8144	0.0230	0.0000	272.8182	0.0220	0.0000
185 CFM Diesel Compressor	Portable Equipment - Non-Rental Compressor	Diesel	164.9786	0.0136	0.0000	166.7772	0.0128	0.0000	168.5953	0.0122	0.0000	170.4333	0.0116	0.0000
375 CFM Diesel Compressor	Portable Equipment - Non-Rental Compressor	Diesel	164.9786	0.0106	0.0000	166.7772	0.0098	0.0000	168.5953	0.0092	0.0000	170.4333	0.0086	0.0000
750 CFM Diesel Compressor	Portable Equipment - Non-Rental Compressor	Diesel	164.9786	0.0088	0.0000	166.7772	0.0084	0.0000	168.5953	0.0080	0.0000	170.4333	0.0077	0.0000
250 Amp Diesel Welder	OFF - Light Commercial - Welders	Diesel	255.7636	0.0284	0.0000	255.7551	0.0282	0.0000	255.7555	0.0281	0.0000	255.7432	0.0280	0.0000
350 Amp Diesel Welder	OFF - Light Commercial - Welders	Diesel	255.7636	0.0284	0.0000	255.7551	0.0282	0.0000	255.7555	0.0281	0.0000	255.7432	0.0280	0.0000
400 Amp Diesel Welder	OFF - Light Commercial - Welders	Diesel	255.7636	0.0284	0.0000	255.7551	0.0282	0.0000	255.7555	0.0281	0.0000	255.7432	0.0280	0.0000
Large Dia. Polyethylene Fusion Machine	OFF - Light Commercial - Welders	Diesel	255.7373	0.0217	0.0000	255.7388	0.0203	0.0000	255.7398	0.0192	0.0000	255.7319	0.0183	0.0000
2000 PSI Pressure Washer	OFF - Light Commercial - Pressure Washers	Diesel	171.0577	0.0187	0.0000	171.1097	0.0187	0.0000	171.0342	0.0186	0.0000	171.5747	0.0186	0.0000
10 GPM Pressure Washer	OFF - Light Commercial - Pressure Washers	Diesel	171.0577	0.0187	0.0000	171.1097	0.0187	0.0000	171.0342	0.0186	0.0000	171.5747	0.0186	0.0000
Hoisting Equipment														
20 Ton Truck Crane	ConstMin - Cranes	Diesel	152.3557	0.0120	0.0000	152.3506	0.0114	0.0000	152.3181	0.0108	0.0000	152.2907	0.0103	0.0000
50 Ton Truck Crane (Linkbelt 108)	ConstMin - Cranes	Diesel	152.3557	0.0120	0.0000	152.3506	0.0114	0.0000	152.3181	0.0108	0.0000	152.2907	0.0103	0.0000
60 Ton Crawler Crane (Linkbelt118)	ConstMin - Cranes	Diesel	151.9935	0.0102	0.0000	151.9926	0.0098	0.0000	151.9875	0.0094	0.0000	151.9976	0.0090	0.0000
150 Ton Crawler Crane (American 9260)	ConstMin - Cranes	Diesel	151.9639	0.0101	0.0000	151.9623	0.0096	0.0000	152.0485	0.0092	0.0000	152.0071	0.0089	0.0000
20 Ton Hydraulic Crane (Grove58)	ConstMin - Cranes	Diesel	152.3557	0.0120	0.0000	152.3506	0.0114	0.0000	152.3181	0.0108	0.0000	152.2907	0.0103	0.0000
30 Ton Hydraulic Crane (Grove500)	ConstMin - Cranes	Diesel	152.3557	0.0120	0.0000	152.3506	0.0114	0.0000	152.3181	0.0108	0.0000	152.2907	0.0103	0.0000
60 Ton Hydraulic Crane (Grove)	ConstMin - Cranes	Diesel	151.9639	0.0101	0.0000	151.9623	0.0096	0.0000	152.0485	0.0092	0.0000	152.0071	0.0089	0.0000
Motorized Manlift 66 Ft	Industrial - Aerial Lifts	Diesel	162.6926	0.0095	0.0000	162.6912	0.0089	0.0000	162.6862	0.0084	0.0000	162.6989	0.0080	0.0000
Drilling & Tunneling Equipment														
Hydraulic Drill 3" (AC1238/Tam400)	ConstMin - Bore/Drill Rigs	Diesel	264.0234	0.0087	0.0000	264.0272	0.0087	0.0000	263.5919	0.0086	0.0000	263.8880	0.0086	0.0000
2.5" Air Track Rockdrill (IR100)	ConstMin - Bore/Drill Rigs	Diesel	264.0234	0.0087	0.0000	264.0272	0.0087	0.0000	263.5919	0.0086	0.0000	263.8880	0.0086	0.0000
Core Drill Skid Mounted 44 Hsp	ConstMin - Bore/Drill Rigs	Diesel	303.7846	0.0236	0.0000	301.5427	0.0236	0.0000	299.0406	0.0236	0.0000	299.5863	0.0236	0.0000
Tunnel Scissor Truck	Industrial - Aerial Lifts	Diesel	162.6926	0.0095	0.0000	162.6912	0.0089	0.0000	162.6862	0.0084	0.0000	162.6989	0.0080	0.0000
1/4 CY Crawler Backhoe	ConstMin - Tractors/Loaders/Backhoes	Diesel	195.2002	0.0148	0.0000	195.1675	0.0144	0.0000	195.1481	0.0140	0.0000	195.0370	0.0138	0.0000

Operating Schedule
20 hours per day
365 days per year
6 years per project
7,300 hours per year
43,800 hours per project

Starting Year
2024

Conversions
1,000,000 grams per metric ton

Onsite Speed Limit
15 miles per hour

Global Warming Potential
CO2 1
CH4 25
N2O 298

Table A-70. Emission Factor Summary by Equipment

Equipment Description	OFFROAD2017 Equipment Category	Fuel	Hours per Project	Size (hp)	Quantity	Unit	Emission Factors - 2024 (g/hp-hr or g/hr)			Emission Factors - 2025 (g/hp-hr or g/hr)		
							CO2	CH4	N2O	CO2	CH4	N2O
Service & Maintenance Equipment												
1/2 Ton Pickup Truck 2x2	n/a - onroad	Diesel	1,287	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
3/4 Ton Pickup Truck 2x2	n/a - onroad	Diesel	404,389	n/a	10	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
3/4 Ton Pickup Truck 4x4	n/a - onroad	Diesel	117,268	n/a	3	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
3/4 Ton Crew Cab Truck	n/a - onroad	Diesel	300	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
3/4 Ton Crew Cab Truck	n/a - onroad	Diesel	300	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
5 Ton Flat Bed Truck	n/a - onroad	Diesel	22,262	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
10 Ton Flat Bed Truck	n/a - onroad	Diesel	3,158	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
1- Ton Mechanic Truck	n/a - onroad	Diesel	3,250	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
2-Ton Mechanic Truck	n/a - onroad	Diesel	116,578	n/a	3	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
Lube Truck	n/a - onroad	Diesel	76,667	n/a	2	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
Fuel Truck (Tandem Axle 20000 litres)	n/a - onroad	Diesel	38,333	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
1000 Gallon Watertruck	n/a - onroad	Diesel	2,091	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
3000 Gallon Watertruck	n/a - onroad	Diesel	26,605	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
5000 Gallon Watertanker	n/a - onroad	Diesel	597	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
631 WaterWagon	ConstMin - Off-Highway Tractors	Diesel	74,735	500	2	g/hp-hr	229.1850	0.0226	0.0000	229.3586	0.0216	0.0000
631 Water Wagon	ConstMin - Off-Highway Tractors	Diesel	3,803	500	1	g/hp-hr	229.1850	0.0226	0.0000	229.3586	0.0216	0.0000
5 Ton Boomtruck	n/a - onroad	Diesel	212	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
10 Ton Boomtruck	n/a - onroad	Diesel	249	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720
20 Ton Boomtruck	n/a - onroad	Diesel	375	n/a	1	g/hr	10,270.7083	0.0765	0.0720	9,933.3115	0.0765	0.0720

