Appendix M

Air Quality and GHG Emissions Calculations

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Otter Tail Power
BSSA
Total Operational Emissions, Year

Equipment	MOVES Lookup ID	SCAB Lookup ID	Fuel	HP [c]	Number of Units [c]	Total Operation Time (hr) [c]	Load Factor
Equipment							
E4_OTL EQP_PICKUP TRUCK-F350_CREW CAB _8001-11K_4X4	Off-Highway Trucks	Off-Highway Trucks	*Diesel*	500	1	15	0.59
K8_OTL EQP_HEAVY BUCKET TRUCK100 FT_RUBBER TIRE_6X6	Off-Highway Trucks	Off-Highway Trucks	*Diesel*	500	1	15	0.59
N4_OTL EQP_TRUCK MOUNTEDCRANE_45T/50T_RUBBER TIRE	Cranes	Cranes	*Diesel*	500	1	15	0.43
S2_OTL EQP_BACKHOE-LOADER_RUBBER TIRE_4X4	Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes	*Diesel*	120	1	15	0.21
U1_OTL EQP_SKID STEERLOADER_TRACKED	Skid Steer Loaders	Skid Steer Loaders	*Diesel*	120	1	15	0.21
W2_OTL EQP_ATV/UTV POLARIS/CANAM/ARGO_RUBBER	Rubber Tire Loaders	Rubber Tired Loaders	*Diesel*	25	1	60	0.59
R1_OTL EQP_TRAILERUTV/FRAMING/ENCLOSED_<=12K_RU BBER TIRE	Other Construction Equipment	Other Construction Equipment	*Diesel*	120	1	60	0.59
D2_OTL EQP_PICKUP TRUCK-F150_6001-8K_4X4	Off-Highway Trucks	Off-Highway Trucks	*Diesel*	500	1	60	0.59
R2_OTL EQP_TRAILER MEDIUMEQUIP_12001-20K_RUBBER TIRE_TAND	Other Construction Equipment	Other Construction Equipment	*Diesel*	120	1	15	0.59
R3_OTL EQP_TRAILER LARGEEQUIP_>20K_RUBBER TIRE_TANDEM	Other Construction Equipment	Other Construction Equipment	*Diesel*	120	1	15	0.59

[a] EPA Tier II Emissions. EPA 420_P_04_009, Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling _ Compression Ignition, USEPA, April 2004 _ Tier 2 Engines.

[b] South Coast AQMD Off Road- Model Mobile Source Emission Factors (https://www.aqmd.gov/home/rules-compliance/ceqa/air-quality-analysis-handbook/off-road-mobile-source-emission-factors)

[c] based on similar project

[d] EPA Exhaust and Crankcase Emission Factors for Nonroad Compression-Ignition Engines in MOVES3.0.2, September 2021. Equation 10 - Assume ultra low sulfur diesel with 15ppm.

[e] NMHC (5% NMHC and 95% NOx in combined NMHC +NOx)
https://www.baaqmd.gov/~/media/Files/Engineering/policy_and_procedures/Engines/EmissionFactorsforDieselEngines.ashx

[f] Global Warming Potentials from EPA GHG Emission Factors Hub, 2024.

[g] N2O emissions estimated based on the ratio of g N2O per gallon of construction diesel to gallons of diesel per g CO2, obtained from Tables 2.7 and 2.1, respectively, of the 2023 Climate Registry Default Emission Factors. Retrieved from https://theclimateregistry.org/wp-content/uploads/2023/06/2023-Default-Emission-Factors-Final.pdf, June 2023.

Assumptions:

1 kWh = 1.34 hp-hr 1.053

lb/metric ton 2204.62

Otter Tail Power
BSSA
Total Operational Emissions, Year

			Emission Factors (g/hp-hr) [a]						Emission Factors (g/hr) [b]				Criteria Air Pollutant Emissions (ton / year)						GHG Emissions (metric ton/year)			
Equipment	**MOVES Lookup ID**	**SCAB Lookup ID**	**CO**	**NO_X**	**SO_2**	**VOC [c]**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O[g]**	**CO_2e[f]**	**CO**	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**
Equipment																						
E4_OTL EQP_PICKUP TRUCK-F350_CREW CAB _8001-11K_4X4	Off-Highway Trucks	Off-Highway Trucks	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	123528.4545	4.8426	11.3728	126677.8506	1.27E-02	2.21E-02	2.38E-05	1.16E-03	7.28E-04	7.28E-04	1.85E+00	7.26E-05	1.71E-04	1.90E+00
K8_OTL EQP_HEAVY BUCKET TRUCK100 FT_RUBBER TIRE_6X6	Off-Highway Trucks	Off-Highway Trucks	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	123528.4545	4.8426	11.3728	126677.8506	1.27E-02	2.21E-02	2.38E-05	1.16E-03	7.28E-04	7.28E-04	1.85E+00	7.26E-05	1.71E-04	1.90E+00
N4_OTL EQP_TRUCK MOUNTEDCRANE_45T/50T_RUBBER TIRE	Cranes	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	3.5108	7.5212	83783.9011	9.29E-03	1.61E-02	1.73E-05	8.49E-04	5.31E-04	5.31E-04	1.23E+00	5.27E-05	1.13E-04	1.26E+00
S2_OTL EQP_BACKHOE-LOADER_RUBBER TIRE_4X4	Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	23463.4126	1.1492	2.1602	24068.0414	1.55E-03	1.95E-03	2.03E-06	1.03E-04	9.33E-05	9.33E-05	3.52E-01	1.72E-05	3.24E-05	3.61E-01
U1_OTL EQP_SKID STEERLOADER_TRACKED	Skid Steer Loaders	Skid Steer Loaders	3.7313	4.6791	0.0054	0.2463	0.2239	0.2239	19396.4227	0.7142	1.7858	19889.6473	1.55E-03	1.95E-03	2.25E-06	1.03E-04	9.33E-05	9.33E-05	2.91E-01	1.07E-05	2.68E-05	2.98E-01
W2_OTL EQP_ATV/UTV POLARIS/CANAM/ARGO_RUBBER	Rubber Tire Loaders	Rubber Tired Loaders	4.9254	5.3172	0.0049	0.2799	0.5970	0.5970	7678.9339	0.8359	0.7070	7889.6857	4.80E-03	5.19E-03	4.75E-06	2.73E-04	5.82E-04	5.82E-04	4.61E-01	5.02E-05	4.24E-05	4.73E-01
R1_OTL EQP_TRAILERUTV/FRAMING/ENCLOSED_<=12K_RU BBER TIRE_T	Other Construction Equipment	Other Construction Equipment	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	36676.8768	1.5524	3.3767	37615.1724	1.75E-02	2.19E-02	2.28E-05	1.15E-03	1.05E-03	1.05E-03	2.20E+00	9.31E-05	2.03E-04	2.26E+00
D2_OTL EQP_PICKUP TRUCK-F150_6001-8K_4X4	Off-Highway Trucks	Off-Highway Trucks	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	123528.4545	4.8426	11.3728	126677.8506	5.10E-02	8.85E-02	9.50E-05	4.66E-03	2.91E-03	2.91E-03	7.41E+00	2.91E-04	6.82E-04	7.60E+00
R2_OTL EQP_TRAILER MEDIUMEQUIP_12001-20K_RUBBER TIRE_TANDEM	Other Construction Equipment	Other Construction Equipment	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	36676.8768	1.5524	3.3767	37615.1724	4.37E-03	5.48E-03	5.70E-06	2.88E-04	2.62E-04	2.62E-04	5.50E-01	2.33E-05	5.07E-05	5.64E-01
R3_OTL EQP_TRAILER LARGEEQUIP_>20K_RUBBER TIRE_TANDEM	Other Construction Equipment	Other Construction Equipment	3.7313	4.6791	0.0054	0.2463	0.2239	0.2239	36676.8768	1.5524	3.3767	37615.1724	4.37E-03	5.48E-03	6.33E-06	2.88E-04	2.62E-04	2.62E-04	5.50E-01	2.33E-05	5.07E-05	5.64E-01

[a] EPA Tier II Emissions. EPA 420_P_04.009, Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling _ Compression Ignition, USEPA, April 2004 _ Tier 2 Engines.

[b] South Coast AQMD Off Road- Model Mobile Source Emission Factors (https://www.aqmd.gov/home/rules-compliance/ceqa/air-quality-analysis-handbook/off-road-mobile-source-emission-factors)

[c] based on similar project

[d] EPA Exhaust and Crankcase Emission Factors for Nonroad Compression-Ignition Engines in MOVES3.0.2, September 2021.
Equation 10 - Assume ultra low sulfur diesel with 15ppm.

[e] NMHC (5% NMHC and 95% NOx in combined NMHC +NOx)
https://www.baaqmd.gov/~/media/Files/Engineering/policy_and_procedures/Engines/EmissionFactorsforDieselEngines.ashx

[f] Global Warming Potentials from EPA GHG Emission Factors Hub, 2024.

[g] N2O emissions estimated based on the ratio of g N2O per gallon of construction diesel to gallons of diesel per g CO2, obtained from Tables 2.7 and 2.1, respectively, of the 2023 Climate Registry Default Emission Factors. Retrieved from https://theclimateregistry.org/wp-content/uploads/2023/06/2023-Default-Emission-Factors-Final.pdf, June 2023.

Assumptions:

1 kWh = 1.34 hp-hr 1.053

lb/metric ton 2204.62

CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e	
0.12	0.19	0.00	0.01	0.01	0.01	16.75	0.00	0.00	17.18	Equipment

Construction Emissions Summary

Year	Activity	Emissions (tons/year)						Emissions (metric tons/year)			
		CO	NOX	SO2	VOC	PM10	PM2.5	CO_2	CH_4	N_2O	CO_2e
2028	Equipment	29.02	49.84	0.05	2.62	1.68	1.68	5126.21	0.09	0.47	5253.84
	Fugitive Dust	0.00	0.00	0.00	0.00	381.18	38.62	0.00	0.00	0.00	0.00
	Onroad	5.13	0.64	0.01	0.05	0.78	0.20	947.80	0.01	0.04	958.41
	Helicopter	1.92	0.88	0.00	1.60	0.03	0.03	428.59	0.02	0.00	430.03
2029	Equipment	29.91	51.36	0.05	2.70	1.73	1.73	5283.68	0.09	0.49	5415.22
	Fugitive Dust	0.00	0.00	0.00	0.00	381.18	38.62	0.00	0.00	0.00	0.00
	Onroad	4.80	0.53	0.00	0.04	0.78	0.20	938.15	0.01	0.04	948.73
	Helicopter	4.33	1.97	0.00	3.61	0.06	0.06	964.32	0.04	0.01	967.57
2030	Equipment	29.91	51.36	0.05	2.70	1.73	1.73	5283.68	0.09	0.49	5415.22
	Fugitive Dust	0.00	0.00	0.00	0.00	381.18	38.62	0.00	0.00	0.00	0.00
	Onroad	4.59	0.47	0.00	0.04	0.78	0.20	931.24	0.01	0.04	941.83
	Helicopter	4.33	1.97	0.00	3.61	0.06	0.06	964.32	0.04	0.01	967.57
2031	Equipment	6.36	10.92	0.01	0.57	0.37	0.37	1123.89	0.02	0.10	1151.88
	Fugitive Dust	0.00	0.00	0.00	0.00	18.08	1.89	0.00	0.00	0.00	0.00
	Onroad	0.68	0.06	0.00	0.00	0.12	0.03	143.99	0.00	0.01	145.62
	Helicopter	0.67	0.31	0.00	0.56	0.01	0.01	150.01	0.01	0.00	150.51
Total		**121.64**	**170.30**	**0.19**	**18.10**	**1169.75**	**124.06**	**22285.88**	**0.44**	**1.69**	**22746.41**

Operational Emissions Summary

Year	Activity	Emissions (tons/year)						Emissions (metric tons/year)			
		CO	NOX	SO2	VOC	PM10	PM2.5	CO_2	CH_4	N_2O	CO_2e
	Equipment	0.12	0.19	0.00	0.01	0.01	0.01	16.75	0.00	0.00	17.18

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Total Construction Emissions, Year
2031 blue denotes cells that change by year

Equipment	MOVES Lookup ID	SCAB Lookup ID	Fuel	HP	Typical Hours per day	Typical Days/Year	Count	Total Hours Used	Load Factor [c]	
Equipment										
ATV 4 TO 6 WHEEL, W/ DUMP	Off-Highway Trucks	Off-Highway Trucks	Diesel	13.5	2	15	1	30	0.59	
BACKHOE W/ LOADER 4X4	Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes	Diesel	94	2	21	2	84	0.21	
BUCKET 105' WORK HEIGHT	Aerial Lifts	Aerial Lifts	Diesel	300	8	35	3	840	0.21	
BUCKET 125' WORK HEIGHT 8X6	Aerial Lifts	Aerial Lifts	Diesel	350	8	35	1	280	0.21	
BUCKET 77' WORK HEIGHT SWAMP TRK MTD	Aerial Lifts	Aerial Lifts	Diesel	300	8	15	2	240	0.21	
TRUCK MTD 4 T ARTICULATING BOOM W/ FORKS & CLAM	Cranes	Cranes	Diesel	450	2	21	1	42	0.43	
CRANE TRUCK 45 T HYDRAULIC 6 AXLE	Cranes	Cranes	Diesel	450	8	35	6	1680	0.43	
DIGGER DERRICK 15 T CAP	Cranes	Cranes	Diesel	330	8	35	4	1120	0.43	
DIGGER DERRICK 15 T CAP SWAMP TRACK MTD	Cranes	Cranes	Diesel	300	8	15	2	240	0.43	
DOZER 10 THRU 12 T, W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	Diesel	80	4	21	1	84	0.59	
DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	Diesel	190	4	21	1	84	0.59	
CRAWLER CARRIER W/ 360 DUMP BOX OR DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	Diesel	80	6	15	1	90	0.59	
EXCAVATOR 25 T	Excavators	Excavators	Diesel	172	4	15	1	60	0.59	
FORKLIFT 11,000 THRU 12,000# TELESCOPIC BOOM	Forklifts	Forklifts	Diesel	142	4	35	3	420	0.59	
FRONT END LOADER 68,000# 4X4	Rubber Tire Loaders	Rubber Tired Loaders	Diesel	386	4	35	4	560	0.59	
GENERATOR 23KW THRU 60KW TRAILER MOUNTED TOW TYPE	Generator Sets	Generator Sets	Diesel	38	8	20	4	640	0.43	
HYDRAULIC BULLWHEEL BUNDLE TENSIONER	Other Construction Equipment	Other Construction Equipment	Diesel	80	2	18	1	36	0.59	
PULLER ROPE TRAILER 4,000# CAP W/ SPLIT REEL TOW TYPE TANDEM A	Other Construction Equipment	Other Construction Equipment	Diesel	74	2	18	1	36	0.59	
PULLER CABLE TRAILER 30,000# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	Other Construction Equipment	Diesel	400	2	18	1	36	0.59	
PULLER ROPE TRAILER 4 DRUM 3,500# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	Other Construction Equipment	Diesel	115	2	18	1	36	0.59	
300T AT Setting Crane	Cranes	Cranes	Diesel	577	6	30	1	180	0.43	
60T RT Crane	Cranes	Cranes	Diesel	320	4	35	4	560	0.43	
SKID STEER LOADER TRACK MTD 80 > 75 HP	Skid Steer Loaders	Skid Steer Loaders	Diesel	95	4	35	5	700	0.21	
DUMP BOX TRUCK 2-1/2 T 6X6	Dumpers/Tenders	Dumpers/Tenders Composite	Diesel	505	2	35	1	70	0.21	
DUMP BOX TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	Dumpers/Tenders Composite	Diesel	420	4	35	2	280	0.21	
FLATBED (FRAMING) TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	Dumpers/Tenders Composite	Diesel	420	4	35	6	840	0.21	
TRUCK TRACTOR 2-1/2 T 6X4 & 5 T 6X6	Off-highway Trucks	Off-highway Trucks	Diesel	450	4	21	6	504	0.59	
PICKUP TRUCK 3/4 T	Off-highway Trucks	Off-highway Trucks	Diesel	420	8	35	14	3920	0.59	

Fugitive Dust										
Dust from On Site Activities										
Onroad	**MOVES Vehicle Class**		**Fuel Type**	**VMT**	**Onroad Fuel ID**	**Year**	**MOVES Road Type**	**MOVES Day Type**		
Resuspended Road Dust										
Worker Commute (Gas Passenger Truck)	31		Gasoline	323,400	1	2031	3	5		
Material Hauling (Single Unit Truck)	52		Diesel	37,800	2	2031	3	5		
Flatbed truck (Combination Long Haul Truck)	62		Diesel	8,400	2	2031	3	5		

Helicopter Emissions	Engine Mode	Quantity	Hours/day	Number of days per year	Total Hours	Fuel Flow (Kg/s) [h]	Max Power (HP)[d]	Load Factor	Loaded Power (HP)	Fuel Usage (kg fuel)	Fuel Usage (mmBtu)
Helicopter with Turboshaft Engine	*Ground Idle*	*1*	1.00	42	42	0.015	420	0.13000	55	2217.09	90.57
Helicopter with Turboshaft Engine	*Hover and Climb*	*1*	1.25	42	52.5	0.033	420	0.87000	365	6181.33	252.51
Helicopter with Turboshaft Engine	*Approach*	*1*	1.25	42	52.5	0.025	420	0.46000	193	4721.86	192.89
Helicopter with Turboshaft Engine	*Flight*	*1*	8.00	42	336	0.031	420	0.80000	336	37724.95	1541.09

[a] EPA Tier II Emissions. EPA 420.P.04.009, Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling _ Compression Ignition, USEPA, April 2004 _ Tier 2 Engines.

[b] South Coast AQMD Off Road- Model Mobile Source Emission Factors (https://www.aqmd.gov/home/rules-compliance/ceqa/air-quality-analysis-handbook/off-road-mobile-source-emission-factors)

[c] Load Factors from MOVES4

[d] EPA Exhaust and Crankcase Emission Factors for Nonroad Compression-Ignition Engines in MOVES3.0.2, September 2021. Equation 10 - Assume ultra low sulfur diesel with 15ppm.

[e] NMHC (5% NMHC and 95% NOx in combined NMHC +NOx)
https://www.baaqmd.gov/~/media/Files/Engineering/policy_and_procedures
/Engines/EmissionFactorsforDieselEngines.ashx

[f] Global Warming Potentials from EPA GHG Emission Factors Hub, 2024.

[g] N2O emissions estimated based on the ratio of g N2O per gallon of construction diesel to gallons of diesel per g CO2, obtained from Tables 2.7 and 2.1, respectively, of the 2023 Climate Registry Default Emission Factors. Retrieved from https://theclimateregistry.org/wp-content/uploads/2023/06/2023-Default-Emission-Factors-Final.pdf, June 2023.

[h] Conservatively, a maximum of 8 hours of flight time is allocated. Based on the helicopter's flying speed of 30 mph over a distance of 110 miles, the estimated actual flight time is approximately 3.7 hours.Assume helicopter starts 25 weeks into year 2028 and continues to the end of the construction duration. Source: Guidance on the Determination of Helicopter Emissions Edition 2 - December 2015.
https://www.bazl.admin.ch/dam/bazl/de/dokumente/Fachleute/Regulationen_und_Grundlagen/guidance_on_the_determinationofhelicopteremissions.pdf.download.pdf/guidance_on_the_determinationofhelicopteremissions.pdf

[i] GHG Emission factors from Title 40 Subchapter C Part 98 Subpart C, Table C-1 and C-2

Assumptions:

VOC/THC for diesel (Source: EPA, Conversion Factors for Hydrocarbon Emission Components, 2005 https://19january2017snapshot.epa.gov/www3/otaq/models/nonrdmdl/nonrdmdl2005/420r05015.pdf)		1.053
1 kWh = 1.34 hp-hr		
	lb/metric ton	2204.62

Otter Tail Power
BSSA
Total Construction Emissions, Year
2031 blue denotes cells that change by year

		Emission Factors (g/hp-hr) [a]						Emission Factors (g/hr) [b]				Criteria Air Pollutant Emissions (ton / year)						GHG Emissions (metric ton/year)			
Equipment	**MOVES Lookup ID**	CO	NO_X	SO_2 [d]	VOC [e]	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O [g]	CO_2e [f]	CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e
Equipment																					
ATV 4 TO 6 WHEEL, W/ DUMP	Off-Highway Trucks	4.9254	5.3172	0.0054	0.2799	0.5970	0.5970	56738.8018	2.5437	5.2237	58194.3187	1.30E-03	1.40E-03	1.42E-06	7.37E-05	1.57E-04	1.57E-04	1.70E+00	7.63E-05	1.57E-04	1.75E+00
BACKHOE W/ LOADER 4X4	Tractors/Loaders/Backhoes	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	23463.4126	0.7832	2.1602	24057.7949	6.82E-03	9.72E-03	9.90E-06	5.12E-04	5.46E-04	5.46E-04	1.97E+00	6.58E-05	1.81E-04	2.02E+00
BUCKET 105' WORK HEIGHT	Aerial Lifts	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	96549.7784	0.4122	8.8890	98916.9083	1.52E-01	2.73E-01	2.84E-04	1.44E-02	8.71E-03	8.71E-03	8.11E+01	3.46E-04	7.47E-03	8.31E+01
BUCKET 125' WORK HEIGHT 8X6	Aerial Lifts	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	96549.7784	0.4122	8.8890	98916.9083	5.93E-02	1.03E-01	1.11E-04	5.42E-03	3.39E-03	3.39E-03	2.70E+01	1.15E-04	2.49E-03	2.77E+01
BUCKET 77' WORK HEIGHT SWAMP TRK MTD	Aerial Lifts	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	96549.7784	0.4122	8.8890	98916.9083	4.35E-02	7.80E-02	8.12E-05	4.10E-03	2.49E-03	2.49E-03	2.32E+01	9.89E-05	2.13E-03	2.37E+01
TRUCK MTD 4 T ARTICULATING BOOM W/ FORKS & CLAM	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	2.34E-02	4.06E-02	4.37E-05	2.14E-03	1.34E-03	1.34E-03	3.43E+00	6.01E-05	3.16E-04	3.52E+00
CRANE TRUCK 45 T HYDRAULIC 6 AXLE	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	9.36E-01	1.63E+00	1.75E-03	8.56E-02	5.35E-02	5.35E-02	1.37E+02	2.40E-03	1.26E-02	1.41E+02
DIGGER DERRICK 15 T CAP	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	4.58E-01	7.95E-01	8.54E-04	4.18E-02	2.61E-02	2.61E-02	9.15E+01	1.60E-03	8.42E-03	9.38E+01
DIGGER DERRICK 15 T CAP SWAMP TRACK MTD	Cranes	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	8.91E-02	1.60E-01	1.66E-04	8.40E-03	5.09E-03	5.09E-03	1.96E+01	3.44E-04	1.81E-03	2.01E+01
DOZER 10 THRU 12 T, W/ WINCH	Crawler Tractor/Dozers	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	29851.1565	1.9934	2.7483	30635.2689	1.63E-02	2.32E-02	2.37E-05	1.22E-03	1.30E-03	1.30E-03	2.51E+00	1.67E-04	2.31E-04	2.57E+00
DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	75355.9475	1.9934	6.9378	77250.2698	2.71E-02	4.86E-02	5.05E-05	2.56E-03	1.55E-03	1.55E-03	6.33E+00	1.67E-04	5.83E-04	6.49E+00
CRAWLER CARRIER W/ 360 DUMP BOX OR DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	29851.1565	1.9934	2.7483	30635.2689	1.75E-02	2.49E-02	2.54E-05	1.31E-03	1.40E-03	1.40E-03	2.69E+00	1.79E-04	2.47E-04	2.76E+00
EXCAVATOR 25 T	Excavators	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	50902.8167	0.8117	4.6864	52167.4535	2.50E-02	3.14E-02	3.27E-05	1.65E-03	1.50E-03	1.50E-03	3.05E+00	4.87E-05	2.81E-04	3.13E+00
FORKLIFT 11,000 THRU 12,000# TELESCOPIC BOOM	Forklifts	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	25425.8129	0.6148	2.3409	26063.3573	1.45E-01	1.81E-01	1.89E-04	9.55E-03	8.68E-03	8.68E-03	1.07E+01	2.58E-04	9.83E-04	1.09E+01
FRONT END LOADER 68,000# 4X4	Rubber Tire Loaders	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	107505.0812	0.8359	9.8976	110151.3563	3.67E-01	6.38E-01	6.85E-04	3.36E-02	2.10E-02	2.10E-02	6.02E+01	4.68E-04	5.54E-03	6.17E+01
GENERATOR 23KW THRU 60KW TRAILER MOUNTED TOW TYPE	Generator Sets	4.1045	5.3172	0.0054	0.2799	0.4478	0.4478	13890.3485	0.4472	1.2788	14241.7630	4.73E-02	6.13E-02	6.24E-05	3.23E-03	5.16E-03	5.16E-03	8.89E+00	2.86E-04	8.18E-04	9.11E+00
HYDRAULIC BULLWHEEL BUNDLE TENSIONER	Other Construction Equipment	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	36676.8768	0.4815	3.3767	37585.1891	6.99E-03	9.96E-03	1.01E-05	5.24E-04	5.59E-04	5.59E-04	1.32E+00	1.73E-05	1.22E-04	1.35E+00
PULLER ROPE TRAILER 4,000# CAP W/ SPLIT REEL TOW TYPE TANDEM A	Other Construction Equipment	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	36676.8768	0.4815	3.3767	37585.1891	6.46E-03	9.21E-03	9.38E-06	4.85E-04	5.17E-04	5.17E-04	1.32E+00	1.73E-05	1.22E-04	1.35E+00
PULLER CABLE TRAILER 30,000# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	115320.5588	0.4815	10.6172	118147.5920	2.45E-02	4.25E-02	4.56E-05	2.24E-03	1.40E-03	1.40E-03	4.15E+00	1.73E-05	3.82E-04	4.25E+00
PULLER ROPE TRAILER 4 DRUM 3,500# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	36676.8768	0.4815	3.3767	37585.1891	1.00E-02	1.26E-02	1.31E-05	6.63E-04	6.03E-04	6.03E-04	1.32E+00	1.73E-05	1.22E-04	1.35E+00
300T AT Setting Crane	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	137458.6383	1.4314	12.6553	140852.3840	1.29E-01	2.23E-01	2.40E-04	1.18E-02	7.35E-03	7.35E-03	2.47E+01	2.58E-04	2.28E-03	2.54E+01
60T RT Crane	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	2.22E-01	3.85E-01	4.14E-04	2.03E-02	1.27E-02	1.27E-02	4.57E+01	8.02E-04	4.21E-03	4.69E+01
SKID STEER LOADER TRACK MTD 80 > 75 HP	Skid Steer Loaders	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	19396.4227	0.6820	1.7858	19888.7461	5.74E-02	8.19E-02	8.34E-05	4.31E-03	4.60E-03	4.60E-03	1.36E+01	4.77E-04	1.25E-03	1.39E+01
DUMP BOX TRUCK 2-1/2 T 6X6	Dumpers/Tenders	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	3458.3652	0.3764	0.3184	3553.2816	2.14E-02	3.71E-02	3.99E-05	1.95E-03	1.22E-03	1.22E-03	2.42E-01	2.64E-05	2.23E-05	2.49E-01
DUMP BOX TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	3458.3652	0.3764	0.3184	3553.2816	7.11E-02	1.24E-01	1.33E-04	6.50E-03	4.06E-03	4.06E-03	9.68E-01	1.05E-04	8.92E-05	9.95E-01
FLATBED (FRAMING) TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	3458.3652	0.3764	0.3184	3553.2816	2.13E-01	3.71E-01	3.98E-04	1.95E-02	1.22E-02	1.22E-02	2.91E+00	3.16E-04	2.67E-04	2.98E+00
TRUCK TRACTOR 2-1/2 T 6X4 & 5 T 6X6	Off-highway Trucks	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	123528.4545	2.5437	11.3728	126613.4819	3.85E-01	6.69E-01	7.19E-04	3.52E-02	2.20E-02	2.20E-02	6.23E+01	1.28E-03	5.73E-03	6.38E+01
PICKUP TRUCK 3/4 T	Off-highway Trucks	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	123528.4545	2.5437	11.3728	126613.4819	2.80E+00	4.86E+00	5.22E-03	2.56E-01	1.60E-01	1.60E-01	4.84E+02	9.97E-03	4.46E-02	4.96E+02

Fugitive Dust												CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e
Dust from On Site Activities												0	0	0	0	1.81E+01	1.89E+00	0	0	0	0

		Emission Factors (g/mi) [i]										Criteria Air Pollutant Emissions (ton / year)						GHG Emissions (metric ton/year)			
Onroad	**MOVES Vehicle Class**	CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e [f]	CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e
Resuspended Road Dust												0	0	0	0	1.19E-01	2.98E-02	0	0	0	0
Worker Commute (Gas Passenger Truck)	31	1.77914	0.04188	0.00174	0.00925	0.00181	0.00160	325.00489	0.00460	0.00099	325.3966	6.34E-01	1.49E-02	6.19E-04	3.30E-03	6.45E-04	5.71E-04	1.05E+02	1.49E-03	3.21E-04	1.05E+02
Material Hauling (Single Unit Truck)	52	0.68479	0.60444	0.00238	0.02328	0.00965	0.00888	711.38546	0.00564	0.10342	738.9500613	2.85E-02	2.52E-02	9.92E-05	9.70E-04	4.02E-04	3.70E-04	2.69E+01	2.13E-04	3.91E-03	2.79E+01
Flatbed truck (Combination Long Haul Truck)	62	1.43418	1.97233	0.00478	0.03435	0.01556	0.01431	1427.45043	0.01239	0.20835	1483.009929	1.33E-02	1.83E-02	4.42E-05	3.18E-04	1.44E-04	1.33E-04	1.20E+01	1.04E-04	1.75E-03	1.25E+01

		Emission Factors (g/kg fuel)						Emission Factors (kg/mmBtu) [i]				Criteria Air Pollutant Emissions (ton / year)						GHG Emissions (metric ton/year)			
Helicopter Emissions	**Engine Mode**	CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e	CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e
Helicopter with Turboshaft Engine	*Ground Idle*	66.76250	2.04693	0.00000	53.46090	0.11838	0.11838	72.22000	0.00300	0.00060	72.4630	1.63E-01	5.00E-03	0.00E+00	1.31E-01	2.89E-04	2.89E-04	6.54E+00	2.72E-04	5.43E-05	6.56E+00
Helicopter with Turboshaft Engine	*Hover and Climb*	8.09363	6.02259	0.00000	6.86012	0.18566	0.18566	72.22000	0.00300	0.00060	72.4630	5.51E-02	4.10E-02	0.00E+00	4.67E-02	1.27E-03	1.27E-03	1.82E+01	7.58E-04	1.52E-04	1.83E+01
Helicopter with Turboshaft Engine	*Approach*	16.41907	4.19436	0.00000	13.65406	0.14953	0.14953	72.22000	0.00300	0.00060	72.4630	8.55E-02	2.18E-02	0.00E+00	7.11E-02	7.78E-04	7.78E-04	1.39E+01	5.79E-04	1.16E-04	1.40E+01
Helicopter with Turboshaft Engine	*Flight*	8.88341	5.74252	0.00000	7.51068	0.17969	0.17969	72.22000	0.00300	0.00060	72.4630	3.69E-01	2.39E-01	0.00E+00	3.12E-01	7.47E-03	7.47E-03	1.11E+02	4.62E-03	9.25E-04	1.12E+02

[a] EPA Tier II Emissions. EPA 420_P_04_009, Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling _ Compression Ignition, USEPA, April 2004 _ Tier 2 Engines.

[b] South Coast AQMD Off Road- Model Mobile Source Emission Factors (https://www.aqmd.gov/home/rules-compliance/ceqa/air-quality-analysis-handbook/off-road-mobile-source-emission-factors)

[c] Load Factors from MOVES4

[d] EPA Exhaust and Crankcase Emission Factors for Nonroad Compression-Ignition Engines in MOVES3.0.2, September 2021. Equation 10 - Assume ultra low sulfur diesel with 15ppm.

[e] NMHC (5% NMHC and 95% NOx in combined NMHC +NOx)
https://www.baaqmd.gov/~/media/Files/Engineering/policy_and_procedures/Engines/EmissionFactorsforDieselEngines.ashx

[f] Global Warming Potentials from EPA GHG Emission Factors Hub, 2024.

[g] N2O emissions estimated based on the ratio of g N2O per gallon of construction diesel to gallons of diesel per g CO2, obtained from Tables 2.7 and 2.1, respectively, of the 2023 Climate Registry Default Emission Factors. Retrieved from https://theclimateregistry.org/wp-content/uploads/2023/06/2023-Default-Emission-Factors-Final.pdf, June 2023.