Notes:
No logging equipment is available in the OFFROAD2017 database for the San Francisco Bay Area Air Basin. Therefore, equipment from the San Joaquin Valley Air Basin was used to estimate emission factors for skidders.
Emission factors are in units of grams per horsepower-hour (g/hp-hr) for offroad construction equipment and grams per hour (g/hr) for on-road motor vehicles (e.g., flatbed trucks).

Table A-70. Emission Factor Summary by Equipment

Equipment Description	OFFROAD2017 Equipment Category	Fuel	Emission Factors - 2026 (g/hp-hr or g/hr)			Emission Factors - 2027 (g/hp-hr or g/hr)			Emission Factors - 2028 (g/hp-hr or g/hr)			Emission Factors - 2029 (g/hp-hr or g/hr)		
			CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O
Service & Maintenance Equipment														
1/2 Ton Pickup Truck 2x2	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
3/4 Ton Pickup Truck 2x2	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
3/4 Ton Pickup Truck 4x4	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
3/4 Ton Crew Cab Truck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
3/4 Ton Crew Cab Truck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
5 Ton Flat Bed Truck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
10 Ton Flat Bed Truck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
1- Ton Mechanic Truck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
2-Ton Mechanic Truck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
Lube Truck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
Fuel Truck (Tandem Axle 20000 litres)	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
1000 Gallon Watertruck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
3000 Gallon Watertruck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
5000 Gallon Watertanker	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
631 WaterWagon	ConstMin - Off-Highway Tractors	Diesel	229.4675	0.0207	0.0000	229.6831	0.0199	0.0000	229.8542	0.0192	0.0000	229.6532	0.0185	0.0000
631 Water Wagon	ConstMin - Off-Highway Tractors	Diesel	229.4675	0.0207	0.0000	229.6831	0.0199	0.0000	229.8542	0.0192	0.0000	229.6532	0.0185	0.0000
5 Ton Boomtruck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
10 Ton Boomtruck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720
20 Ton Boomtruck	n/a - onroad	Diesel	9,640.9808	0.0765	0.0720	9,377.7968	0.0765	0.0720	9,143.9901	0.0765	0.0720	8,939.1982	0.0765	0.0720

Notes:
No logging equipment is available in the OFFROAD2017 database for the San Francisco Bay Area Air Basin. Therefore, equipment from th
Emission factors are in units of grams per horsepower-hour (g/hp-hr) for offroad construction equipment and grams per hour (g/hr) for on-r