[h] Conservatively, a maximum of 8 hours of flight time is allocated. Based on the helicopter's flying speed of 30 mph over a distance of 110 miles, the estimated actual flight time is approximately 3.7 hours.Assume helicopter starts 25 weeks into year 2028 and continues to the end of the construction duration. Source: Guidance on the Determination of Helicopter Emissions Edition 2 - December 2015.
https://www.bazl.admin.ch/dam/bazl/de/dokumente/Fachleute/Regulationen_und_Grundlagen/guidance_on_the_determinationofhelicopteremissions.pdf.download.pdf/guidance_on_the_determinationofhelicopteremissions.pdf

[i] GHG Emission factors from Title 40 Subchapter C Part 98 Subpart C, Table C-1 and C-2

CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e	
6.36	10.92	0.01	0.57	0.37	0.37	1123.89	0.02	0.10	1151.88	Equipment
0.00	0.00	0.00	0.00	18.08	1.89	0.00	0.00	0.00	0.00	Fugitive Dust
0.68	0.06	0.00	0.00	0.12	0.03	143.99	0.00	0.01	145.62	Onroad
0.67	0.31	0.00	0.56	0.01	0.01	150.01	0.01	0.00	150.51	Helicopter
7.71	**11.28**	**0.01**	**1.14**	**18.58**	**2.30**	**1,417.89**	**0.03**	**0.11**	**1,448.01**	**Total**

Assumptions:

VOC/THC for diesel (Source: EPA, Conversion Factors for Hydrocarbon Emission Components, 2005 https://19january2017snapshot.epa.gov/www3/otaq/models/nonrdmdl/nonrdmdl2005/420r05015.pdf)	1.053
1 kWh = 1.34 hp-hr	
lb/metric ton	2204.62

Otter Tail Power
BSSA
Total Construction Emissions, Year
2030 blue denotes cells that change by year

Equipment	MOVES Lookup ID	SCAB Lookup ID	Fuel	HP	Typical Hours per day	Typical Days/Year	Count	Total Hours Used	Load Factor [c]	
Equipment										
ATV 4 TO 6 WHEEL, W/ DUMP	Off-Highway Trucks	Off-Highway Trucks	Diesel	13.5	2	69	1	138	0.59	
BACKHOE W/ LOADER 4X4	Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes	Diesel	94	2	99	2	396	0.21	
BUCKET 105' WORK HEIGHT	Aerial Lifts	Aerial Lifts	Diesel	300	8	165	3	3960	0.21	
BUCKET 125' WORK HEIGHT 8X6	Aerial Lifts	Aerial Lifts	Diesel	350	8	165	1	1320	0.21	
BUCKET 77' WORK HEIGHT SWAMP TRK MTD	Aerial Lifts	Aerial Lifts	Diesel	300	8	69	2	1104	0.21	
TRUCK MTD 4 T ARTICULATING BOOM W/ FORKS & CLAM	Cranes	Cranes	Diesel	450	2	99	1	198	0.43	
CRANE TRUCK 45 T HYDRAULIC 6 AXLE	Cranes	Cranes	Diesel	450	8	165	6	7920	0.43	
DIGGER DERRICK 15 T CAP	Cranes	Cranes	Diesel	330	8	165	4	5280	0.43	
DIGGER DERRICK 15 T CAP SWAMP TRACK MTD	Cranes	Cranes	Diesel	300	8	69	2	1104	0.43	
DOZER 10 THRU 12 T, W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	Diesel	80	4	99	1	396	0.59	
DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	Diesel	190	4	99	1	396	0.59	
CRAWLER CARRIER W/ 360 DUMP BOX OR DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	Diesel	80	6	69	1	414	0.59	
EXCAVATOR 25 T	Excavators	Excavators	Diesel	172	4	69	1	276	0.59	
FORKLIFT 11,000 THRU 12,000# TELESCOPIC BOOM	Forklifts	Forklifts	Diesel	142	4	165	3	1980	0.59	
FRONT END LOADER 68,000# 4X4	Rubber Tire Loaders	Rubber Tired Loaders	Diesel	386	4	165	4	2640	0.59	
GENERATOR 23KW THRU 60KW TRAILER MOUNTED TOW TYPE	Generator Sets	Generator Sets	Diesel	38	8	90	4	2880	0.43	
HYDRAULIC BULLWHEEL BUNDLE TENSIONER	Other Construction Equipment	Other Construction Equipment	Diesel	80	2	81	1	162	0.59	
PULLER ROPE TRAILER 4,000# CAP W/ SPLIT REEL TOW TYPE TANDEM A	Other Construction Equipment	Other Construction Equipment	Diesel	74	2	81	1	162	0.59	
PULLER CABLE TRAILER 30,000# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	Other Construction Equipment	Diesel	400	2	81	1	162	0.59	
PULLER ROPE TRAILER 4 DRUM 3,500# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	Other Construction Equipment	Diesel	115	2	81	1	162	0.59	
300T AT Setting Crane	Cranes	Cranes	Diesel	577	6	135	1	810	0.43	
60T RT Crane	Cranes	Cranes	Diesel	320	4	165	4	2640	0.43	
SKID STEER LOADER TRACK MTD 80 > 75 HP	Skid Steer Loaders	Skid Steer Loaders	Diesel	95	4	165	5	3300	0.21	
DUMP BOX TRUCK 2-1/2 T 6X6	Dumpers/Tenders	Dumpers/Tenders Composite	Diesel	505	2	165	1	330	0.21	
DUMP BOX TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	Dumpers/Tenders Composite	Diesel	420	4	165	2	1320	0.21	
FLATBED (FRAMING) TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	Dumpers/Tenders Composite	Diesel	420	4	165	6	3960	0.21	
TRUCK TRACTOR 2-1/2 T 6X4 & 5 T 6X6	Off-highway Trucks	Off-highway Trucks	Diesel	450	4	99	6	2376	0.59	
PICKUP TRUCK 3/4 T	Off-highway Trucks	Off-highway Trucks	Diesel	420	8	165	14	18480	0.59	

Fugitive Dust										
Dust from On Site Activities										
Onroad	**MOVES Vehicle Class**		**Fuel Type**	**VMT**	**Onroad Fuel ID**	**Year**	**MOVES Road Type**	**MOVES Day Type**		
Resuspended Road Dust										
Worker Commute (Gas Passenger Truck)	31		Gasoline	2,079,000	1	2030	3	5		
Material Hauling (Single Unit Truck)	52		Diesel	243,000	2	2030	3	5		
Flatbed truck (Combination Long Haul Truck)	62		Diesel	54,000	2	2030	3	5		

Helicopter Emissions	Engine Mode	Quantity	Hours/day	Number of days per year	Total Hours	Fuel Flow (Kg/s) [h]	Max Power (HP)	Load Factor	Loaded Power (HP)	Fuel Usage (kg fuel)	Fuel Usage (mmBtu)
Helicopter with Turboshaft Engine	*Ground Idle*	*1*	1.00	270	270	0.015	420	0.13000	55	14252.71	582.23
Helicopter with Turboshaft Engine	*Hover and Climb*	*1*	1.25	270	337.5	0.033	420	0.87000	365	39737.12	1623.29
Helicopter with Turboshaft Engine	*Approach*	*1*	1.25	270	337.5	0.025	420	0.46000	193	30354.82	1240.02
Helicopter with Turboshaft Engine	*Flight*	*1*	8.00	270	2160	0.031	420	0.80000	336	#######	9907.03

[a] [illegible] Factors for Nonroad Engine Modeling

[b] South Coast AQMD Off Road- Model Mobile Source Emission Factors (https://www.aqmd.gov/home/rules-compliance/ceqa/air-quality-analysis-handbook/off-road-mobile-source-emission-factors)

[c] Load Factors from MOVES4

[d] EPA Exhaust and Crankcase Emission Factors for Nonroad Compression-Ignition Engines in MOVES3.0.2, September 2021. Equation 10 - Assume ultra low sulfur diesel with 15ppm.

[e] NMHC (5% NMHC and 95% NOx in combined NMHC +NOx)
https://www.baaqmd.gov/~/media/Files/Engineering/policy_and_procedures
/Engines/EmissionFactorsforDieselEngines.ashx

[f] Global Warming Potentials from EPA GHG Emission Factors Hub, 2024.

[g] N2O emissions estimated based on the ratio of g N2O per gallon of construction diesel to gallons of diesel per g CO2, obtained from Tables 2.7 and 2.1, respectively, of the 2023 Climate Registry Default Emission Factors. Retrieved from https://theclimateregistry.org/wp-content/uploads/2023/06/2023-Default-Emission-Factors-Final.pdf, June 2023.

[h] Conservatively, a maximum of 8 hours of flight time is allocated. Based on the helicopter's flying speed of 30 mph over a distance of 110 miles, the estimated actual flight time is approximately 3.7 hours.Assume helicopter starts 25 weeks into year 2028 and continues to the end of the construction duration. Source: Guidance on the Determination of Helicopter Emissions Edition 2 - December 2015.
https://www.bazl.admin.ch/dam/bazl/de/dokumente/Fachleute/Regulationen_und_Grundlagen/guidance_on_the_determinationofhelicopteremissions.pdf.download.pdf/guidance_on_the_determinationofhelicopteremissions.pdf

[i] GHG Emission factors from Title 40 Subchapter C Part 98 Subpart C, Table C-1 and C-2

Assumptions:

VOC/THC for diesel (Source: EPA, Conversion Factors for Hydrocarbon Emission Components, 2005 https://19january2017snapshot.epa.gov/www3/otaq/models/nonrdmdl/nonrdmdl2005/420r05015.pdf)		1.053
1 kWh = 1.34 hp-hr		
	lb/metric ton	2204.62

Otter Tail Power
BSSA
Total Construction Emissions, Year
2030 blue denotes cells that change by year

			Emission Factors (g/hp-hr) [a]						Emission Factors (g/hr) [b]				Criteria Air Pollutant Emissions (ton / year)						GHG Emissions (metric ton/year)			
Equipment	**MOVES Lookup ID**	**SCAB Lookup ID**	**CO**	**NO_X**	**SO_2 [d]**	**VOC [e]**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O [g]**	**CO_2e [f]**	**CO**	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**
Equipment																						
ATV 4 TO 6 WHEEL, W/ DUMP	Off-Highway Trucks	Off-Highway Trucks	4.9254	5.3172	0.0054	0.2799	0.5970	0.5970	56738.8018	2.5437	5.2237	58194.3187	5.97E-03	6.44E-03	6.55E-06	3.39E-04	7.23E-04	7.23E-04	7.83E+00	3.51E-04	7.21E-04	8.03E+00
BACKHOE W/ LOADER 4X4	Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	23463.4126	0.7832	2.1602	24057.7949	3.22E-02	4.58E-02	4.67E-05	2.41E-03	2.57E-03	2.57E-03	9.29E+00	3.10E-04	8.55E-04	9.53E+00
BUCKET 105' WORK HEIGHT	Aerial Lifts	Aerial Lifts	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	96549.7784	0.4122	8.8890	98916.9083	7.18E-01	1.29E+00	1.34E-03	6.77E-02	4.10E-02	4.10E-02	3.82E+02	1.63E-03	3.52E-02	3.92E+02
BUCKET 125' WORK HEIGHT 8X6	Aerial Lifts	Aerial Lifts	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	96549.7784	0.4122	8.8890	98916.9083	2.79E-01	4.85E-01	5.21E-04	2.55E-02	1.60E-02	1.60E-02	1.27E+02	5.44E-04	1.17E-02	1.31E+02
BUCKET 77' WORK HEIGHT SWAMP TRK MTD	Aerial Lifts	Aerial Lifts	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	96549.7784	0.4122	8.8890	98916.9083	2.00E-01	3.59E-01	3.74E-04	1.89E-02	1.14E-02	1.14E-02	1.07E+02	4.55E-04	9.81E-03	1.09E+02
TRUCK MTD 4 T ARTICULATING BOOM W/ FORKS & CLAM	Cranes	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	1.10E-01	1.92E-01	2.06E-04	1.01E-02	6.30E-03	6.30E-03	1.62E+01	2.83E-04	1.49E-03	1.66E+01
CRANE TRUCK 45 T HYDRAULIC 6 AXLE	Cranes	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	4.41E+00	7.66E+00	8.23E-03	4.03E-01	2.52E-01	2.52E-01	6.47E+02	1.13E-02	5.96E-02	6.63E+02
DIGGER DERRICK 15 T CAP	Cranes	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	2.16E+00	3.75E+00	4.02E-03	1.97E-01	1.23E-01	1.23E-01	4.31E+02	7.56E-03	3.97E-02	4.42E+02
DIGGER DERRICK 15 T CAP SWAMP TRACK MTD	Cranes	Cranes	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	4.10E-01	7.35E-01	7.65E-04	3.87E-02	2.34E-02	2.34E-02	9.02E+01	1.58E-03	8.30E-03	9.24E+01
DOZER 10 THRU 12 T, W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	29851.1565	1.9934	2.7483	30635.2689	7.69E-02	1.10E-01	1.12E-04	5.77E-03	6.15E-03	6.15E-03	1.18E+01	7.89E-04	1.09E-03	1.21E+01
DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	75355.9475	1.9934	6.9378	77250.2698	1.28E-01	2.29E-01	2.38E-04	1.21E-02	7.30E-03	7.30E-03	2.98E+01	7.89E-04	2.75E-03	3.06E+01
CRAWLER CARRIER W/ 360 DUMP BOX OR DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	29851.1565	1.9934	2.7483	30635.2689	8.04E-02	1.15E-01	1.17E-04	6.03E-03	6.43E-03	6.43E-03	1.24E+01	8.25E-04	1.14E-03	1.27E+01
EXCAVATOR 25 T	Excavators	Excavators	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	50902.8167	0.8117	4.6864	52167.4535	1.15E-01	1.44E-01	1.50E-04	7.60E-03	6.91E-03	6.91E-03	1.40E+01	2.24E-04	1.29E-03	1.44E+01
FORKLIFT 11,000 THRU 12,000# TELESCOPIC BOOM	Forklifts	Forklifts	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	25425.8129	0.6148	2.3409	26063.3573	6.82E-01	8.56E-01	8.90E-04	4.50E-02	4.09E-02	4.09E-02	5.03E+01	1.22E-03	4.63E-03	5.16E+01
FRONT END LOADER 68,000# 4X4	Rubber Tire Loaders	Rubber Tired Loaders	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	107505.0812	0.8359	9.8976	110151.3563	1.73E+00	3.01E+00	3.23E-03	1.58E-01	9.89E-02	9.89E-02	2.84E+02	2.21E-03	2.61E-02	2.91E+02
GENERATOR 23KW THRU 60KW TRAILER MOUNTED TOW TYPE	Generator Sets	Generator Sets	4.1045	5.3172	0.0054	0.2799	0.4478	0.4478	13890.3485	0.4472	1.2788	14241.7630	2.13E-01	2.76E-01	2.81E-04	1.45E-02	2.32E-02	2.32E-02	4.00E+01	1.29E-03	3.68E-03	4.10E+01
HYDRAULIC BULLWHEEL BUNDLE TENSIONER	Other Construction Equipment	Other Construction Equipment	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	36676.8768	0.4815	3.3767	37585.1891	3.15E-02	4.48E-02	4.56E-05	2.36E-03	2.52E-03	2.52E-03	5.94E+00	7.80E-05	5.47E-04	6.09E+00
PULLER ROPE TRAILER 4,000# CAP W/ SPLIT REEL TOW TYPE TANDEM A	Other Construction Equipment	Other Construction Equipment	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	36676.8768	0.4815	3.3767	37585.1891	2.91E-02	4.15E-02	4.22E-05	2.18E-03	2.33E-03	2.33E-03	5.94E+00	7.80E-05	5.47E-04	6.09E+00
PULLER CABLE TRAILER 30,000# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	Other Construction Equipment	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	115320.5588	0.4815	10.6172	118147.5920	1.10E-01	1.91E-01	2.05E-04	1.01E-02	6.29E-03	6.29E-03	1.87E+01	7.80E-05	1.72E-03	1.91E+01
PULLER ROPE TRAILER 4 DRUM 3,500# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	Other Construction Equipment	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	36676.8768	0.4815	3.3767	37585.1891	4.52E-02	5.67E-02	5.90E-05	2.98E-03	2.71E-03	2.71E-03	5.94E+00	7.80E-05	5.47E-04	6.09E+00
300T AT Setting Crane	Cranes	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	137458.6383	1.4314	12.6553	140852.3840	5.79E-01	1.01E+00	1.08E-03	5.29E-02	3.31E-02	3.31E-02	1.11E+02	1.16E-03	1.03E-02	1.14E+02
60T RT Crane	Cranes	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	1.05E+00	1.82E+00	1.95E-03	9.56E-02	5.98E-02	5.98E-02	2.16E+02	3.78E-03	1.99E-02	2.21E+02
SKID STEER LOADER TRACK MTD 80 > 75 HP	Skid Steer Loaders	Skid Steer Loaders	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	19396.4227	0.6820	1.7858	19888.7461	2.71E-01	3.86E-01	3.93E-04	2.03E-02	2.17E-02	2.17E-02	6.40E+01	2.25E-03	5.89E-03	6.56E+01
DUMP BOX TRUCK 2-1/2 T 6X6	Dumpers/Tenders	Dumpers/Tenders Composite	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	3458.3652	0.3764	0.3184	3553.2816	1.01E-01	1.75E-01	1.88E-04	9.21E-03	5.76E-03	5.76E-03	1.14E+00	1.24E-04	1.05E-04	1.17E+00
DUMP BOX TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	Dumpers/Tenders Composite	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	3458.3652	0.3764	0.3184	3553.2816	3.35E-01	5.82E-01	6.25E-04	3.06E-02	1.92E-02	1.92E-02	4.57E+00	4.97E-04	4.20E-04	4.69E+00
FLATBED (FRAMING) TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	Dumpers/Tenders Composite	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	3458.3652	0.3764	0.3184	3553.2816	1.01E+00	1.75E+00	1.88E-03	9.19E-02	5.75E-02	5.75E-02	1.37E+01	1.49E-03	1.26E-03	1.41E+01
TRUCK TRACTOR 2-1/2 T 6X4 & 5 T 6X6	Off-highway Trucks	Off-highway Trucks	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	123528.4545	2.5437	11.3728	126613.4819	1.82E+00	3.16E+00	3.39E-03	1.66E-01	1.04E-01	1.04E-01	2.94E+02	6.04E-03	2.70E-02	3.01E+02
PICKUP TRUCK 3/4 T	Off-highway Trucks	Off-highway Trucks	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	123528.4545	2.5437	11.3728	126613.4819	1.32E+01	2.29E+01	2.46E-02	1.21E+00	7.53E-01	7.53E-01	2.28E+03	4.70E-02	2.10E-01	2.34E+03