Table A-71. Annual Unmitgated Emissions - Onsite Construction Equipment

Equipment Description	OFFROAD2017 Equipment Category	Fuel	Hours per Project	Size (hp)	Quantity	Unit	Annual Emissions - 2024 (metric tons per year)			Annual Emissions - 2025 (metric tons per year)			Annual Emissions - 2026 (metric tons per year)			Annual Emissions - 2027 (metric tons per year)		
							CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O
Earthmoving Equipment																		
110 Hsp Bulldozer (Cat D5)	ConstMin - Rubber Tired Dozers	Diesel	53	110	1	g/hp-hr	1.22	0.00	--	--	--	--	--	--	--	--	--	--
170 Hsp Bulldozer (Cat D6)	ConstMin - Rubber Tired Dozers	Diesel	71,036	170	2	g/hp-hr	518.09	0.07	--	518.17	0.07	--	518.08	0.06	--	517.81	0.06	--
305 Hsp Bulldozer (Cat D8)	ConstMin - Rubber Tired Dozers	Diesel	110,098	305	3	g/hp-hr	1,405.26	0.14	--	1,405.17	0.14	--	1,406.17	0.13	--	1,406.20	0.13	--
3.5 CY Loader (Cat 950)	ConstMin - Rubber Tired Loaders	Diesel	1,867	202	1	g/hp-hr	71.87	0.00	--	--	--	--	--	--	--	--	--	--
6.5 CY Loader (Cat 980)	ConstMin - Rubber Tired Loaders	Diesel	59,824	373	2	g/hp-hr	1,036.36	0.07	--	1,038.63	0.07	--	1,038.75	0.06	--	1,039.65	0.06	--
11.2 CY Loader (Cat 990)	ConstMin - Rubber Tired Loaders	Diesel	9,507	699	1	g/hp-hr	971.36	0.06	--	293.65	0.02	--	--	--	--	--	--	--
3.0 CY Track Loader (Cat 963)	ConstMin - Crawler Tractors	Diesel	914	193	1	g/hp-hr	39.92	0.00	--	--	--	--	--	--	--	--	--	--
1300LB Skid Steer Loader (Bobcat 743)	ConstMin - Skid Steer Loaders	Diesel	138	36	1	g/hp-hr	1.07	0.00	--	--	--	--	--	--	--	--	--	--
200 Hsp Grader (Cat 14G)	ConstMin - Graders	Diesel	70,318	200	2	g/hp-hr	630.01	0.04	--	629.78	0.04	--	629.77	0.04	--	630.10	0.04	--
1.7 CY Backhoe (JD 790)	ConstMin - Tractors/Loaders/Backhoes	Diesel	914	27	1	g/hp-hr	5.29	0.00	--	--	--	--	--	--	--	--	--	--
2.0 CY Backhoe (Cat 330)	ConstMin - Tractors/Loaders/Backhoes	Diesel	11,600	235	1	g/hp-hr	332.61	0.02	--	196.18	0.01	--	--	--	--	--	--	--
2.0 CY Excavator	ConstMin - Excavators	Diesel	75	235	1	g/hp-hr	3.56	0.00	--	--	--	--	--	--	--	--	--	--
2.6 CY Backhoe (Cat 350)	ConstMin - Tractors/Loaders/Backhoes	Diesel	1,063	286	1	g/hp-hr	58.92	0.00	--	--	--	--	--	--	--	--	--	--
2.7 CY Backhoe (Cat 345 BL)	ConstMin - Tractors/Loaders/Backhoes	Diesel	5,755	290	1	g/hp-hr	323.58	0.02	--	--	--	--	--	--	--	--	--	--
1.7 CY Backhoe Loader (Case680)	ConstMin - Tractors/Loaders/Backhoes	Diesel	24,968	80	1	g/hp-hr	114.05	0.01	--	114.03	0.01	--	114.00	0.01	--	47.89	0.00	--
5 Ton Flatbed Truck	n/a - onroad	Diesel	5,457	n/a	1	g/hr	56.05	0.00	0.00	--	--	--	--	--	--	--	--	--
20 Ton (10 CY) Tandem Truck	n/a - onroad	Diesel	83	n/a	1	g/hr	0.85	0.00	0.00	--	--	--	--	--	--	--	--	--
24 Ton (12 CY) Tandem Truck	n/a - onroad	Diesel	5,080	n/a	1	g/hr	52.18	0.00	0.00	--	--	--	--	--	--	--	--	--
35 Ton Articulated Truck (Cat D350)	ConstMin - Off-Highway Trucks	Diesel	256,985	340	6	g/hp-hr	3,001.57	0.20	--	3,006.26	0.19	--	3,009.56	0.18	--	3,008.66	0.18	--
50 Ton Off Hwy Truck 680 Hsp (Cat 773)	ConstMin - Off-Highway Trucks	Diesel	43,944	680	2	g/hp-hr	1,999.88	0.13	--	2,004.56	0.13	--	2,004.85	0.12	--	19.71	0.00	--
26 CY Tandem Scraper (Cat 637)	ConstMin - Scrapers	Diesel	12,112	783	1	g/hp-hr	1,455.14	0.12	--	959.14	0.08	--	--	--	--	--	--	--
22" Smooth Drum Manual (Bomag 55)	ConstMin - Rollers	Diesel	2,021	4	1	g/hp-hr	1.73	0.00	--	--	--	--	--	--	--	--	--	--
10 Ton Compactor 120 hsp (Dyn CA25)	ConstMin - Rollers	Diesel	50	120	1	g/hp-hr	1.19	0.00	--	--	--	--	--	--	--	--	--	--
13 Ton Compactor 72" (Cat 553)	ConstMin - Rollers	Diesel	597	145	1	g/hp-hr	17.14	0.00	--	--	--	--	--	--	--	--	--	--
15 Ton Compactor 84" (Cat 563)	ConstMin - Rollers	Diesel	157	145	1	g/hp-hr	4.51	0.00	--	--	--	--	--	--	--	--	--	--
15 Ton Compactor 84" (Cat 663)	ConstMin - Rollers	Diesel	5,391	165	1	g/hp-hr	176.02	0.01	--	--	--	--	--	--	--	--	--	--
20 Ton Compactor 190 hsp (Bomag 217)	ConstMin - Rollers	Diesel	55	190	1	g/hp-hr	2.07	0.00	--	--	--	--	--	--	--	--	--	--
30 Ton Compactor 315 hsp (Cat 825)	ConstMin - Rollers	Diesel	23,482	315	1	g/hp-hr	457.74	0.03	--	457.04	0.03	--	456.37	0.03	--	98.87	0.01	--
180 Hsp Wheel Skidder (Cat 535)	OFF - Logging - Skidders	Diesel	2,210	180	1	g/hp-hr	167.27	--	--	--	--	--	--	--	--	--	--	--
210 Hsp Harvester (Cat 580)	OFF - Logging - Skidders	Diesel	2,210	210	1	g/hp-hr	195.15	--	--	--	--	--	--	--	--	--	--	--
150 Hsp Grapple (Cat 527)	OFF - Logging - Skidders	Diesel	1,105	150	1	g/hp-hr	69.71	--	--	--	--	--	--	--	--	--	--	--
Concrete Equipment																		
Grout Mixer	OFF - ConstMin - Cement and Mortar Mixers	Diesel	5,334	10	1	g/hp-hr	16.99	0.00	--	--	--	--	--	--	--	--	--	--