Fugitive Dust													**CO**	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**
Dust from On Site Activities													0	0	0	0	3.81E+02	3.86E+01	0	0	0	0
			Emission Factors (g/mi) [1]										Criteria Air Pollutant Emissions (ton / year)						GHG Emissions (metric ton/year)			
Onroad	**MOVES Vehicle Class**		**CO**	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e [f]**	**CO**	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**
Resuspended Road Dust													0	0	0	0	7.67E-01	1.92E-01	0	0	0	0
Worker Commute (Gas Passenger Truck)	31		1.88427	0.06936	0.00174	0.01125	0.00196	0.00174	326.15178	0.00484	0.00114	326.5897	4.32E+00	1.59E-01	3.99E-03	2.58E-02	4.50E-03	3.98E-03	6.78E+02	1.01E-02	2.37E-03	6.79E+02
Material Hauling (Single Unit Truck)	52		0.70063	0.67618	0.00241	0.02726	0.01138	0.01047	720.53416	0.00585	0.10313	748.0274875	1.88E-01	1.81E-01	6.47E-04	7.30E-03	3.05E-03	2.80E-03	1.75E+02	1.42E-03	2.51E-02	1.82E+02
Flatbed truck (Combination Long Haul Truck)	62		1.46488	2.15773	0.00484	0.03818	0.01839	0.01692	1445.97672	0.01272	0.20764	1501.356601	8.72E-02	1.28E-01	2.88E-04	2.27E-03	1.09E-03	1.01E-03	7.81E+01	6.87E-04	1.12E-02	8.11E+01
			Emission Factors (g/kg fuel)						Emission Factors (kg/mmBtu) [1]				Criteria Air Pollutant Emissions (ton / year)						GHG Emissions (metric ton/year)			
Helicopter Emissions	**Engine Mode**	**Quantity**	**CO**	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**	**CO**	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**
Helicopter with Turboshaft Engine	*Ground Idle*	*1*	66.76250	2.04693	0.00000	53.46090	0.11838	0.11838	72.22000	0.00300	0.00060	72.4630	1.05E+00	3.22E-02	0.00E+00	8.40E-01	1.86E-03	1.86E-03	4.20E+01	1.75E-03	3.49E-04	4.22E+01
Helicopter with Turboshaft Engine	*Hover and Climb*	*1*	8.09363	6.02259	0.00000	6.86012	0.18566	0.18566	72.22000	0.00300	0.00060	72.4630	3.55E-01	2.64E-01	0.00E+00	3.00E-01	8.13E-03	8.13E-03	1.17E+02	4.87E-03	9.74E-04	1.18E+02
Helicopter with Turboshaft Engine	*Approach*	*1*	16.41907	4.19436	0.00000	13.65406	0.14953	0.14953	72.22000	0.00300	0.00060	72.4630	5.49E-01	1.40E-01	0.00E+00	4.57E-01	5.00E-03	5.00E-03	8.96E+01	3.72E-03	7.44E-04	8.99E+01
Helicopter with Turboshaft Engine	*Flight*	*1*	8.88341	5.74252	0.00000	7.51068	0.17969	0.17969	72.22000	0.00300	0.00060	72.4630	2.37E+00	1.54E+00	0.00E+00	2.01E+00	4.80E-02	4.80E-02	7.15E+02	2.97E-02	5.94E-03	7.18E+02

[a] [illegible] Factors for Nonroad Engine Modeling

[b] South Coast AQMD Off Road- Model Mobile Source Emission Factors (https://www.aqmd.gov/home/rules-compliance/ceqa/air-quality-analysis-handbook/off-road-mobile-source-emission-factors)

[c] Load Factors from MOVES4

[d] EPA Exhaust and Crankcase Emission Factors for Nonroad Compression-Ignition Engines in MOVES3.0.2, September 2021. Equation 10 - Assume ultra low sulfur diesel with 15ppm.

[e] NMHC (5% NMHC and 95% NOx in combined NMHC +NOx)
https://www.baaqmd.gov/~/media/Files/Engineering/policy_and_procedures/Engines/EmissionFactorsforDieselEngines.ashx

[f] Global Warming Potentials from EPA GHG Emission Factors Hub, 2024.

[g] N2O emissions estimated based on the ratio of g N2O per gallon of construction diesel to gallons of diesel per g CO2, obtained from Tables 2.7 and 2.1, respectively, of the 2023 Climate Registry Default Emission Factors. Retrieved from https://theclimateregistry.org/wp-content/uploads/2023/06/2023-Default-Emission-Factors-Final.pdf, June 2023.

[h] Conservatively, a maximum of 8 hours of flight time is allocated. Based on the helicopter's flying speed of 30 mph over a distance of 110 miles, the estimated actual flight time is approximately 3.7 hours.Assume helicopter starts 25 weeks into year 2028 and continues to the end of the construction duration. Source: Guidance on the Determination of Helicopter Emissions Edition 2 - December 2015.
https://www.bazl.admin.ch/dam/bazl/de/dokumente/Fachleute/Regulationen_und_Grundlagen/guidance_on_the_determinationofhelicopteremissions.pdf.download.pdf/guidance_on_the_determinationofhelicopteremissions.pdf

[i] GHG Emission factors from Title 40 Subchapter C Part 98 Subpart C, Table C-1 and C-2

[1] Tier II has a default sulfur level of 0.20 mass percent.

CO	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**	
29.91	51.36	0.05	2.70	1.73	1.73	5283.68	0.09	0.49	5415.22	Equipment
0.00	0.00	0.00	0.00	381.18	38.62	0.00	0.00	0.00	0.00	Fugitive Dust
4.59	0.47	0.00	0.04	0.78	0.20	931.24	0.01	0.04	941.83	Onroad
4.33	1.97	0.00	3.61	0.06	0.06	964.32	0.04	0.01	967.57	Helicopter
38.83	**53.80**	**0.06**	**6.34**	**383.75**	**40.62**	**7,179.24**	**0.15**	**0.53**	**7,324.61**	**Total**

Assumptions:

VOC/THC for diesel (Source: EPA, Conversion Factors for Hydrocarbon Emission Components, 2005
https://19january2017snapshot.epa.gov/www3/otaq/models/nonrdmdl/nonrdmdl2005/420r05015.pdf) 1.053

1 kWh = 1.34 hp-hr

lb/metric ton 2204.62

Otter Tail Power
BSSA
Total Construction Emissions, Year
2029 blue denotes cells that change by year

Equipment	MOVES Lookup ID	SCAB Lookup ID	Fuel	HP	Typical Hours per day	Typical Days/Year	Count	Total Hours Used	Load Factor [c]	
Equipment										
ATV 4 TO 6 WHEEL, W/ DUMP	Off-Highway Trucks	Off-Highway Trucks	Diesel	13.5	2	69	1	138	0.59	
BACKHOE W/ LOADER 4X4	Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes	Diesel	94	2	99	2	396	0.21	
BUCKET 105' WORK HEIGHT	Aerial Lifts	Aerial Lifts	Diesel	300	8	165	3	3960	0.21	
BUCKET 125' WORK HEIGHT 8X6	Aerial Lifts	Aerial Lifts	Diesel	350	8	165	1	1320	0.21	
BUCKET 77' WORK HEIGHT SWAMP TRK MTD	Aerial Lifts	Aerial Lifts	Diesel	300	8	69	2	1104	0.21	
TRUCK MTD 4 T ARTICULATING BOOM W/ FORKS & CLAM	Cranes	Cranes	Diesel	450	2	99	1	198	0.43	
CRANE TRUCK 45 T HYDRAULIC 6 AXLE	Cranes	Cranes	Diesel	450	8	165	6	7920	0.43	
DIGGER DERRICK 15 T CAP	Cranes	Cranes	Diesel	330	8	165	4	5280	0.43	
DIGGER DERRICK 15 T CAP SWAMP TRACK MTD	Cranes	Cranes	Diesel	300	8	69	2	1104	0.43	
DOZER 10 THRU 12 T, W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	Diesel	80	4	99	1	396	0.59	
DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	Diesel	190	4	99	1	396	0.59	
CRAWLER CARRIER W/ 360 DUMP BOX OR DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	Diesel	80	6	69	1	414	0.59	
EXCAVATOR 25 T	Excavators	Excavators	Diesel	172	4	69	1	276	0.59	
FORKLIFT 11,000 THRU 12,000# TELESCOPIC BOOM	Forklifts	Forklifts	Diesel	142	4	165	3	1980	0.59	
FRONT END LOADER 68,000# 4X4	Rubber Tire Loaders	Rubber Tired Loaders	Diesel	386	4	165	4	2640	0.59	
GENERATOR 23KW THRU 60KW TRAILER MOUNTED TOW TYPE	Generator Sets	Generator Sets	Diesel	38	8	90	4	2880	0.43	
HYDRAULIC BULLWHEEL BUNDLE TENSIONER	Other Construction Equipment	Other Construction Equipment	Diesel	80	2	81	1	162	0.59	
PULLER ROPE TRAILER 4,000# CAP W/ SPLIT REEL TOW TYPE TANDEM A	Other Construction Equipment	Other Construction Equipment	Diesel	74	2	81	1	162	0.59	
PULLER CABLE TRAILER 30,000# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	Other Construction Equipment	Diesel	400	2	81	1	162	0.59	
PULLER ROPE TRAILER 4 DRUM 3,500# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	Other Construction Equipment	Diesel	115	2	81	1	162	0.59	
300T AT Setting Crane	Cranes	Cranes	Diesel	577	6	135	1	810	0.43	
60T RT Crane	Cranes	Cranes	Diesel	320	4	165	4	2640	0.43	
SKID STEER LOADER TRACK MTD 80 > 75 HP	Skid Steer Loaders	Skid Steer Loaders	Diesel	95	4	165	5	3300	0.21	
DUMP BOX TRUCK 2-1/2 T 6X6	Dumpers/Tenders	Dumpers/Tenders Composite	Diesel	505	2	165	1	330	0.21	
DUMP BOX TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	Dumpers/Tenders Composite	Diesel	420	4	165	2	1320	0.21	
FLATBED (FRAMING) TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	Dumpers/Tenders Composite	Diesel	420	4	165	6	3960	0.21	
TRUCK TRACTOR 2-1/2 T 6X4 & 5 T 6X6	Off-highway Trucks	Off-highway Trucks	Diesel	450	4	99	6	2376	0.59	
PICKUP TRUCK 3/4 T	Off-highway Trucks	Off-highway Trucks	Diesel	420	8	165	14	18480	0.59	

Fugitive Dust										
Dust from On Site Activities										
Onroad	**MOVES Vehicle Class**		**Fuel Type**	**VMT**	**Onroad Fuel ID**	**Year**	**MOVES Road Type**	**MOVES Day Type**		
Resuspended Road Dust										
Worker Commute (Gas Passenger Truck)	31		Gasoline	2,079,000	1	2029	3	5		
Material Hauling (Single Unit Truck)	52		Diesel	243,000	2	2029	3	5		
Flatbed truck (Combination Long Haul Truck)	62		Diesel	54,000	2	2029	3	5		

Helicopter Emissions	Engine Mode	Quantity	Hours/day	Number of days per year	Total Hours	Fuel Flow (Kg/s) [h]	Max Power (HP)	Load Factor	Loaded Power (HP)	Fuel Usage (kg fuel)	Fuel Usage (mmBtu)
Helicopter with Turboshaft Engine	*Ground Idle*	*1*	1.00	270	270	0.015	420	0.13000	55	14252.71	582.23
Helicopter with Turboshaft Engine	*Hover and Climb*	*1*	1.25	270	337.5	0.033	420	0.87000	365	39737.12	1623.29
Helicopter with Turboshaft Engine	*Approach*	*1*	1.25	270	337.5	0.025	420	0.46000	193	30354.82	1240.02
Helicopter with Turboshaft Engine	*Flight*	*1*	8.00	270	2160	0.031	420	0.80000	336	#######	9907.03

[a] EPA Tier II Emissions. EPA 420_P_04_009, Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling _ Compression Ignition, USEPA, April 2004 _ Tier 2 Engines.

[b] South Coast AQMD Off Road- Model Mobile Source Emission Factors (https://www.aqmd.gov/home/rules-compliance/ceqa/air-quality-analysis-handbook/off-road-mobile-source-emission-factors)

[c] Load Factors from MOVES4

[d] EPA Exhaust and Crankcase Emission Factors for Nonroad Compression-Ignition Engines in MOVES3.0.2, September 2021. Equation 10 - Assume ultra low sulfur diesel with 15ppm.

[e] NMHC (5% NMHC and 95% NOx in combined NMHC +NOx)
https://www.baaqmd.gov/~/media/Files/Engineering/policy_and_procedures
/Engines/EmissionFactorsforDieselEngines.ashx

[f] Global Warming Potentials from EPA GHG Emission Factors Hub, 2024.

[g] N2O emissions estimated based on the ratio of g N2O per gallon of construction diesel to gallons of diesel per g CO2, obtained from Tables 2.7 and 2.1, respectively, of the 2023 Climate Registry Default Emission Factors. Retrieved from https://theclimateregistry.org/wp-content/uploads/2023/06/2023-Default-Emission-Factors-Final.pdf, June 2023.