90 YPH Trailer Mounted Concrete Pump	Portable Equipment - Non-Rental Pump	Diesel	15,182	220	1	g/hp-hr	259.27	0.02	--	262.10	0.02	--	21.11	0.00	--	--	--	--
124 YPH Trailer Mounted Concrete Pump	Portable Equipment - Non-Rental Pump	Diesel	917	330	1	g/hp-hr	48.87	0.00	--	--	--	--	--	--	--	--	--	--
Grout Pump	OFF - Light Commercial - Pumps	Diesel	8,685	18	1	g/hp-hr	55.26	0.01	--	10.48	0.00	--	--	--	--	--	--	--
8 YPH Wet Shotcrete Pump (Swing 750)	Portable Equipment - Non-Rental Pump	Diesel	9,808	100	1	g/hp-hr	117.85	0.01	--	40.93	0.00	--	--	--	--	--	--	--
Utility Equipment																		
10 KW Generator Set (Gas)	OFF - Light Commercial - Generator Sets	Gasoline	34,088	13	1	g/hp-hr	27.71	0.02	0.02	27.71	0.02	0.02	27.71	0.02	0.02	27.71	0.02	0.02
100 KW Diesel Generator Set	Portable Equipment - Non-Rental Generator	Diesel	200	134	1	g/hp-hr	4.33	0.00	--	--	--	--	--	--	--	--	--	--
200 KW Diesel Generator Set	Portable Equipment - Non-Rental Generator	Diesel	20,262	268	1	g/hp-hr	315.84	0.02	--	319.28	0.02	--	250.33	0.01	--	--	--	--
320 KW Diesel Generator Set	Portable Equipment - Non-Rental Generator	Diesel	2,843	429	1	g/hp-hr	196.90	0.01	--	--	--	--	--	--	--	--	--	--
Tower 4-Lights 12 Hsp	OFF - ConstMin - Signal Boards	Diesel	483,274	12	12	g/hp-hr	489.87	0.05	--	489.87	0.05	--	489.87	0.05	--	489.87	0.05	--
3" Gas Water Pump 20,000 gph	OFF - Light Commercial - Pumps	Gasoline	200	18	1	g/hp-hr	1.07	0.00	0.00	--	--	--	--	--	--	--	--	--
150 CFM Diesel Compressor	OFF - Light Commercial - Air Compressors	Diesel	1,060	35	1	g/hp-hr	10.12	0.00	--	--	--	--	--	--	--	--	--	--
185 CFM Diesel Compressor	Portable Equipment - Non-Rental Compressor	Diesel	19,943	61	1	g/hp-hr	71.89	0.01	--	72.67	0.01	--	53.77	0.00	--	--	--	--
375 CFM Diesel Compressor	Portable Equipment - Non-Rental Compressor	Diesel	7,171	130	1	g/hp-hr	150.49	0.01	--	--	--	--	--	--	--	--	--	--
750 CFM Diesel Compressor	Portable Equipment - Non-Rental Compressor	Diesel	30,483	266	1	g/hp-hr	313.48	0.02	--	316.90	0.02	--	320.36	0.02	--	323.85	0.02	--
250 Amp Diesel Welder	OFF - Light Commercial - Welders	Diesel	19,230	19	1	g/hp-hr	35.47	0.00	--	35.47	0.00	--	22.50	0.00	--	--	--	--
350 Amp Diesel Welder	OFF - Light Commercial - Welders	Diesel	38,711	22	1	g/hp-hr	41.07	0.00	--	41.07	0.00	--	41.08	0.00	--	41.07	0.00	--
400 Amp Diesel Welder	OFF - Light Commercial - Welders	Diesel	237	24	1	g/hp-hr	1.46	0.00	--	--	--	--	--	--	--	--	--	--
Large Dia. Polyethylene Fusion Machine	OFF - Light Commercial - Welders	Diesel	111	33	1	g/hp-hr	0.94	0.00	--	--	--	--	--	--	--	--	--	--
2000 PSI Pressure Washer	OFF - Light Commercial - Pressure Washers	Diesel	19,299	21	1	g/hp-hr	26.25	0.00	--	26.27	0.00	--	16.88	0.00	--	--	--	--
10 GPM Pressure Washer	OFF - Light Commercial - Pressure Washers	Diesel	12,675	21	1	g/hp-hr	26.25	0.00	--	19.34	0.00	--	--	--	--	--	--	--
Hoisting Equipment																		
20 Ton Truck Crane	ConstMin - Cranes	Diesel	50	123	1	g/hp-hr	0.94	0.00	--	--	--	--	--	--	--	--	--	--
50 Ton Truck Crane (Linkbelt 108)	ConstMin - Cranes	Diesel	148	170	1	g/hp-hr	3.83	0.00	--	--	--	--	--	--	--	--	--	--
60 Ton Crawler Crane (Linkbelt118)	ConstMin - Cranes	Diesel	26,245	178	1	g/hp-hr	197.50	0.01	--	197.50	0.01	--	197.50	0.01	--	117.55	0.01	--
150 Ton Crawler Crane (American 9260)	ConstMin - Cranes	Diesel	14,545	308	1	g/hp-hr	341.72	0.02	--	339.20	0.02	--	--	--	--	--	--	--
20 Ton Hydraulic Crane (Grove58)	ConstMin - Cranes	Diesel	6,457	123	1	g/hp-hr	120.91	0.01	--	--	--	--	--	--	--	--	--	--
30 Ton Hydraulic Crane (Grove500)	ConstMin - Cranes	Diesel	300	130	1	g/hp-hr	5.94	0.00	--	--	--	--	--	--	--	--	--	--
60 Ton Hydraulic Crane (Grove)	ConstMin - Cranes	Diesel	1,050	355	1	g/hp-hr	56.65	0.00	--	--	--	--	--	--	--	--	--	--
Motorized Manlift 66 Ft	Industrial - Aerial Lifts	Diesel	375	63	1	g/hp-hr	3.84	0.00	--	--	--	--	--	--	--	--	--	--
Drilling & Tunneling Equipment																		
Hydraulic Drill 3" (AC1238/Tam400)	ConstMin - Bore/Drill Rigs	Diesel	54,435	221	2	g/hp-hr	851.10	0.03	--	852.22	0.03	--	851.90	0.03	--	620.53	0.02	--
2.5" Air Track Rockdrill (IR100)	ConstMin - Bore/Drill Rigs	Diesel	4,319	221	1	g/hp-hr	251.79	0.01	--	--	--	--	--	--	--	--	--	--
Core Drill Skid Mounted 44 Hsp	ConstMin - Bore/Drill Rigs	Diesel	338	44	1	g/hp-hr	4.47	0.00	--	--	--	--	--	--	--	--	--	--
Tunnel Scissor Truck	Industrial - Aerial Lifts	Diesel	19	63	1	g/hp-hr	0.19	0.00	--	--	--	--	--	--	--	--	--	--
1/4 CY Crawler Backhoe	ConstMin - Tractors/Loaders/Backhoes	Diesel	1,585	98	1	g/hp-hr	30.33	0.00	--	--	--	--	--	--	--	--	--	--

Table A-71. Annual Unmitgated Emissions - Onsite Construction Equipment

Equipment Description	OFFROAD2017 Equipment Category	Fuel	Hours per Project	Size (hp)	Quantity	Unit	Annual Emissions - 2024 (metric tons per year)			Annual Emissions - 2025 (metric tons per year)			Annual Emissions - 2026 (metric tons per year)			Annual Emissions - 2027 (metric tons per year)		
							CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O	CO2	CH4	N2O

Table A-71. Annual Unmitgated Emissions - Onsite Construction Equipment

Equipment Description	OFFROAD2017 Equipment Category	Fuel	Annual Emissions - 2028 (metric tons per year)			Annual Emissions - 2029 (metric tons per year)			Annual Emissions (metric tons CO2e per year)							
			CO2	CH4	N2O	CO2	CH4	N2O	2024	2025	2026	2027	2028	2029	Annual Maximum	Project Total
Earthmoving Equipment																
110 Hsp Bulldozer (Cat D5)	ConstMin - Rubber Tired Dozers	Diesel	--	--	--	--	--	--	1.22	--	--	--	--	--	1.22	1.22
170 Hsp Bulldozer (Cat D6)	ConstMin - Rubber Tired Dozers	Diesel	448.67	0.05	--	--	--	--	519.86	519.86	519.68	519.33	449.92	--	519.86	2,528.65
305 Hsp Bulldozer (Cat D8)	ConstMin - Rubber Tired Dozers	Diesel	1,406.99	0.12	--	38.37	0.00	--	1,408.88	1,408.64	1,409.50	1,409.39	1,410.06	38.45	1,410.06	7,084.92
3.5 CY Loader (Cat 950)	ConstMin - Rubber Tired Loaders	Diesel	--	--	--	--	--	--	72.00	--	--	--	--	--	72.00	72.00
6.5 CY Loader (Cat 980)	ConstMin - Rubber Tired Loaders	Diesel	101.31	0.01	--	--	--	--	1,038.07	1,040.27	1,040.33	1,041.18	101.45	--	1,041.18	4,261.30
11.2 CY Loader (Cat 990)	ConstMin - Rubber Tired Loaders	Diesel	--	--	--	--	--	--	972.97	294.11	--	--	--	--	972.97	1,267.08
3.0 CY Track Loader (Cat 963)	ConstMin - Crawler Tractors	Diesel	--	--	--	--	--	--	40.00	--	--	--	--	--	40.00	40.00
1300LB Skid Steer Loader (Bobcat 743)	ConstMin - Skid Steer Loaders	Diesel	--	--	--	--	--	--	1.08	--	--	--	--	--	1.08	1.08
200 Hsp Grader (Cat 14G)	ConstMin - Graders	Diesel	514.42	0.03	--	--	--	--	631.09	630.81	630.76	631.06	515.17	--	631.09	3,038.89
1.7 CY Backhoe (JD 790)	ConstMin - Tractors/Loaders/Backhoes	Diesel	--	--	--	--	--	--	5.30	--	--	--	--	--	5.30	5.30
2.0 CY Backhoe (Cat 330)	ConstMin - Tractors/Loaders/Backhoes	Diesel	--	--	--	--	--	--	333.08	196.44	--	--	--	--	333.08	529.52
2.0 CY Excavator	ConstMin - Excavators	Diesel	--	--	--	--	--	--	3.56	--	--	--	--	--	3.56	3.56
2.6 CY Backhoe (Cat 350)	ConstMin - Tractors/Loaders/Backhoes	Diesel	--	--	--	--	--	--	59.00	--	--	--	--	--	59.00	59.00
2.7 CY Backhoe (Cat 345 BL)	ConstMin - Tractors/Loaders/Backhoes	Diesel	--	--	--	--	--	--	324.03	--	--	--	--	--	324.03	324.03
1.7 CY Backhoe Loader (Case680)	ConstMin - Tractors/Loaders/Backhoes	Diesel	--	--	--	--	--	--	114.28	114.25	114.21	47.98	--	--	114.28	390.73
5 Ton Flatbed Truck	n/a - onroad	Diesel	--	--	--	--	--	--	56.17	--	--	--	--	--	56.17	56.17
20 Ton (10 CY) Tandem Truck	n/a - onroad	Diesel	--	--	--	--	--	--	0.85	--	--	--	--	--	0.85	0.85
24 Ton (12 CY) Tandem Truck	n/a - onroad	Diesel	--	--	--	--	--	--	52.29	--	--	--	--	--	52.29	52.29
35 Ton Articulated Truck (Cat D350)	ConstMin - Off-Highway Trucks	Diesel	3,010.30	0.17	--	2,611.69	0.15	--	3,006.49	3,010.99	3,014.12	3,013.08	3,014.60	2,615.35	3,014.60	17,674.63
50 Ton Off Hwy Truck 680 Hsp (Cat 773)	ConstMin - Off-Highway Trucks	Diesel	--	--	--	--	--	--	2,003.16	2,007.72	2,007.90	19.74	--	--	2,007.90	6,038.52
26 CY Tandem Scraper (Cat 637)	ConstMin - Scrapers	Diesel	--	--	--	--	--	--	1,458.15	961.04	--	--	--	--	1,458.15	2,419.20
22" Smooth Drum Manual (Bomag 55)	ConstMin - Rollers	Diesel	--	--	--	--	--	--	1.73	--	--	--	--	--	1.73	1.73
10 Ton Compactor 120 hsp (Dyn CA25)	ConstMin - Rollers	Diesel	--	--	--	--	--	--	1.19	--	--	--	--	--	1.19	1.19
13 Ton Compactor 72" (Cat 553)	ConstMin - Rollers	Diesel	--	--	--	--	--	--	17.17	--	--	--	--	--	17.17	17.17
15 Ton Compactor 84" (Cat 563)	ConstMin - Rollers	Diesel	--	--	--	--	--	--	4.52	--	--	--	--	--	4.52	4.52
15 Ton Compactor 84" (Cat 663)	ConstMin - Rollers	Diesel	--	--	--	--	--	--	176.37	--	--	--	--	--	176.37	176.37
20 Ton Compactor 190 hsp (Bomag 217)	ConstMin - Rollers	Diesel	--	--	--	--	--	--	2.07	--	--	--	--	--	2.07	2.07
30 Ton Compactor 315 hsp (Cat 825)	ConstMin - Rollers	Diesel	--	--	--	--	--	--	458.47	457.73	457.03	99.00	--	--	458.47	1,472.23
180 Hsp Wheel Skidder (Cat 535)	OFF - Logging - Skidders	Diesel	--	--	--	--	--	--	167.27	--	--	--	--	--	167.27	167.27
210 Hsp Harvester (Cat 580)	OFF - Logging - Skidders	Diesel	--	--	--	--	--	--	195.15	--	--	--	--	--	195.15	195.15
150 Hsp Grapple (Cat 527)	OFF - Logging - Skidders	Diesel	--	--	--	--	--	--	69.71	--	--	--	--	--	69.71	69.71
Concrete Equipment																
Grout Mixer	OFF - ConstMin - Cement and Mortar Mixers	Diesel	--	--	--	--	--	--	17.03	--	--	--	--	--	17.03	17.03
90 YPH Trailer Mounted Concrete Pump	Portable Equipment - Non-Rental Pump	Diesel	--	--	--	--	--	--	259.71	262.51	21.15	--	--	--	262.51	543.37
124 YPH Trailer Mounted Concrete Pump	Portable Equipment - Non-Rental Pump	Diesel	--	--	--	--	--	--	48.95	--	--	--	--	--	48.95	48.95
Grout Pump	OFF - Light Commercial - Pumps	Diesel	--	--	--	--	--	--	55.42	10.51	--	--	--	--	55.42	65.93
8 YPH Wet Shotcrete Pump (Swing 750)	Portable Equipment - Non-Rental Pump	Diesel	--	--	--	--	--	--	118.17	41.04	--	--	--	--	118.17	159.21
Utility Equipment																
10 KW Generator Set (Gas)	OFF - Light Commercial - Generator Sets	Gasoline	18.56	0.01	0.02	--	--	--	34.83	34.83	34.82	34.82	23.31	--	34.83	162.62
100 KW Diesel Generator Set	Portable Equipment - Non-Rental Generator	Diesel	--	--	--	--	--	--	4.34	--	--	--	--	--	4.34	4.34
200 KW Diesel Generator Set	Portable Equipment - Non-Rental Generator	Diesel	--	--	--	--	--	--	316.32	319.74	250.67	--	--	--	319.74	886.73
320 KW Diesel Generator Set	Portable Equipment - Non-Rental Generator	Diesel	--	--	--	--	--	--	197.20	--	--	--	--	--	197.20	197.20
Tower 4-Lights 12 Hsp	OFF - ConstMin - Signal Boards	Diesel	489.88	0.05	--	253.18	0.03	--	491.15	491.16	491.15	491.16	491.17	253.84	491.17	2,709.64
3" Gas Water Pump 20,000 gph	OFF - Light Commercial - Pumps	Gasoline	--	--	--	--	--	--	1.32	--	--	--	--	--	1.32	1.32
150 CFM Diesel Compressor	OFF - Light Commercial - Air Compressors	Diesel	--	--	--	--	--	--	10.15	--	--	--	--	--	10.15	10.15
185 CFM Diesel Compressor	Portable Equipment - Non-Rental Compressor	Diesel	--	--	--	--	--	--	72.06	72.83	53.89	--	--	--	72.83	198.78
375 CFM Diesel Compressor	Portable Equipment - Non-Rental Compressor	Diesel	--	--	--	--	--	--	150.77	--	--	--	--	--	150.77	150.77
750 CFM Diesel Compressor	Portable Equipment - Non-Rental Compressor	Diesel	57.55	0.00	--	--	--	--	313.95	317.35	320.78	324.25	57.62	--	324.25	1,333.95
250 Amp Diesel Welder	OFF - Light Commercial - Welders	Diesel	--	--	--	--	--	--	35.57	35.57	22.56	--	--	--	35.57	93.71
350 Amp Diesel Welder	OFF - Light Commercial - Welders	Diesel	41.07	0.00	--	12.44	0.00	--	41.19	41.19	41.19	41.19	41.19	12.47	41.19	218.42
400 Amp Diesel Welder	OFF - Light Commercial - Welders	Diesel	--	--	--	--	--	--	1.46	--	--	--	--	--	1.46	1.46
Large Dia. Polyethylene Fusion Machine	OFF - Light Commercial - Welders	Diesel	--	--	--	--	--	--	0.94	--	--	--	--	--	0.94	0.94
2000 PSI Pressure Washer	OFF - Light Commercial - Pressure Washers	Diesel	--	--	--	--	--	--	26.32	26.34	16.93	--	--	--	26.34	69.59
10 GPM Pressure Washer	OFF - Light Commercial - Pressure Washers	Diesel	--	--	--	--	--	--	26.32	19.40	--	--	--	--	26.32	45.72
Hoisting Equipment																
20 Ton Truck Crane	ConstMin - Cranes	Diesel	--	--	--	--	--	--	0.94	--	--	--	--	--	0.94	0.94
50 Ton Truck Crane (Linkbelt 108)	ConstMin - Cranes	Diesel	--	--	--	--	--	--	3.84	--	--	--	--	--	3.84	3.84
60 Ton Crawler Crane (Linkbelt118)	ConstMin - Cranes	Diesel	--	--	--	--	--	--	197.87	197.85	197.83	117.73	--	--	197.87	711.28
150 Ton Crawler Crane (American 9260)	ConstMin - Cranes	Diesel	--	--	--	--	--	--	342.34	339.79	--	--	--	--	342.34	682.13
20 Ton Hydraulic Crane (Grove58)	ConstMin - Cranes	Diesel	--	--	--	--	--	--	121.18	--	--	--	--	--	121.18	121.18
30 Ton Hydraulic Crane (Grove500)	ConstMin - Cranes	Diesel	--	--	--	--	--	--	5.95	--	--	--	--	--	5.95	5.95
60 Ton Hydraulic Crane (Grove)	ConstMin - Cranes	Diesel	--	--	--	--	--	--	56.75	--	--	--	--	--	56.75	56.75
Motorized Manlift 66 Ft	Industrial - Aerial Lifts	Diesel	--	--	--	--	--	--	3.85	--	--	--	--	--	3.85	3.85
Drilling & Tunneling Equipment																
Hydraulic Drill 3" (AC1238/Tam400)	ConstMin - Bore/Drill Rigs	Diesel	--	--	--	--	--	--	851.81	852.92	852.60	621.04	--	--	852.92	3,178.37
2.5" Air Track Rockdrill (IR100)	ConstMin - Bore/Drill Rigs	Diesel	--	--	--	--	--	--	252.00	--	--	--	--	--	252.00	252.00
Core Drill Skid Mounted 44 Hsp	ConstMin - Bore/Drill Rigs	Diesel	--	--	--	--	--	--	4.48	--	--	--	--	--	4.48	4.48
Tunnel Scissor Truck	Industrial - Aerial Lifts	Diesel	--	--	--	--	--	--	0.19	--	--	--	--	--	0.19	0.19
1/4 CY Crawler Backhoe	ConstMin - Tractors/Loaders/Backhoes	Diesel	--	--	--	--	--	--	30.40	--	--	--	--	--	30.40	30.40