[h] Conservatively, a maximum of 8 hours of flight time is allocated. Based on the helicopter's flying speed of 30 mph over a distance of 110 miles, the estimated actual flight time is approximately 3.7 hours.Assume helicopter starts 25 weeks into year 2028 and continues to the end of the construction duration. Source: Guidance on the Determination of Helicopter Emissions Edition 2 - December 2015.
https://www.bazl.admin.ch/dam/bazl/de/dokumente/Fachleute/Regulationen_und_Grundlagen/guidance_on_the_determinationofhelicopteremissions.pdf.download.pdf/guidance_on_the_determinationofhelicopteremissions.pdf

[i] GHG Emission factors from Title 40 Subchapter C Part 98 Subpart C, Table C-1 and C-2

Assumptions:

VOC/THC for diesel (Source: EPA, Conversion Factors for Hydrocarbon Emission Components, 2005 https://19january2017snapshot.epa.gov/www3/otaq/models/nonrdmdl/nonrdmdl2005/420r05015.pdf)		1.053
1 kWh = 1.34 hp-hr		
	lb/metric ton	2204.62

Otter Tail Power
BSSA
Total Construction Emissions, Year
2029 blue denotes cells that change by year

		Emission Factors (g/hp-hr) [a]						Emission Factors (g/hr) [b]				Criteria Air Pollutant Emissions (ton / year)						GHG Emissions (metric ton/year)			
Equipment	**MOVES Lookup ID**	**CO**	**NO_X**	**SO_2 [d]**	**VOC [e]**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O [g]**	**CO_2e [f]**	**CO**	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**
Equipment																					
ATV 4 TO 6 WHEEL, W/ DUMP	Off-Highway Trucks	4.9254	5.3172	0.0054	0.2799	0.5970	0.5970	56738.8018	2.5437	5.2237	58194.3187	5.97E-03	6.44E-03	6.55E-06	3.39E-04	7.23E-04	7.23E-04	7.83E+00	3.51E-04	7.21E-04	8.03E+00
BACKHOE W/ LOADER 4X4	Tractors/Loaders/Backhoes	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	23463.4126	0.7832	2.1602	24057.7949	3.22E-02	4.58E-02	4.67E-05	2.41E-03	2.57E-03	2.57E-03	9.29E+00	3.10E-04	8.55E-04	9.53E+00
BUCKET 105' WORK HEIGHT	Aerial Lifts	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	96549.7784	0.4122	8.8890	98916.9083	7.18E-01	1.29E+00	1.34E-03	6.77E-02	4.10E-02	4.10E-02	3.82E+02	1.63E-03	3.52E-02	3.92E+02
BUCKET 125' WORK HEIGHT 8X6	Aerial Lifts	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	96549.7784	0.4122	8.8890	98916.9083	2.79E-01	4.85E-01	5.21E-04	2.55E-02	1.60E-02	1.60E-02	1.27E+02	5.44E-04	1.17E-02	1.31E+02
BUCKET 77' WORK HEIGHT SWAMP TRK MTD	Aerial Lifts	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	96549.7784	0.4122	8.8890	98916.9083	2.00E-01	3.59E-01	3.74E-04	1.89E-02	1.14E-02	1.14E-02	1.07E+02	4.55E-04	9.81E-03	1.09E+02
TRUCK MTD 4 T ARTICULATING BOOM W/ FORKS & CLAM	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	1.10E-01	1.92E-01	2.06E-04	1.01E-02	6.30E-03	6.30E-03	1.62E+01	2.83E-04	1.49E-03	1.66E+01
CRANE TRUCK 45 T HYDRAULIC 6 AXLE	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	4.41E+00	7.66E+00	8.23E-03	4.03E-01	2.52E-01	2.52E-01	6.47E+02	1.13E-02	5.96E-02	6.63E+02
DIGGER DERRICK 15 T CAP	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	2.16E+00	3.75E+00	4.02E-03	1.97E-01	1.23E-01	1.23E-01	4.31E+02	7.56E-03	3.97E-02	4.42E+02
DIGGER DERRICK 15 T CAP SWAMP TRACK MTD	Cranes	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	4.10E-01	7.35E-01	7.65E-04	3.87E-02	2.34E-02	2.34E-02	9.02E+01	1.58E-03	8.30E-03	9.24E+01
DOZER 10 THRU 12 T, W/ WINCH	Crawler Tractor/Dozers	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	29851.1565	1.9934	2.7483	30635.2689	7.69E-02	1.10E-01	1.12E-04	5.77E-03	6.15E-03	6.15E-03	1.18E+01	7.89E-04	1.09E-03	1.21E+01
DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	75355.9475	1.9934	6.9378	77250.2698	1.28E-01	2.29E-01	2.38E-04	1.21E-02	7.30E-03	7.30E-03	2.98E+01	7.89E-04	2.75E-03	3.06E+01
CRAWLER CARRIER W/ 360 DUMP BOX OR DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	29851.1565	1.9934	2.7483	30635.2689	8.04E-02	1.15E-01	1.17E-04	6.03E-03	6.43E-03	6.43E-03	1.24E+01	8.25E-04	1.14E-03	1.27E+01
EXCAVATOR 25 T	Excavators	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	50902.8167	0.8117	4.6864	52167.4535	1.15E-01	1.44E-01	1.50E-04	7.60E-03	6.91E-03	6.91E-03	1.40E+01	2.24E-04	1.29E-03	1.44E+01
FORKLIFT 11,000 THRU 12,000# TELESCOPIC BOOM	Forklifts	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	25425.8129	0.6148	2.3409	26063.3573	6.82E-01	8.56E-01	8.90E-04	4.50E-02	4.09E-02	4.09E-02	5.03E+01	1.22E-03	4.63E-03	5.16E+01
FRONT END LOADER 68,000# 4X4	Rubber Tire Loaders	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	107505.0812	0.8359	9.8976	110151.3563	1.73E+00	3.01E+00	3.23E-03	1.58E-01	9.89E-02	9.89E-02	2.84E+02	2.21E-03	2.61E-02	2.91E+02
GENERATOR 23KW THRU 60KW TRAILER MOUNTED TOW TYPE	Generator Sets	4.1045	5.3172	0.0054	0.2799	0.4478	0.4478	13890.3485	0.4472	1.2788	14241.7630	2.13E-01	2.76E-01	2.81E-04	1.45E-02	2.32E-02	2.32E-02	4.00E+01	1.29E-03	3.68E-03	4.10E+01
HYDRAULIC BULLWHEEL BUNDLE TENSIONER	Other Construction Equipment	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	36676.8768	0.4815	3.3767	37585.1891	3.15E-02	4.48E-02	4.56E-05	2.36E-03	2.52E-03	2.52E-03	5.94E+00	7.80E-05	5.47E-04	6.09E+00
PULLER ROPE TRAILER 4,000# CAP W/ SPLIT REEL TOW TYPE TANDEM A	Other Construction Equipment	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	36676.8768	0.4815	3.3767	37585.1891	2.91E-02	4.15E-02	4.22E-05	2.18E-03	2.33E-03	2.33E-03	5.94E+00	7.80E-05	5.47E-04	6.09E+00
PULLER CABLE TRAILER 30,000# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	115320.5588	0.4815	10.6172	118147.5920	1.10E-01	1.91E-01	2.05E-04	1.01E-02	6.29E-03	6.29E-03	1.87E+01	7.80E-05	1.72E-03	1.91E+01
PULLER ROPE TRAILER 4 DRUM 3,500# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	36676.8768	0.4815	3.3767	37585.1891	4.52E-02	5.67E-02	5.90E-05	2.98E-03	2.71E-03	2.71E-03	5.94E+00	7.80E-05	5.47E-04	6.09E+00
300T AT Setting Crane	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	137458.6383	1.4314	12.6553	140852.3840	5.79E-01	1.01E+00	1.08E-03	5.29E-02	3.31E-02	3.31E-02	1.11E+02	1.16E-03	1.03E-02	1.14E+02
60T RT Crane	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	1.05E+00	1.82E+00	1.95E-03	9.56E-02	5.98E-02	5.98E-02	2.16E+02	3.78E-03	1.99E-02	2.21E+02
SKID STEER LOADER TRACK MTD 80 > 75 HP	Skid Steer Loaders	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	19396.4227	0.6820	1.7858	19888.7461	2.71E-01	3.86E-01	3.93E-04	2.03E-02	2.17E-02	2.17E-02	6.40E+01	2.25E-03	5.89E-03	6.56E+01
DUMP BOX TRUCK 2-1/2 T 6X6	Dumpers/Tenders	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	3458.3652	0.3764	0.3184	3553.2816	1.01E-01	1.75E-01	1.88E-04	9.21E-03	5.76E-03	5.76E-03	1.14E+00	1.24E-04	1.05E-04	1.17E+00
DUMP BOX TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	3458.3652	0.3764	0.3184	3553.2816	3.35E-01	5.82E-01	6.25E-04	3.06E-02	1.92E-02	1.92E-02	4.57E+00	4.97E-04	4.20E-04	4.69E+00
FLATBED (FRAMING) TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	3458.3652	0.3764	0.3184	3553.2816	1.01E+00	1.75E+00	1.88E-03	9.19E-02	5.75E-02	5.75E-02	1.37E+01	1.49E-03	1.26E-03	1.41E+01
TRUCK TRACTOR 2-1/2 T 6X4 & 5 T 6X6	Off-highway Trucks	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	123528.4545	2.5437	11.3728	126613.4819	1.82E+00	3.16E+00	3.39E-03	1.66E-01	1.04E-01	1.04E-01	2.94E+02	6.04E-03	2.70E-02	3.01E+02
PICKUP TRUCK 3/4 T	Off-highway Trucks	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	123528.4545	2.5437	11.3728	126613.4819	1.32E+01	2.29E+01	2.46E-02	1.21E+00	7.53E-01	7.53E-01	2.28E+03	4.70E-02	2.10E-01	2.34E+03

Fugitive Dust												**CO**	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**
Dust from On Site Activities												0	0	0	0	3.81E+02	3.86E+01	0	0	0	0
		Emission Factors (g/mi) [i]										**Criteria Air Pollutant Emissions (ton / year)**						**GHG Emissions (metric ton/year)**			
Onroad	**MOVES Vehicle Class**	**CO**	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e [f]**	**CO**	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**
Resuspended Road Dust												0	0	0	0	7.67E-01	1.92E-01	0	0	0	0
Worker Commute (Gas Passenger Truck)	31	1.97337	0.08279	0.00175	0.01249	0.00201	0.00178	327.75242	0.00507	0.00118	328.2061	4.52E+00	1.90E-01	4.01E-03	2.86E-02	4.61E-03	4.08E-03	6.81E+02	1.05E-02	2.45E-03	6.82E+02
Material Hauling (Single Unit Truck)	52	0.71093	0.73854	0.00245	0.03046	0.01293	0.01190	730.69279	0.00606	0.10285	758.1175495	1.90E-01	1.98E-01	6.56E-04	8.16E-03	3.46E-03	3.19E-03	1.78E+02	1.47E-03	2.50E-02	1.84E+02
Flatbed truck (Combination Long Haul Truck)	62	1.49239	2.36047	0.00491	0.04326	0.02211	0.02034	1466.49952	0.01298	0.20661	1521.61366	8.88E-02	1.41E-01	2.92E-04	2.57E-03	1.32E-03	1.21E-03	7.92E+01	7.01E-04	1.12E-02	8.22E+01
		Emission Factors (g/kg fuel)						**Emission Factors (kg/mmBtu) [i]**				**Criteria Air Pollutant Emissions (ton / year)**						**GHG Emissions (metric ton/year)**			
Helicopter Emissions	**Engine Mode**	**CO**	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**	**CO**	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**
Helicopter with Turboshaft Engine	*Ground Idle*	66.76250	2.04693	0.00000	53.46090	0.11838	0.11838	72.22000	0.00300	0.00060	72.4630	1.05E+00	3.22E-02	0.00E+00	8.40E-01	1.86E-03	1.86E-03	4.20E+01	1.75E-03	3.49E-04	4.22E+01
Helicopter with Turboshaft Engine	*Hover and Climb*	8.09363	6.02259	0.00000	6.86012	0.18566	0.18566	72.22000	0.00300	0.00060	72.4630	3.55E-01	2.64E-01	0.00E+00	3.00E-01	8.13E-03	8.13E-03	1.17E+02	4.87E-03	9.74E-04	1.18E+02
Helicopter with Turboshaft Engine	*Approach*	16.41907	4.19436	0.00000	13.65406	0.14953	0.14953	72.22000	0.00300	0.00060	72.4630	5.49E-01	1.40E-01	0.00E+00	4.57E-01	5.00E-03	5.00E-03	8.96E+01	3.72E-03	7.44E-04	8.99E+01
Helicopter with Turboshaft Engine	*Flight*	8.88341	5.74252	0.00000	7.51068	0.17969	0.17969	72.22000	0.00300	0.00060	72.4630	2.37E+00	1.54E+00	0.00E+00	2.01E+00	4.80E-02	4.80E-02	7.15E+02	2.97E-02	5.94E-03	7.18E+02

CO	**NO_X**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**	**CH_4**	**N_2O**	**CO_2e**	
29.91	51.36	0.05	2.70	1.73	1.73	5283.68	0.09	0.49	5415.22	Equipment
0.00	0.00	0.00	0.00	381.18	38.62	0.00	0.00	0.00	0.00	Fugitive Dust
4.80	0.53	0.00	0.04	0.78	0.20	938.15	0.01	0.04	948.73	Onroad
4.33	1.97	0.00	3.61	0.06	0.06	964.32	0.04	0.01	967.57	Helicopter
39.04	**53.86**	**0.06**	**6.35**	**383.75**	**40.62**	**7,186.15**	**0.15**	**0.53**	**7,331.52**	**Total**

[a] EPA Tier II Emissions. EPA 420_P_04_009, Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling _ Compression Ignition, USEPA, April 2004 _ Tier 2 Engines.

[b] South Coast AQMD Off Road- Model Mobile Source Emission Factors (https://www.aqmd.gov/home/rules-compliance/ceqa/air-quality-analysis-handbook/off-road-mobile-source-emission-factors)

[c] Load Factors from MOVES4

[d] EPA Exhaust and Crankcase Emission Factors for Nonroad Compression-Ignition Engines in MOVES3.0.2, September 2021. Equation 10 - Assume ultra low sulfur diesel with 15ppm.

[e] NMHC (5% NMHC and 95% NOx in combined NMHC +NOx)
https://www.baaqmd.gov/~/media/Files/Engineering/policy_and_procedures/Engines/EmissionFactorsforDieselEngines.ashx

[f] Global Warming Potentials from EPA GHG Emission Factors Hub, 2024.

[g] N2O emissions estimated based on the ratio of g N2O per gallon of construction diesel to gallons of diesel per g CO2, obtained from Tables 2.7 and 2.1, respectively, of the 2023 Climate Registry Default Emission Factors. Retrieved from https://theclimateregistry.org/wp-content/uploads/2023/06/2023-Default-Emission-Factors-Final.pdf, June 2023.

[h] Conservatively, a maximum of 8 hours of flight time is allocated. Based on the helicopter's flying speed of 30 mph over a distance of 110 miles, the estimated actual flight time is approximately 3.7 hours.Assume helicopter starts 25 weeks into year 2028 and continues to the end of the construction duration. Source: Guidance on the Determination of Helicopter Emissions Edition 2 - December 2015.
https://www.bazl.admin.ch/dam/bazl/de/dokumente/Fachleute/Regulationen_und_Grundlagen/guidance_on_the_determinationofhelicopteremissions.pdf.download.pdf/guidance_on_the_determinationofhelicopteremissions.pdf

[i] GHG Emission factors from Title 40 Subchapter C Part 98 Subpart C, Table C-1 and C-2

Assumptions:

VOC/THC for diesel (Source: EPA, Conversion Factors for Hydrocarbon Emission Components, 2005 https://19january2017snapshot.epa.gov/www3/otaq/models/nonrdmdl/nonrdmdl2005/420r05015.pdf)	1.053
1 kWh = 1.34 hp-hr	
lb/metric ton	2204.62

Otter Tail Power
BSSA
Total Construction Emissions, Year
2028 blue denotes cells that change by year