Table A-71. Annual Unmitgated Emissions - Onsite Construction Equipment

Equipment Description	OFFROAD2017 Equipment Category	Fuel	Annual Emissions - 2028 (metric tons per year)			Annual Emissions - 2029 (metric tons per year)			Annual Emissions (metric tons CO2e per year)							
			CO2	CH4	N2O	CO2	CH4	N2O	2024	2025	2026	2027	2028	2029	Annual Maximum	Project Total

Service & Maintenance Equipment																		
1/2 Ton Pickup Truck 2x2	n/a - onroad	Diesel	1,287	n/a	1	g/hr	--	--	--	--	--	--	--	--	--	--	--	--
3/4 Ton Pickup Truck 2x2	n/a - onroad	Diesel	404,389	n/a	10	g/hr	#VALUE!	#VALUE!	#VALUE!	--	--	--	--	--	--	--	--	--
3/4 Ton Pickup Truck 4x4	n/a - onroad	Diesel	117,268	n/a	3	g/hr	20.79	0.00	0.00	20.11	0.00	0.00	19.53	0.00	0.00	19.01	0.00	0.00
3/4 Ton Crew Cab Truck	n/a - onroad	Diesel	300	n/a	1	g/hr	--	--	--	--	--	--	--	--	--	--	--	--
3/4 Ton Crew Cab Truck	n/a - onroad	Diesel	300	n/a	1	g/hr	13.21	0.00	0.00	--	--	--	--	--	--	--	--	--
5 Ton Flat Bed Truck	n/a - onroad	Diesel	22,262	n/a	1	g/hr	749.76	0.01	0.01	725.13	0.01	0.01	703.79	0.01	0.01	684.58	0.01	0.01
10 Ton Flat Bed Truck	n/a - onroad	Diesel	3,158	n/a	1	g/hr	224.93	0.00	0.00	217.54	0.00	0.00	211.14	0.00	0.00	205.37	0.00	0.00
1- Ton Mechanic Truck	n/a - onroad	Diesel	3,250	n/a	1	g/hr	3.08	0.00	0.00	--	--	--	--	--	--	--	--	--
2-Ton Mechanic Truck	n/a - onroad	Diesel	116,578	n/a	3	g/hr	3.08	0.00	0.00	--	--	--	--	--	--	--	--	--
Lube Truck	n/a - onroad	Diesel	76,667	n/a	2	g/hr	74.98	0.00	0.00	72.51	0.00	0.00	70.38	0.00	0.00	3.39	0.00	0.00
Fuel Truck (Tandem Axle 20000 litres)	n/a - onroad	Diesel	38,333	n/a	1	g/hr	32.44	0.00	0.00	--	--	--	--	--	--	--	--	--
1000 Gallon Watertruck	n/a - onroad	Diesel	2,091	n/a	1	g/hr	33.38	0.00	0.00	--	--	--	--	--	--	--	--	--
3000 Gallon Watertruck	n/a - onroad	Diesel	26,605	n/a	1	g/hr	224.93	0.00	0.00	217.54	0.00	0.00	211.14	0.00	0.00	205.37	0.00	0.00
5000 Gallon Watertanker	n/a - onroad	Diesel	597	n/a	1	g/hr	149.95	0.00	0.00	145.03	0.00	0.00	140.76	0.00	0.00	136.92	0.00	0.00
631 WaterWagon	ConstMin - Off-Highway Tractors	Diesel	74,735	500	2	g/hp-hr	836.53	0.08	--	837.16	0.08	--	837.56	0.08	--	838.34	0.07	--
631 Water Wagon	ConstMin - Off-Highway Tractors	Diesel	3,803	500	1	g/hp-hr	239.60	0.02	--	--	--	--	--	--	--	--	--	--
5 Ton Boomtruck	n/a - onroad	Diesel	212	n/a	1	g/hr	74.98	0.00	0.00	72.51	0.00	0.00	70.38	0.00	0.00	44.13	0.00	0.00
10 Ton Boomtruck	n/a - onroad	Diesel	249	n/a	1	g/hr	6.13	0.00	0.00	--	--	--	--	--	--	--	--	--
20 Ton Boomtruck	n/a - onroad	Diesel	375	n/a	1	g/hr	149.95	0.00	0.00	145.03	0.00	0.00	140.76	0.00	0.00	136.92	0.00	0.00
		Total	**2,461,102**	**n/a**	**n/a**	**n/a**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**18,151.21**	**2,026.07**	**2,025.03**	**15,901.99**	**2,026.88**	**2,026.03**	**12,690.51**	**2,027.68**	**2,027.03**