Equipment	MOVES Lookup ID	SCAB Lookup ID	Fuel	HP	Typical Hours per day	Typical Days/Year	Count	Total Hours Used	Load Factor [c]	
Equipment										
ATV 4 TO 6 WHEEL, W/ DUMP	Off-Highway Trucks	Off-Highway Trucks	Diesel	13.5	2	66	1	132	0.59	
BACKHOE W/ LOADER 4X4	Tractors/Loaders/Backhoes	Tractors/Loaders/Backhoes	Diesel	94	2	96	2	384	0.21	
BUCKET 105' WORK HEIGHT	Aerial Lifts	Aerial Lifts	Diesel	300	8	160	3	3840	0.21	
BUCKET 125' WORK HEIGHT 8X6	Aerial Lifts	Aerial Lifts	Diesel	350	8	160	1	1280	0.21	
BUCKET 77' WORK HEIGHT SWAMP TRK MTD	Aerial Lifts	Aerial Lifts	Diesel	300	8	66	2	1056	0.21	
TRUCK MTD 4 T ARTICULATING BOOM W/ FORKS & CLAM	Cranes	Cranes	Diesel	450	2	96	1	192	0.43	
CRANE TRUCK 45 T HYDRAULIC 6 AXLE	Cranes	Cranes	Diesel	450	8	160	6	7680	0.43	
DIGGER DERRICK 15 T CAP	Cranes	Cranes	Diesel	330	8	160	4	5120	0.43	
DIGGER DERRICK 15 T CAP SWAMP TRACK MTD	Cranes	Cranes	Diesel	300	8	66	2	1056	0.43	
DOZER 10 THRU 12 T, W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	Diesel	80	4	96	1	384	0.59	
DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	Diesel	190	4	96	1	384	0.59	
CRAWLER CARRIER W/ 360 DUMP BOX OR DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	Crawler Tractors	Diesel	80	6	66	1	396	0.59	
EXCAVATOR 25 T	Excavators	Excavators	Diesel	172	4	66	1	264	0.59	
FORKLIFT 11,000 THRU 12,000# TELESCOPIC BOOM	Forklifts	Forklifts	Diesel	142	4	160	3	1920	0.59	
FRONT END LOADER 68,000# 4X4	Rubber Tire Loaders	Rubber Tired Loaders	Diesel	386	4	160	4	2560	0.59	
GENERATOR 23KW THRU 60KW TRAILER MOUNTED TOW TYPE	Generator Sets	Generator Sets	Diesel	38	8	90	4	2880	0.43	
HYDRAULIC BULLWHEEL BUNDLE TENSIONER	Other Construction Equipment	Other Construction Equipment	Diesel	80	2	81	1	162	0.59	
PULLER ROPE TRAILER 4,000# CAP W/ SPLIT REEL TOW TYPE TANDEM A	Other Construction Equipment	Other Construction Equipment	Diesel	74	2	81	1	162	0.59	
PULLER CABLE TRAILER 30,000# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	Other Construction Equipment	Diesel	400	2	81	1	162	0.59	
PULLER ROPE TRAILER 4 DRUM 3,500# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	Other Construction Equipment	Diesel	115	2	81	1	162	0.59	
300T AT Setting Crane	Cranes	Cranes	Diesel	577	6	135	1	810	0.43	
60T RT Crane	Cranes	Cranes	Diesel	320	4	160	4	2560	0.43	
SKID STEER LOADER TRACK MTD 80 > 75 HP	Skid Steer Loaders	Skid Steer Loaders	Diesel	95	4	160	5	3200	0.21	
DUMP BOX TRUCK 2-1/2 T 6X6	Dumpers/Tenders	Dumpers/Tenders Composite	Diesel	505	2	160	1	320	0.21	
DUMP BOX TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	Dumpers/Tenders Composite	Diesel	420	4	160	2	1280	0.21	
FLATBED (FRAMING) TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	Dumpers/Tenders Composite	Diesel	420	4	160	6	3840	0.21	
TRUCK TRACTOR 2-1/2 T 6X4 & 5 T 6X6	Off-highway Trucks	Off-highway Trucks	Diesel	450	4	96	6	2304	0.59	
PICKUP TRUCK 3/4 T	Off-highway Trucks	Off-highway Trucks	Diesel	420	8	160	14	17920	0.59	

Fugitive Dust										
Dust from On Site Activities										
Onroad	**MOVES Vehicle Class**		**Fuel Type**	**VMT**	**Onroad Fuel ID**	**Year**	**MOVES Road Type**	**MOVES Day Type**		
Resuspended Road Dust										
Worker Commute (Gas Passenger Truck)	31		Gasoline	2,079,000	1	2028	3	5		
Material Hauling (Single Unit Truck)	52		Diesel	243,000	2	2028	3	5		
Flatbed truck (Combination Long Haul Truck)	62		Diesel	54,000	2	2028	3	5		

Helicopter Emissions	**Engine Mode**	**Quantity**	**Hours/day**	**Number of days per year**	**Total Hours**	**Fuel Flow (Kg/s) [h]**	**Max Power (HP)**	**Load Factor**	**Loaded Power (HP)**	**Fuel Usage (kg fuel)**	**Fuel Usage (mmBtu)**
Helicopter with Turboshaft Engine	*Ground Idle*	*1*	1.00	120	120	0.015	420	0.13000	55	6334.54	258.77
Helicopter with Turboshaft Engine	*Hover and Climb*	*1*	1.25	120	150	0.033	420	0.87000	365	17660.94	721.46
Helicopter with Turboshaft Engine	*Approach*	*1*	1.25	120	150	0.025	420	0.46000	193	13491.03	551.12
Helicopter with Turboshaft Engine	*Flight*	*1*	8.00	120	960	0.031	420	0.80000	336	#######	4403.12

[a] EPA Tier II Emissions. EPA 420_P_04_009, Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling _ Compression Ignition, USEPA, April 2004 _ Tier 2 Engines.

[b] South Coast AQMD Off Road- Model Mobile Source Emission Factors (https://www.aqmd.gov/home/rules-compliance/ceqa/air-quality-analysis-handbook/off-road-mobile-source-emission-factors)

[c] Load Factors from MOVES4

[d] EPA Exhaust and Crankcase Emission Factors for Nonroad Compression-Ignition Engines in MOVES3.0.2, September 2021. Equation 10 - Assume ultra low sulfur diesel with 15ppm.

[e] NMHC (5% NMHC and 95% NOx in combined NMHC +NOx)
https://www.baaqmd.gov/~/media/Files/Engineering/policy_and_procedures
/Engines/EmissionFactorsforDieselEngines.ashx

[f] Global Warming Potentials from EPA GHG Emission Factors Hub, 2024.

[g] N2O emissions estimated based on the ratio of g N2O per gallon of construction diesel to gallons of diesel per g CO2, obtained from Tables 2.7 and 2.1, respectively, of the 2023 Climate Registry Default Emission Factors. Retrieved from https://theclimateregistry.org/wp-content/uploads/2023/06/2023-Default-Emission-Factors-Final.pdf, June 2023.

[h] Conservatively, a maximum of 8 hours of flight time is allocated. Based on the helicopter's flying speed of 30 mph over a distance of 110 miles, the estimated actual flight time is approximately 3.7 hours.Assume helicopter starts 25 weeks into year 2028 and continues to the end of the construction duration. Source: Guidance on the Determination of Helicopter Emissions Edition 2 - December 2015.
https://www.bazl.admin.ch/dam/bazl/de/dokumente/Fachleute/Regulationen_und_Grundlagen/guidance_on_the_determinationofhelicopteremissions.pdf.download.pdf/guidance_on_the_determinationofhelicopteremissions.pdf

[i] GHG Emission factors from Title 40 Subchapter C Part 98 Subpart C, Table C-1 and C-2

Assumptions:

VOC/THC for diesel (Source: EPA, Conversion Factors for Hydrocarbon Emission Components, 2005
https://19january2017snapshot.epa.gov/www3/otaq/models/nonrdmdl/nonrdmdl2005/420r05015.pdf) 1.053

1 kWh = 1.34 hp-hr

lb/metric ton 2204.62

Otter Tail Power
BSSA
Total Construction Emissions, Year
2028 blue denotes cells that change by year

Equipment	MOVES Lookup ID	Emission Factors (g/hp-hr) [a] CO	NO_X	SO_2 [d]	VOC [e]	PM_{10}	$PM_{2.5}$	Emission Factors (g/hr) [b] CO_2	CH_4	N_2O [g]	CO_2e [f]	Criteria Air Pollutant Emissions (ton / year) CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	GHG Emissions (metric ton/year) CO_2	CH_4	N_2O	CO_2e
Equipment																					
ATV 4 TO 6 WHEEL, W/ DUMP	Off-Highway Trucks	4.9254	5.3172	0.0054	0.2799	0.5970	0.5970	56738.8018	2.5437	5.2237	58194.3187	5.71E-03	6.16E-03	6.27E-06	3.24E-04	6.92E-04	6.92E-04	7.49E+00	3.36E-04	6.90E-04	7.68E+00
BACKHOE W/ LOADER 4X4	Tractors/Loaders/Backhoes	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	23463.4126	0.7832	2.1602	24057.7949	3.12E-02	4.44E-02	4.52E-05	2.34E-03	2.49E-03	2.49E-03	9.01E+00	3.01E-04	8.30E-04	9.24E+00
BUCKET 105' WORK HEIGHT	Aerial Lifts	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	96549.7784	0.4122	8.8890	98916.9083	6.97E-01	1.25E+00	1.30E-03	6.57E-02	3.98E-02	3.98E-02	3.71E+02	1.58E-03	3.41E-02	3.80E+02
BUCKET 125' WORK HEIGHT 8X6	Aerial Lifts	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	96549.7784	0.4122	8.8890	98916.9083	2.71E-01	4.71E-01	5.05E-04	2.48E-02	1.55E-02	1.55E-02	1.24E+02	5.28E-04	1.14E-02	1.27E+02
BUCKET 77' WORK HEIGHT SWAMP TRK MTD	Aerial Lifts	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	96549.7784	0.4122	8.8890	98916.9083	1.92E-01	3.43E-01	3.57E-04	1.81E-02	1.09E-02	1.09E-02	1.02E+02	4.35E-04	9.39E-03	1.04E+02
TRUCK MTD 4 T ARTICULATING BOOM W/ FORKS & CLAM	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	1.07E-01	1.86E-01	2.00E-04	9.78E-03	6.11E-03	6.11E-03	1.57E+01	2.75E-04	1.44E-03	1.61E+01
CRANE TRUCK 45 T HYDRAULIC 6 AXLE	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	4.28E+00	7.43E+00	7.98E-03	3.91E-01	2.44E-01	2.44E-01	6.27E+02	1.10E-02	5.78E-02	6.43E+02
DIGGER DERRICK 15 T CAP	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	2.09E+00	3.63E+00	3.90E-03	1.91E-01	1.20E-01	1.20E-01	4.18E+02	7.33E-03	3.85E-02	4.29E+02
DIGGER DERRICK 15 T CAP SWAMP TRACK MTD	Cranes	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	3.92E-01	7.03E-01	7.32E-04	3.70E-02	2.24E-02	2.24E-02	8.63E+01	1.51E-03	7.94E-03	8.84E+01
DOZER 10 THRU 12 T, W/ WINCH	Crawler Tractor/Dozers	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	29851.1565	1.9934	2.7483	30635.2689	7.45E-02	1.06E-01	1.08E-04	5.59E-03	5.96E-03	5.96E-03	1.15E+01	7.65E-04	1.06E-03	1.18E+01
DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	2.6119	4.6791	0.0049	0.2463	0.1493	0.1493	75355.9475	1.9934	6.9378	77250.2698	1.24E-01	2.22E-01	2.31E-04	1.17E-02	7.08E-03	7.08E-03	2.89E+01	7.65E-04	2.66E-03	2.97E+01
CRAWLER CARRIER W/ 360 DUMP BOX OR DOZER 18 T W/ WINCH	Crawler Tractor/Dozers	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	29851.1565	1.9934	2.7483	30635.2689	7.69E-02	1.10E-01	1.12E-04	5.77E-03	6.15E-03	6.15E-03	1.18E+01	7.89E-04	1.09E-03	1.21E+01
EXCAVATOR 25 T	Excavators	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	50902.8167	0.8117	4.6864	52167.4535	1.10E-01	1.38E-01	1.44E-04	7.27E-03	6.61E-03	6.61E-03	1.34E+01	2.14E-04	1.24E-03	1.38E+01
FORKLIFT 11,000 THRU 12,000# TELESCOPIC BOOM	Forklifts	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	25425.8129	0.6148	2.3409	26063.3573	6.62E-01	8.30E-01	8.63E-04	4.37E-02	3.97E-02	3.97E-02	4.88E+01	1.18E-03	4.49E-03	5.00E+01
FRONT END LOADER 68,000# 4X4	Rubber Tire Loaders	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	107505.0812	0.8359	9.8976	110151.3563	1.68E+00	2.92E+00	3.13E-03	1.53E-01	9.59E-02	9.59E-02	2.75E+02	2.14E-03	2.53E-02	2.82E+02
GENERATOR 23KW THRU 60KW TRAILER MOUNTED TOW TYPE	Generator Sets	4.1045	5.3172	0.0054	0.2799	0.4478	0.4478	13890.3485	0.4472	1.2788	14241.7630	2.13E-01	2.76E-01	2.81E-04	1.45E-02	2.32E-02	2.32E-02	4.00E+01	1.29E-03	3.68E-03	4.10E+01
HYDRAULIC BULLWHEEL BUNDLE TENSIONER	Other Construction Equipment	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	36676.8768	0.4815	3.3767	37585.1891	3.15E-02	4.48E-02	4.56E-05	2.36E-03	2.52E-03	2.52E-03	5.94E+00	7.80E-05	5.47E-04	6.09E+00
PULLER ROPE TRAILER 4,000# CAP W/ SPLIT REEL TOW TYPE TANDEM A	Other Construction Equipment	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	36676.8768	0.4815	3.3767	37585.1891	2.91E-02	4.15E-02	4.22E-05	2.18E-03	2.33E-03	2.33E-03	5.94E+00	7.80E-05	5.47E-04	6.09E+00
PULLER CABLE TRAILER 30,000# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	115320.5588	0.4815	10.6172	118147.5920	1.10E-01	1.91E-01	2.05E-04	1.01E-02	6.29E-03	6.29E-03	1.87E+01	7.80E-05	1.72E-03	1.91E+01
PULLER ROPE TRAILER 4 DRUM 3,500# CAP TOW TYPE TANDEM AXLE	Other Construction Equipment	3.7313	4.6791	0.0049	0.2463	0.2239	0.2239	36676.8768	0.4815	3.3767	37585.1891	4.52E-02	5.67E-02	5.90E-05	2.98E-03	2.71E-03	2.71E-03	5.94E+00	7.80E-05	5.47E-04	6.09E+00
300T AT Setting Crane	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	137458.6383	1.4314	12.6553	140852.3840	5.79E-01	1.01E+00	1.08E-03	5.29E-02	3.31E-02	3.31E-02	1.11E+02	1.16E-03	1.03E-02	1.14E+02
60T RT Crane	Cranes	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	81692.4933	1.4314	7.5212	83725.6762	1.01E+00	1.76E+00	1.89E-03	9.27E-02	5.80E-02	5.80E-02	2.09E+02	3.66E-03	1.93E-02	2.14E+02
SKID STEER LOADER TRACK MTD 80 > 75 HP	Skid Steer Loaders	3.7313	5.3172	0.0054	0.2799	0.2985	0.2985	19396.4227	0.6820	1.7858	19888.7461	2.63E-01	3.74E-01	3.81E-04	1.97E-02	2.10E-02	2.10E-02	6.21E+01	2.18E-03	5.71E-03	6.36E+01
DUMP BOX TRUCK 2-1/2 T 6X6	Dumpers/Tenders	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	3458.3652	0.3764	0.3184	3553.2816	9.77E-02	1.70E-01	1.82E-04	8.93E-03	5.58E-03	5.58E-03	1.11E+00	1.20E-04	1.02E-04	1.14E+00
DUMP BOX TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	3458.3652	0.3764	0.3184	3553.2816	3.25E-01	5.65E-01	6.06E-04	2.97E-02	1.86E-02	1.86E-02	4.43E+00	4.82E-04	4.08E-04	4.55E+00
FLATBED (FRAMING) TRUCK 1-1/4 & 1-1/2 T	Dumpers/Tenders	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	3458.3652	0.3764	0.3184	3553.2816	9.75E-01	1.69E+00	1.82E-03	8.92E-02	5.57E-02	5.57E-02	1.33E+01	1.45E-03	1.22E-03	1.36E+01
TRUCK TRACTOR 2-1/2 T 6X4 & 5 T 6X6	Off-highway Trucks	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	123528.4545	2.5437	11.3728	126613.4819	1.76E+00	3.06E+00	3.29E-03	1.61E-01	1.01E-01	1.01E-01	2.85E+02	5.86E-03	2.62E-02	2.92E+02
PICKUP TRUCK 3/4 T	Off-highway Trucks	2.6119	4.5373	0.0049	0.2388	0.1493	0.1493	123528.4545	2.5437	11.3728	126613.4819	1.28E+01	2.22E+01	2.39E-02	1.17E+00	7.31E-01	7.31E-01	2.21E+03	4.56E-02	2.04E-01	2.27E+03

Fugitive Dust		CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e
Dust from On Site Activities		0	0	0	0	3.81E+02	3.86E+01	0	0	0	0

Onroad	MOVES Vehicle Class	Emission Factors (g/mi) [i] CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e [f]	Criteria Air Pollutant Emissions (ton / year) CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	GHG Emissions (metric ton/year) CO_2	CH_4	N_2O	CO_2e
Resuspended Road Dust												0	0	0	0	7.67E-01	1.92E-01	0	0	0	0
Worker Commute (Gas Passenger Truck)	31	2.11264	0.11115	0.00177	0.01440	0.00215	0.00190	330.40119	0.00542	0.00127	330.8881	4.84E+00	2.55E-01	4.05E-03	3.30E-02	4.92E-03	4.35E-03	6.87E+02	1.13E-02	2.63E-03	6.88E+02
Material Hauling (Single Unit Truck)	52	0.72884	0.84247	0.00249	0.03655	0.01548	0.01425	742.72877	0.00630	0.10233	770.0238031	1.95E-01	2.26E-01	6.67E-04	9.79E-03	4.15E-03	3.82E-03	1.80E+02	1.53E-03	2.49E-02	1.87E+02
Flatbed truck (Combination Long Haul Truck)	62	1.52587	2.61028	0.00499	0.04924	0.02645	0.02433	1489.13197	0.01327	0.20540	1543.935471	9.08E-02	1.55E-01	2.97E-04	2.93E-03	1.57E-03	1.45E-03	8.04E+01	7.17E-04	1.11E-02	8.34E+01

Helicopter Emissions	Engine Mode	Emission Factors (g/kg fuel) CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	Emission Factors (kg/mmBtu) [i] CO_2	CH_4	N_2O	CO_2e	Criteria Air Pollutant Emissions (ton / year) CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	GHG Emissions (metric ton/year) CO_2	CH_4	N_2O	CO_2e
Helicopter with Turboshaft Engine	*Ground Idle*	66.76250	2.04693	0.00000	53.46090	0.11838	0.11838	72.22000	0.00300	0.00060	72.4630	4.66E-01	1.43E-02	0.00E+00	3.73E-01	8.27E-04	8.27E-04	1.87E+01	7.76E-04	1.55E-04	1.88E+01
Helicopter with Turboshaft Engine	*Hover and Climb*	8.09363	6.02259	0.00000	6.86012	0.18566	0.18566	72.22000	0.00300	0.00060	72.4630	1.58E-01	1.17E-01	0.00E+00	1.34E-01	3.61E-03	3.61E-03	5.21E+01	2.16E-03	4.33E-04	5.23E+01
Helicopter with Turboshaft Engine	*Approach*	16.41907	4.19436	0.00000	13.65406	0.14953	0.14953	72.22000	0.00300	0.00060	72.4630	2.44E-01	6.24E-02	0.00E+00	2.03E-01	2.22E-03	2.22E-03	3.98E+01	1.65E-03	3.31E-04	3.99E+01
Helicopter with Turboshaft Engine	*Flight*	8.88341	5.74252	0.00000	7.51068	0.17969	0.17969	72.22000	0.00300	0.00060	72.4630	1.06E+00	6.82E-01	0.00E+00	8.92E-01	2.13E-02	2.13E-02	3.18E+02	1.32E-02	2.64E-03	3.19E+02

[a] EPA Tier II Emissions. EPA 420_P_04_009, Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling _ Compression Ignition, USEPA, April 2004 _ Tier 2 Engines.

[b] South Coast AQMD Off Road- Model Mobile Source Emission Factors (https://www.aqmd.gov/home/rules-compliance/ceqa/air-quality-analysis-handbook/off-road-mobile-source-emission-factors)

[c] Load Factors from MOVES4

[d] EPA Exhaust and Crankcase Emission Factors for Nonroad Compression-Ignition Engines in MOVES3.0.2, September 2021. Equation 10 - Assume ultra low sulfur diesel with 15ppm.

[e] NMHC (5% NMHC and 95% NOx in combined NMHC +NOx)
https://www.baaqmd.gov/~/media/Files/Engineering/policy_and_procedures/Engines/EmissionFactorsforDieselEngines.ashx

[f] Global Warming Potentials from EPA GHG Emission Factors Hub, 2024.

[g] N2O emissions estimated based on the ratio of g N2O per gallon of construction diesel to gallons of diesel per g CO2, obtained from Tables 2.7 and 2.1, respectively, of the 2023 Climate Registry Default Emission Factors. Retrieved from https://theclimateregistry.org/wp-content/uploads/2023/06/2023-Default-Emission-Factors-Final.pdf, June 2023.

[h] Conservatively, a maximum of 8 hours of flight time is allocated. Based on the helicopter's flying speed of 30 mph over a distance of 110 miles, the estimated actual flight time is approximately 3.7 hours.Assume helicopter starts 25 weeks into year 2028 and continues to the end of the construction duration. Source: Guidance on the Determination of Helicopter Emissions Edition 2 - December 2015.
https://www.bazl.admin.ch/dam/bazl/de/dokumente/Fachleute/Regulationen_und_Grundlagen/guidance_on_the_determinationofhelicopteremissions.pdf.download.pdf/guidance_on_the_determinationofhelicopteremissions.pdf

[i] GHG Emission factors from Title 40 Subchapter C Part 98 Subpart C, Table C-1 and C-2

CO	NO_X	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e	
29.02	49.84	0.05	2.62	1.68	1.68	5126.21	0.09	0.47	5253.84	Equipment
0.00	0.00	0.00	0.00	381.18	38.62	0.00	0.00	0.00	0.00	Fugitive Dust
5.13	0.64	0.01	0.05	0.78	0.20	947.80	0.01	0.04	958.41	Onroad
1.92	0.88	0.00	1.60	0.03	0.03	428.59	0.02	0.00	430.03	Helicopter
36.07	**51.35**	**0.06**	**4.27**	**383.67**	**40.53**	**6,502.60**	**0.12**	**0.51**	**6,642.27**	**Total**

Assumptions:

VOC/THC for diesel (Source: EPA, Conversion Factors for Hydrocarbon Emission Components, 2005
https://19january2017snapshot.epa.gov/www3/otaq/models/nonrdmdl/nonrdmdl2005/420r05015.pdf) 1.053

1 kWh = 1.34 hp-hr

lb/metric ton 2204.62

Resuspended Road Dust

Silt Loading	AP-42 Roadway Category	sL (Winter)
High ADT Road	5000-10000 ADT	0.12
Low ADT Road	500-5000 ADT	0.6

Total Vehicle Miles Traveled (VMT) per Speed Bin

Year	SpeedBin	MOVES ID	Weight tons	Low ADT Road 5	Low ADT Road 6	Low ADT Road 7	High ADT Road 12	High ADT Road 13	High ADT Road 16	Low ADT Road sum	High ADT Road sum
2028	Passenger Truck	31	5	0	0	415800	1663200	0	0	415800	1663200
2028	Single Unit Truck	52	20	0	0	48600	194400	0	0	48600	194400
2028	Combination Long Haul Truck	62	35	0	0	10800	43200	0	0	10800	43200
2029	Passenger Truck	31	5	0	0	415800	1663200	0	0	415800	1663200
2029	Single Unit Truck	52	20	0	0	48600	194400	0	0	48600	194400
2029	Combination Long Haul Truck	62	35	0	0	10800	43200	0	0	10800	43200
2030	Passenger Truck	31	5	0	0	415800	1663200	0	0	415800	1663200
2030	Single Unit Truck	52	20	0	0	48600	194400	0	0	48600	194400
2030	Combination Long Haul Truck	62	35	0	0	10800	43200	0	0	10800	43200
2031	Passenger Truck	31	5	0	0	64680	258720	0	0	64680	258720
2031	Single Unit Truck	52	20	0	0	7560	30240	0	0	7560	30240
2031	Combination Long Haul Truck	62	35	0	0	1680	6720	0	0	1680	6720

Total			
	$PM_{2.5}$	0.604861993	tons
	PM_{10}	2.419447973	tons
By year			
2028	$PM_{2.5}$	0.191681618	tons
2028	PM_{10}	0.76672647	tons
2029	$PM_{2.5}$	0.191681618	tons
2029	PM_{10}	0.76672647	tons
2030	$PM_{2.5}$	0.191681618	tons
2030	PM_{10}	0.76672647	tons
2031	$PM_{2.5}$	0.029817141	tons
2031	PM_{10}	0.119268562	tons

Year	Vehicle Type	Pollutant	Road Type	k (g/VMT)	sL	W	P	VMT	Emissions (tons)
2028	Passenger Truck	$PM_{2.5}$	High ADT Road	0.25	0.12	5	110	1663200	0.0552
2028	Passenger Truck	PM_{10}	High ADT Road	1	0.12	5	110	1663200	0.2206
2028	Passenger Truck	$PM_{2.5}$	Low ADT Road	0.25	0.6	5	110	415800	0.0596
2028	Passenger Truck	PM_{10}	Low ADT Road	1	0.6	5	110	415800	0.2386
2028	Single Unit Truck	$PM_{2.5}$	High ADT Road	0.25	0.12	20	110	194400	0.0265
2028	Single Unit Truck	PM_{10}	High ADT Road	1	0.12	20	110	194400	0.1060
2028	Single Unit Truck	$PM_{2.5}$	Low ADT Road	0.25	0.6	20	110	48600	0.0287
2028	Single Unit Truck	PM_{10}	Low ADT Road	1	0.6	20	110	48600	0.1147
2028	Combination Long Haul Truck	$PM_{2.5}$	High ADT Road	0.25	0.12	35	110	43200	0.0104
2028	Combination Long Haul Truck	PM_{10}	High ADT Road	1	0.12	35	110	43200	0.0417
2028	Combination Long Haul Truck	$PM_{2.5}$	Low ADT Road	0.25	0.6	35	110	10800	0.0113
2028	Combination Long Haul Truck	PM_{10}	Low ADT Road	1	0.6	35	110	10800	0.0451
2029	Passenger Truck	$PM_{2.5}$	High ADT Road	0.25	0.12	5	110	1663200	0.0552
2029	Passenger Truck	PM_{10}	High ADT Road	1	0.12	5	110	1663200	0.2206
2029	Passenger Truck	$PM_{2.5}$	Low ADT Road	0.25	0.6	5	110	415800	0.0596
2029	Passenger Truck	PM_{10}	Low ADT Road	1	0.6	5	110	415800	0.2386
2029	Single Unit Truck	$PM_{2.5}$	High ADT Road	0.25	0.12	20	110	194400	0.0265
2029	Single Unit Truck	PM_{10}	High ADT Road	1	0.12	20	110	194400	0.1060
2029	Single Unit Truck	$PM_{2.5}$	Low ADT Road	0.25	0.6	20	110	48600	0.0287
2029	Single Unit Truck	PM_{10}	Low ADT Road	1	0.6	20	110	48600	0.1147
2029	Combination Long Haul Truck	$PM_{2.5}$	High ADT Road	0.25	0.12	35	110	43200	0.0104
2029	Combination Long Haul Truck	PM_{10}	High ADT Road	1	0.12	35	110	43200	0.0417
2029	Combination Long Haul Truck	$PM_{2.5}$	Low ADT Road	0.25	0.6	35	110	10800	0.0113
2029	Combination Long Haul Truck	PM_{10}	Low ADT Road	1	0.6	35	110	10800	0.0451
2030	Passenger Truck	$PM_{2.5}$	High ADT Road	0.25	0.12	5	110	1663200	0.0552
2030	Passenger Truck	PM_{10}	High ADT Road	1	0.12	5	110	1663200	0.2206
2030	Passenger Truck	$PM_{2.5}$	Low ADT Road	0.25	0.6	5	110	415800	0.0596
2030	Passenger Truck	PM_{10}	Low ADT Road	1	0.6	5	110	415800	0.2386
2030	Single Unit Truck	$PM_{2.5}$	High ADT Road	0.25	0.12	20	110	194400	0.0265
2030	Single Unit Truck	PM_{10}	High ADT Road	1	0.12	20	110	194400	0.1060
2030	Single Unit Truck	$PM_{2.5}$	Low ADT Road	0.25	0.6	20	110	48600	0.0287
2030	Single Unit Truck	PM_{10}	Low ADT Road	1	0.6	20	110	48600	0.1147
2030	Combination Long Haul Truck	$PM_{2.5}$	High ADT Road	0.25	0.12	35	110	43200	0.0104
2030	Combination Long Haul Truck	PM_{10}	High ADT Road	1	0.12	35	110	43200	0.0417
2030	Combination Long Haul Truck	$PM_{2.5}$	Low ADT Road	0.25	0.6	35	110	10800	0.0113
2030	Combination Long Haul Truck	PM_{10}	Low ADT Road	1	0.6	35	110	10800	0.0451
2031	Passenger Truck	$PM_{2.5}$	High ADT Road	0.25	0.12	5	110	258720	0.0086
2031	Passenger Truck	PM_{10}	High ADT Road	1	0.12	5	110	258720	0.0343
2031	Passenger Truck	$PM_{2.5}$	Low ADT Road	0.25	0.6	5	110	64680	0.0093
2031	Passenger Truck	PM_{10}	Low ADT Road	1	0.6	5	110	64680	0.0371
2031	Single Unit Truck	$PM_{2.5}$	High ADT Road	0.25	0.12	20	110	30240	0.0041
2031	Single Unit Truck	PM_{10}	High ADT Road	1	0.12	20	110	30240	0.0165
2031	Single Unit Truck	$PM_{2.5}$	Low ADT Road	0.25	0.6	20	110	7560	0.0045
2031	Single Unit Truck	PM_{10}	Low ADT Road	1	0.6	20	110	7560	0.0178
2031	Combination Long Haul Truck	$PM_{2.5}$	High ADT Road	0.25	0.12	35	110	6720	0.0016
2031	Combination Long Haul Truck	PM_{10}	High ADT Road	1	0.12	35	110	6720	0.0065
2031	Combination Long Haul Truck	$PM_{2.5}$	Low ADT Road	0.25	0.6	35	110	1680	0.0018
2031	Combination Long Haul Truck	PM_{10}	Low ADT Road	1	0.6	35	110	1680	0.0070

Formula used from AP-42 Section 13.2.1 "Paved Roads"

$E=k\,(sL/2)^{0.91}\,(W/3)^{1.02}\,(1-P/4N)$

E = particulate emission factor (having units matching the units of k)
k = particle size multiplier for particle size range and units of interest, From AP-42 Table 13.2-1.1
sL = road surface silt loading (grams per square meter) (g/m2), Assume winter time condition
W = average weight (tons) of the vehicles traveling the road
Figure 13.2.1-2 estimates that days of precipitation >0.01 inch per year (P) is approximately 110 days in Douglas County; N is 365 days.

Fugitive Dust

	Activities	Construction Duration (Days)	Area Affected (ac) *or* *Mileage* [6]	WRAP Level[1]	Duration or *Tonnage* [5]	Emission Factor[2,3] Emission Factor Unit	PM_{10}	$PM_{2.5}$	Control Efficiency[4]	Emission (tons/year) PM_{10}	$PM_{2.5}$
2028	ROW (Soil Disturbance)	270	633.8	1	9	ton/ac-month	0.11	0.011	50%	313.732	31.373
2028	Passenger Trucks Onsite Mileage (Passenger Truck)	270	*40500*	*4*	*5*	lb/ton-mile	0.21	0.021	50%	10.631	1.063
2028	Material Hauling Trucks Onsite Mileage (Heavy Vehicle)	270	*16200*	*4*	*20*	lb/ton-mile	0.21	0.021	50%	17.010	1.701
2028	Flatbed Trucks Onsite Mileage (Heavy heavy Vehicle)	270	*16200*	*4*	*35*	lb/ton-mile	0.21	0.021	50%	29.768	2.977
2028	Wind Erosion	270	633.8		1.00	ton/ac-year	0.38	0.057	50%	10.035	1.505
2029	ROW (Soil Disturbance)	270	633.8	1	9	ton/ac-month	0.11	0.011	50%	313.732	31.373
2029	Passenger Trucks Onsite Mileage (Passenger Truck)	270	*40500*	*4*	*5*	lb/ton-mile	0.21	0.021	50%	10.631	1.063
2029	Material Hauling Trucks Onsite Mileage (Heavy Vehicle)	270	*16200*	*4*	*20*	lb/ton-mile	0.21	0.021	50%	17.010	1.701
2029	Flatbed Trucks Onsite Mileage (Heavy heavy Vehicle)	270	*16200*	*4*	*35*	lb/ton-mile	0.21	0.021	50%	29.768	2.977
2029	Material Hauling Trucks Onsite Mileage (Heavy Vehicle)	270	633.8		1.00	ton/ac-year	0.38	0.057	50%	10.035	1.505
2030	ROW (Soil Disturbance)	270	633.8	1	9	ton/ac-month	0.11	0.011	50%	313.732	31.373
2030	Passenger Trucks Onsite Mileage (Passenger Truck)	270	*40500*	*4*	*5*	lb/ton-mile	0.21	0.021	50%	10.631	1.063
2030	Material Hauling Trucks Onsite Mileage (Heavy Vehicle)	270	*16200*	*4*	*20*	lb/ton-mile	0.21	0.021	50%	17.010	1.701
2030	Flatbed Trucks Onsite Mileage (Heavy heavy Vehicle)	270	*16200*	*4*	*35*	lb/ton-mile	0.21	0.021	50%	29.768	2.977
2030	Wind Erosion	270	633.8		1.00	ton/ac-year	0.38	0.057	50%	10.035	1.505
2031	ROW (Soil Disturbance)	42	98.6	1	1.4	ton/ac-month	0.11	0.011	50%	7.592	0.759
2031	Passenger Trucks Onsite Mileage (Passenger Truck)	42	*6300*	*4*	*5*	lb/ton-mile	0.21	0.021	50%	1.654	0.165
2031	Material Hauling Trucks Onsite Mileage (Heavy Vehicle)	42	*2520*	*4*	*20*	lb/ton-mile	0.21	0.021	50%	2.646	0.265
2031	Flatbed Trucks Onsite Mileage (Heavy heavy Vehicle)	42	*2520*	*4*	*35*	lb/ton-mile	0.21	0.021	50%	4.631	0.463
2031	Wind Erosion	42	98.6		1.00	ton/ac-year	0.38	0.057	50%	1.561	0.234
									Fugutive Dust Total	**1161.612**	**117.745**