Service & Maintenance Equipment															
1/2 Ton Pickup Truck 2x2	n/a - onroad	Diesel	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3/4 Ton Pickup Truck 2x2	n/a - onroad	Diesel	--	--	--	--	--	--	#VALUE!	--	--	--	--	--	#VALUE!	#VALUE!
3/4 Ton Pickup Truck 4x4	n/a - onroad	Diesel	18.54	0.00	0.00	18.14	0.00	0.00	20.84	20.16	19.58	19.06	18.59	18.19	20.84	116.41
3/4 Ton Crew Cab Truck	n/a - onroad	Diesel	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3/4 Ton Crew Cab Truck	n/a - onroad	Diesel	--	--	--	--	--	--	13.24	--	--	--	--	--	13.24	13.24
5 Ton Flat Bed Truck	n/a - onroad	Diesel	667.51	0.01	0.01	352.10	0.00	0.00	751.47	726.84	705.50	686.29	669.22	353.03	751.47	3,892.33
10 Ton Flat Bed Truck	n/a - onroad	Diesel	200.25	0.00	0.00	69.44	0.00	0.00	225.44	218.05	211.65	205.89	200.77	69.62	225.44	1,131.41
1- Ton Mechanic Truck	n/a - onroad	Diesel	--	--	--	--	--	--	3.08	--	--	--	--	--	3.08	3.08
2-Ton Mechanic Truck	n/a - onroad	Diesel	--	--	--	--	--	--	3.08	--	--	--	--	--	3.08	3.08
Lube Truck	n/a - onroad	Diesel	--	--	--	--	--	--	75.15	72.68	70.55	3.40	--	--	75.15	221.78
Fuel Truck (Tandem Axle 20000 litres)	n/a - onroad	Diesel	--	--	--	--	--	--	32.51	--	--	--	--	--	32.51	32.51
1000 Gallon Watertruck	n/a - onroad	Diesel	--	--	--	--	--	--	33.46	--	--	--	--	--	33.46	33.46
3000 Gallon Watertruck	n/a - onroad	Diesel	200.25	0.00	0.00	63.27	0.00	0.00	225.44	218.05	211.65	205.89	200.77	63.43	225.44	1,125.22
5000 Gallon Watertanker	n/a - onroad	Diesel	133.50	0.00	0.00	32.78	0.00	0.00	150.29	145.37	141.10	137.26	133.84	32.86	150.29	740.72
631 WaterWagon	ConstMin - Off-Highway Tractors	Diesel	838.97	0.07	--	210.51	0.02	--	838.59	839.13	839.45	840.16	840.72	210.94	840.72	4,408.99
631 Water Wagon	ConstMin - Off-Highway Tractors	Diesel	--	--	--	--	--	--	240.19	--	--	--	--	--	240.19	240.19
5 Ton Boomtruck	n/a - onroad	Diesel	--	--	--	--	--	--	75.15	72.68	70.55	44.24	--	--	75.15	262.62
10 Ton Boomtruck	n/a - onroad	Diesel	--	--	--	--	--	--	6.15	--	--	--	--	--	6.15	6.15
20 Ton Boomtruck	n/a - onroad	Diesel	133.50	0.00	0.00	15.51	0.00	0.00	150.29	145.37	141.10	137.26	133.84	15.55	150.29	723.41
		Total	**10,309.28**	**2,028.53**	**2,028.03**	**5,706.43**	**2,029.20**	**2,029.00**	**#VALUE!**	**18,188.24**	**15,934.21**	**12,717.38**	**10,330.24**	**5,712.73**	**#VALUE!**	**#VALUE!**

Pacheco Reservoir Expansion Alternative
Offsite Construction Emissions

Table A-72. Construction Worker Commuting Emissions

Year	Annual Trips	Emission Factors, grams per mile			Annual Emissions, tons per year			
		CO2	CH4	N2O	CO2	CH4	N2O	CO2e
2024	159,250	254.53	0.18	0.08	1,621.34	1.17	0.49	1,795.59
2025	191,889	243.80	0.18	0.08	1,871.26	1.41	0.59	2,081.37
2026	291,261	234.50	0.18	0.08	2,731.98	2.14	0.89	3,051.10
2027	309,400	226.32	0.18	0.08	2,800.95	2.27	0.95	3,140.14
2028	309,400	219.16	0.18	0.08	2,712.34	2.27	0.95	3,051.72
2029	142,567	212.89	0.18	0.08	1,214.06	1.05	0.44	1,370.52
				Maximum	**2,800.95**	**2.27**	**0.95**	**3,140.14**
				Total	**12,951.93**	**10.32**	**4.30**	**14,490.43**

Table A-73. Haul Trucks Emissions

Year	Annual Trips	Emission Factors, grams per mile			Annual Emissions, tons per year			
		CO2	CH4	N2O	CO2	CH4	N2O	CO2e
2024	48,230	1,539.49	0.01	0.00	2,969.98	0.01	0.01	2,972.98
2025	132,253	1,533.94	0.01	0.00	8,114.72	0.03	0.03	8,122.96
2026	156,520	1,528.77	0.01	0.00	9,571.34	0.03	0.03	9,581.09
2027	144,387	1,523.51	0.01	0.00	8,798.98	0.03	0.03	8,807.98
2028	10,920	1,518.96	0.01	0.00	663.48	0.00	0.00	664.16
2029	4,550	1,514.70	0.01	0.00	275.67	0.00	0.00	275.96
				Maximum	**9,571.34**	**0.03**	**0.03**	**9,581.09**
				Total	**30,394.17**	**0.10**	**0.10**	**30,425.13**

One-way trip distance	
Workers	40 miles
Trucks	40 miles

Global Warming Potential	
CO2	1
CH4	25
N2O	298

Conversions

1,000,000 grams per metric ton

EMFAC2014 Emission Factors
On-Road Motor Vehicles

Table A-74. Unmitigated Emission Factors for Construction Worker Commutes and Haul Trucks (San Francisco Bay Area Air Basin

	Workers			Heavy-Duty Trucks		
Year	CO2	CH4	N2O	CO2	CH4	N2O
2024	254.5274	0.1837	0.0764	1,539.4861	0.0051	0.0048
2025	243.7953	0.1837	0.0764	1,533.9352	0.0051	0.0048
2026	234.4962	0.1837	0.0765	1,528.7722	0.0051	0.0048
2027	226.3207	0.1837	0.0766	1,523.5095	0.0051	0.0048
2028	219.1616	0.1838	0.0766	1,518.9573	0.0051	0.0048
2029	212.8932	0.1838	0.0766	1,514.6963	0.0051	0.0048

Note:
Vehicle fleet mix includes gasoline, diesel, and electric automobiles (LDA) and light-duty trucks (LDT1 and LDT2) for construction workers.

Table A-75. On-Road Medium-Duty Vehicle Diesel Emission Factors (San Francisco Bay Area Air Basin), grams per hour

Speed	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
5	5,335.24	5,190.32	5,042.84	4,891.44	4,738.47	4,585.27	4,453.02	4,333.36	4,226.99	4,134.20	4,051.88
10	9,061.54	8,815.38	8,564.04	8,305.84	8,044.73	7,783.39	7,556.62	7,352.88	7,172.74	7,014.92	6,874.88
15	11,585.95	11,266.48	10,941.40	10,607.53	10,270.71	9,933.31	9,640.98	9,377.80	9,143.99	8,939.20	8,757.65
20	12,725.83	12,379.54	12,026.54	11,663.95	11,298.07	10,931.80	10,615.58	10,331.46	10,080.08	9,860.21	9,665.16
25	13,455.78	13,089.96	12,716.94	12,333.81	11,947.09	11,559.93	11,225.43	10,924.85	10,659.01	10,426.39	10,220.02
30	13,938.32	13,559.46	13,173.55	12,777.18	12,377.30	11,976.86	11,631.74	11,320.71	11,045.15	10,804.57	10,591.21
35	14,784.54	14,379.20	13,966.55	13,542.89	13,115.40	12,687.24	12,318.41	11,985.46	11,690.32	11,433.46	11,206.00
40	15,779.91	15,348.81	14,909.89	14,458.98	14,003.72	13,548.11	13,155.84	12,801.57	12,487.59	12,214.53	11,972.77
45	17,063.49	16,603.53	16,134.97	15,653.57	15,168.04	14,681.66	14,262.38	13,884.17	13,548.71	13,255.23	12,994.54
50	19,040.69	18,523.59	17,996.69	17,455.74	16,909.48	16,362.56	15,891.68	15,467.11	15,091.43	14,764.05	14,473.93
55	22,145.35	21,544.69	20,932.70	20,304.08	19,670.03	19,034.75	18,487.21	17,992.60	17,554.13	17,171.58	16,832.19
60	26,111.76	25,403.47	24,681.94	23,941.23	23,194.31	22,446.14	21,801.74	21,222.00	20,708.94	20,260.34	19,862.33
65	31,823.18	30,948.94	30,059.10	29,145.79	28,223.56	27,300.60	26,506.23	25,790.37	25,156.66	24,605.57	24,118.01

CH4 and N2O Emission Factors

Table A-76. San Francisco Bay Area Air Basin County Emission Factors

Year	Type	Fuel	VMT	CH4 (g/mi)	N2O (g/mi)
2024	LDA	GAS	93,606,028	0.1780	0.0647
		DSL	1,166,100	0.0006	0.0012
	LDT1	GAS	6,707,310	0.2024	0.1056
		DSL	4,809	0.0011	0.0017
	LDT2	GAS	33,923,737	0.2024	0.1056
		DSL	72,319	0.0011	0.0017
	Weighted Average Emission Factor (2024), grams per mile			**0.1837**	**0.0764**
2025	LDA	GAS	93,311,764	0.1780	0.0647
		DSL	1,184,105	0.0006	0.0012
	LDT1	GAS	6,680,049	0.2024	0.1056
		DSL	4,639	0.0011	0.0017
	LDT2	GAS	34,172,007	0.2024	0.1056
		DSL	73,654	0.0011	0.0017
	Weighted Average Emission Factor (2025), grams per mile			**0.1837**	**0.0764**
2026	LDA	GAS	92,870,572	0.1780	0.0647
		DSL	1,195,720	0.0006	0.0012
	LDT1	GAS	6,646,085	0.2024	0.1056
		DSL	4,438	0.0011	0.0017
	LDT2	GAS	34,322,944	0.2024	0.1056
		DSL	74,460	0.0011	0.0017
	Weighted Average Emission Factor (2026), grams per mile			**0.1837**	**0.0765**
2027	LDA	GAS	92,720,306	0.1780	0.0647
		DSL	1,207,526	0.0006	0.0012
	LDT1	GAS	6,635,950	0.2024	0.1056
		DSL	3,976	0.0011	0.0017
	LDT2	GAS	34,549,525	0.2024	0.1056
		DSL	75,253	0.0011	0.0017
	Weighted Average Emission Factor (2027), grams per mile			**0.1837**	**0.0766**
2028	LDA	GAS	92,625,303	0.1780	0.0647
		DSL	1,217,683	0.0006	0.0012
	LDT1	GAS	6,633,341	0.2024	0.1056
		DSL	3,799	0.0011	0.0017
	LDT2	GAS	34,768,297	0.2024	0.1056
		DSL	75,916	0.0011	0.0017
	Weighted Average Emission Factor (2028), grams per mile			**0.1838**	**0.0766**
2029	LDA	GAS	92,582,004	0.1780	0.0647
		DSL	1,226,926	0.0006	0.0012
	LDT1	GAS	6,636,213	0.2024	0.1056
		DSL	3,707	0.0011	0.0017
	LDT2	GAS	34,978,472	0.2024	0.1056
		DSL	76,507	0.0011	0.0017
	Weighted Average Emission Factor (2029), grams per mile			**0.1838**	**0.0766**

Table A-77. Emission Factors for Highway Vehicles by Technology Type

Vehicle Type/ Control Technology	CH4 (g/mi)	N2O (g/mi)
Gasoline Passenger Cars		
EPA Tier 2	0.0173	0.0036
Low Emission Vehicles	0.0105	0.0150
EPA Tier 1	0.0271	0.0429
EPA Tier 0	0.0704	0.0647
Oxidation Catalyst	0.1355	0.0504
Non-Catalyst Control	0.1696	0.0197
Uncontrolled	0.1780	0.0197
Gasoline Light Trucks (Vans, Pickup Trucks, SUVs)		
EPA Tier 2	0.0163	0.0066
Low Emission Vehicles	0.0148	0.0157
EPA Tier 1	0.0452	0.0871
EPA Tier 0	0.0776	0.1056
Oxidation Catalyst	0.1516	0.0639
Non-Catalyst Control	0.1908	0.0218
Uncontrolled	0.2024	0.0220
Gasoline Medium and Heavy-Duty Vehicles (Trucks and Busses)		
EPA Tier 2	0.0333	0.0134
Low Emission Vehicles	0.0303	0.0320
EPA Tier 1	0.0655	0.1750
EPA Tier 0	0.2630	0.2135
Oxidation Catalyst	0.2356	0.1317
Non-Catalyst Control	0.4181	0.0473
Uncontrolled	0.4604	0.0497
Diesel Passenger Cars		
Advanced	0.0005	0.0010
Moderate	0.0005	0.0010
Uncontrolled	0.0006	0.0012
Diesel Light Trucks		
Advanced	0.0010	0.0015
Moderate	0.0009	0.0014
Uncontrolled	0.0011	0.0017
Diesel Medium and Heavy-Duty Vehicles (Trucks and Busses)		
Aftertreatment	0.0051	0.0048
Advanced	0.0051	0.0048
Moderate	0.0051	0.0048
Uncontrolled	0.0051	0.0048
Motorcycles		
Non-Catalyst Control	0.0672	0.0069
Uncontrolled	0.0899	0.0087

0.0765 0.072

Source:
2018 Climate Registry Default Emissions Factors
Table 13.4 Default CH4 and N2O Emission Factors for Highway Vehicles by Technology Type
https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf

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