Fugitive Dust by Year Summary

	PM_{10}	$PM_{2.5}$
2028	381.17636	38.6194
2029	381.17636	38.6194
2030	381.17636	38.6194
2031	18.082832	1.886335
Total	1161.6119	117.7445

[1] WRAP level from Table 3-2 Ch 3 of WRAP Fugitive Dust Handbook Sep/2006: https://www.env.nm.gov/wp-content/uploads/sites/2/2017/02/WRAP_FDHandbook_Rev_06.pdf

[2] PM2.5/PM10 is set at 0.1 per guideline listed on section 3.3.1 of WRAP handbook, 0.15 for Wind Erosion per Section 9.2 of WRAP handbook

[3] Wind Erosion Emission Factor extracted from WRAP handbook Table 11-6, assumed 100% of TSP is PM10

[4] 50% of Wet Suppression per WRAP handbook Page 8

[5] The unit for Duration is either month or year depending on the Emission Factor Unit. 20 tons was assume for Heavy Truck, 5 tons for passenger trucks

[6] Assume daily on-site mileage would be 30 mi per crew and there are 5 passenger vehicle crews, 2 material hauling crews, and 2 flatbed truck crews

Civil crew starts first, then transmission crew but transmission crew there nearly 5-6 guys per crew

Equipment	Fuel	Quantity	HP	Hours/day	Typical Days/week	Weeks	Total Construction Days	Weeks by Year 2028	2029	2030	2031	keep Tier 2	Days by Year 2028	2029	2030	2031
ATV 4 TO 6 WHEEL, W/ DUMP	Diesel	1	13.5	2	3	73	219	22	23	23	5		66	69	69	15
BACKHOE W/ LOADER 4X4	Diesel	2	94	2	3	105	315	32	33	33	7		96	99	99	21
BUCKET 105' WORK HEIGHT	Diesel	3	300	8	5	105	525	32	33	33	7		160	165	165	35
BUCKET 125' WORK HEIGHT 8X6	Diesel	1	350	8	5	105	525	32	33	33	7		160	165	165	35
BUCKET 77' WORK HEIGHT SWAMP TRK MTD	Diesel	2	300	8	3	73	219	22	23	23	5		66	69	69	15
TRUCK MTD 4 T ARTICULATING BOOM W/ FORKS & CLAM	Diesel	1	450	2	3	105	315	32	33	33	7		96	99	99	21
CRANE TRUCK 45 T HYDRAULIC 6 AXLE	Diesel	6	450	8	5	105	525	32	33	33	7		160	165	165	35
DIGGER DERRICK 15 T CAP	Diesel	4	330	8	5	105	525	32	33	33	7		160	165	165	35
DIGGER DERRICK 15 T CAP SWAMP TRACK MTD	Diesel	2	300	8	3	73	219	22	23	23	5		66	69	69	15
DOZER 10 THRU 12 T, W/ WINCH	Diesel	1	80	4	3	105	315	32	33	33	7		96	99	99	21
DOZER 18 T W/ WINCH	Diesel	1	190	4	3	105	315	32	33	33	7		96	99	99	21
CRAWLER CARRIER W/ 360 DUMP BOX OR DOZER 18 T W/ WINCH	Diesel	1	80	6	3	73	219	22	23	23	5		66	69	69	15
EXCAVATOR 25 T	Diesel	1	172	4	3	73	219	22	23	23	5		66	69	69	15
FORKLIFT 11,000 THRU 12,000# TELESCOPIC BOOM	Diesel	3	142	4	5	105	525	32	33	33	7		160	165	165	35
FRONT END LOADER 68,000# 4X4	Diesel	4	386	4	5	105	525	32	33	33	7		160	165	165	35
GENERATOR 23KW THRU 60KW TRAILER MOUNTED TOW TYPE	Diesel	4	38	8	5	58	290	18	18	18	4		90	90	90	20
HYDRAULIC BULLWHEEL BUNDLE TENSIONER	Diesel	1	80	2	3	87	261	27	27	27	6		81	81	81	18
PULLER ROPE TRAILER 4,000# CAP W/ SPLIT REEL TOW TYPE TA	Diesel	1	74	2	3	87	261	27	27	27	6		81	81	81	18
PULLER CABLE TRAILER 30,000# CAP TOW TYPE TANDEM AXLE	Diesel	1	400	2	3	87	261	27	27	27	6		81	81	81	18
PULLER ROPE TRAILER 4 DRUM 3,500# CAP TOW TYPE TANDEM /	Diesel	1	115	2	3	87	261	27	27	27	6		81	81	81	18
300T AT Setting Crane	Diesel	1	577	6	5	87	435	27	27	27	6		135	135	135	30
60T RT Crane	Diesel	4	320	4	5	105	525	32	33	33	7		160	165	165	35
SKID STEER LOADER TRACK MTD 80 > 75 HP	Diesel	5	95	4	5	105	525	32	33	33	7		160	165	165	35
DUMP BOX TRUCK 2-1/2 T 6X6	Diesel	1	505	2	5	105	525	32	33	33	7		160	165	165	35
DUMP BOX TRUCK 1-1/4 & 1-1/2 T	Diesel	2	420	4	5	105	525	32	33	33	7		160	165	165	35
FLATBED (FRAMING) TRUCK 1-1/4 & 1-1/2 T	Diesel	6	420	4	5	105	525	32	33	33	7		160	165	165	35
TRUCK TRACTOR 2-1/2 T 6X4 & 5 T 6X6	Diesel	6	450	4	3	105	315	32	33	33	7		96	99	99	21
PICKUP TRUCK 3/4 T	Diesel	14	420	8	5	105	525	32	33	33	7		160	165	165	35
								Expanded schedule to meet 3/1/2028 start date and 3 yrs long								
On Road																
F150 - Commuter Vehicles	Gasoline	70	300	2	6	142	852	45	45	45	7		270	270	270	42
Concrete mixer truck	Diesel	6	300	3	6	142	852	45	45	45	7		270	270	270	42
Flat bed truck	Diesel	1	420	4	6	142	852	45	45	45	7		270	270	270	42

Notes: 105 miles, 5 structures per mile, avg 60 yards per structure, 31500 yards concrete, 9 yds per load, 3500 loads
concrete mixer truck - one way 75 miles
390 loads and 135 single loads (one piece on truck) for flat bed truck - one way 100 miles

Total Workers	70	workers			average of civil crew, transmission crew, support crew, roadway crew. Civil and transmission are largest crews.
VMT Assumption					**MOVES Lookı MOVES Item**
Work Days per week	6	days			still TBD on route, very early in process
Work Weeks on 2028	45	weeks			
Work Weeks in 2029	45	weeks			
Work Weeks in 2030	45	weeks			
Work Weeks in 2031	7	weeks			
Commute Roundtrips or Delivery Days per Month		Trips			
Worker Commute Distance Round Trip	110	miles	31	Veh Class	Hotels in Jamestown, Alexandria, or campers
Concrete Mixer Distance Round Trip	150	miles	52	Veh Class	20 mi in SD, 90 mi in MN
Flat bed truck distance round trip	200	miles	62	Veh Class	
Worker Commute Distance Round Trip 2028 total	2079000	miles	31	Veh Class	
Worker Commute Distance Round Trip 2029 total	2079000	miles	31	Veh Class	
Worker Commute Distance Round Trip 2030 total	2079000	miles	31	Veh Class	
Worker Commute Distance Round Trip 2031 total	323400	miles	31	Veh Class	
Concrete Mixer Distance Round Trip 2028 total	243000	miles	52	Veh Class	
Concrete Mixer Distance Round Trip 2029 total	243000	miles	52	Veh Class	
Concrete Mixer Distance Round Trip 2030 total	243000	miles	52	Veh Class	
Concrete Mixer Distance Round Trip 2031 total	37800	miles	52	Veh Class	
Flatbed Truck Distance Round Trip 2028 total	54000	miles	62	Veh Class	
Flatbed Truck Distance Round Trip 2029 total	54000	miles	62	Veh Class	
Flatbed Truck Distance Round Trip 2030 total	54000	miles	62	Veh Class	
Flatbed Truck Distance Round Trip 2031 total	8400	miles	62	Veh Class	
Assumed Highway Speed	55	mph	12	Speed Bin	
Assumed Local Speed	30	mph	7	Speed Bin	
Highway VMT Percentage	80%				

Total Affected Area	2000	ac	Note: 110 mi length and 150 ft ROW width
2028 Affected Area	633.8	ac	
2029 Affected Area	633.8	ac	
2030 Affected Area	633.8	ac	
2031 Affected Area	98.6	ac	

Helicopter Emissions	Engine Mode	Quantity	Hours/day	Number of days per year	Total Hours	Fuel Flow (Kg/s) [f]	Max Power (HP)	Load Factor [f]	Loaded Power (HP)	Fuel Usage (kg fuel)	Fuel Usage (mmBtu)
Helicopter	*Ground Idle*	*1*	1.00	1	1	0.015	420	0.13000	55	52.79	2.16
Helicopter	*Hover and Climb*	*1*	1.25	1	1.25	0.033	420	0.87000	365	147.17	6.01
Helicopter	*Approach*	*1*	1.25	1	1.25	0.025	420	0.46000	193	112.43	4.59
Helicopter	*Flight*	*1*	8.00	1	8	0.031	420	0.80000	336	898.21	36.69

One helicopter will be used to string wire during construction (Kevin McCormick at Beste Consulting, 2024).
Will start 6 months in (assume 25 weeks into 2028) and continue until end of construction

MJ_kgfuel	43.1
MJ_mmBTU	1055.06

Equipment [b]	SCAB Lookup ID	Fuel	HP	Number of Units	Total Operation Time (hr)
Equipment					
E4_OTL EQP_PICKUP TRUCK-F350_CREW CAB _8001-11K_4X4	Off-Highway Trucks	*Diesel*	500	1	15
K8_OTL EQP_HEAVY BUCKET TRUCK100 FT_RUBBER TIRE_6X6	Off-Highway Trucks	*Diesel*	500	1	15
N4_OTL EQP_TRUCK MOUNTEDCRANE_45T/50T_RUBBER TIRE	Cranes	*Diesel*	500	1	15
S2_OTL EQP_BACKHOE-LOADER_RUBBER TIRE_4X4	Tractors/Loaders/Backhoes	*Diesel*	120	1	15
U1_OTL EQP_SKID STEERLOADER_TRACKED	Skid Steer Loaders	*Diesel*	120	1	15
W2_OTL EQP_ATV/UTV POLARIS/CANAM/ARGO_RUBBER	Rubber Tired Loaders	*Diesel*	25	1	60
R1_OTL EQP_TRAILERUTV/FRAMING/ENCLOSED_<=12K_RU BBER TIRE_TANDEM	Other Construction Equipment	*Diesel*	120	1	60
D2_OTL EQP_PICKUP TRUCK-F150_6001-8K_4X4	Off-Highway Trucks	*Diesel*	500	1	60
R2_OTL EQP_TRAILER MEDIUMEQUIP_12001-20K_RUBBER TIRE_TANDEM	Other Construction Equipment	*Diesel*	120	1	15
R3_OTL EQP_TRAILER LARGEEQUIP_>20K_RUBBER TIRE_TANDEM	Other Construction Equipment	*Diesel*	120	1	15

Note: No onroad emissions considered as these will be handled by the utility company. Helicopter use is only considered in construction not operation. Helicopters will not be used for inspections. No equipment modifications and no permanent land use change (Kevin McCormick at Beste Consulting, 2024)

SCAB Fleet Average Emission Factors (Diesel)

SCAB_EF_2025

Air Basin	SC

Equipment	MaxHP	ROG (lb/hr)	CO (lb/hr)	NOX (lb/hr)	SOX (lb/hr)	PM (lb/hr)	CO2 (lb/hr)	CH4 (lb/hr)
Aerial Lifts	15	0.0101	0.0528	0.0631	0.0001	0.0025	8.7	0.0009
Aerial Lifts	25	0.0132	0.0451	0.0838	0.0001	0.0032	11.0	0.0012
Aerial Lifts	50	0.0168	0.1351	0.1218	0.0003	0.0035	19.6	0.0015
Aerial Lifts	120	0.0176	0.2265	0.1496	0.0004	0.0063	38.1	0.0016
Aerial Lifts	500	0.0580	0.3710	0.3660	0.0021	0.0109	213	0.0052
Aerial Lifts	750	0.1054	0.6706	0.6753	0.0039	0.0199	385	0.0095
Aerial Lifts Composite		0.0184	0.1646	0.1366	0.0004	0.0048	34.7	0.0017
Air Compressors	15	0.0087	0.0444	0.0545	0.0001	0.0023	7.2	0.0008
Air Compressors	25	0.0181	0.0605	0.1121	0.0002	0.0045	14.4	0.0016
Air Compressors	50	0.0263	0.1911	0.1476	0.0003	0.0047	22.3	0.0024
Air Compressors	120	0.0289	0.3023	0.1928	0.0006	0.0088	47.0	0.0026
Air Compressors	175	0.0424	0.4998	0.2187	0.0010	0.0104	88.5	0.0038
Air Compressors	250	0.0514	0.2531	0.2553	0.0015	0.0078	131	0.0046
Air Compressors	500	0.0894	0.4292	0.4150	0.0023	0.0134	232	0.0081
Air Compressors	750	0.1385	0.6633	0.6545	0.0036	0.0210	358	0.0125
Air Compressors	1000	0.1999	0.9265	2.5439	0.0049	0.0483	486	0.0180
Air Compressors Composite		0.0349	0.3027	0.2104	0.0007	0.0088	63.6	0.0031
Bore/Drill Rigs	15	0.0120	0.0632	0.0754	0.0002	0.0029	10.3	0.0011
Bore/Drill Rigs	25	0.0193	0.0658	0.1219	0.0002	0.0046	16.0	0.0017
Bore/Drill Rigs	50	0.0190	0.2200	0.1662	0.0004	0.0009	31.0	0.0017
Bore/Drill Rigs	120	0.0252	0.4660	0.1955	0.0009	0.0020	77.1	0.0023
Bore/Drill Rigs	175	0.0324	0.7542	0.0787	0.0016	0.0030	141	0.0029
Bore/Drill Rigs	250	0.0427	0.3426	0.0981	0.0021	0.0035	188	0.0039
Bore/Drill Rigs	500	0.0706	0.5512	0.1622	0.0031	0.0058	311	0.0064
Bore/Drill Rigs	750	0.1396	1.0891	0.3204	0.0062	0.0115	615	0.0126
Bore/Drill Rigs	1000	0.2115	1.6437	3.8912	0.0093	0.0364	928	0.0191
Bore/Drill Rigs Composite		0.0428	0.5007	0.2864	0.0017	0.0042	165	0.0039
Cement and Mortar Mixers	15	0.0074	0.0386	0.0461	0.0001	0.0018	6.3	0.0007
Cement and Mortar Mixers	25	0.0213	0.0724	0.1346	0.0002	0.0052	17.6	0.0019
Cement and Mortar Mixers Composite		0.0085	0.0414	0.0534	0.0001	0.0021	7.2	0.0008
Concrete/Industrial Saws	25	0.0199	0.0678	0.1256	0.0002	0.0047	16.5	0.0018
Concrete/Industrial Saws	50	0.0279	0.2284	0.1910	0.0004	0.0053	30.2	0.0025
Concrete/Industrial Saws	120	0.0370	0.4561	0.2840	0.0009	0.0117	74.1	0.0033
Concrete/Industrial Saws	175	0.0623	0.8663	0.3523	0.0018	0.0160	160	0.0056
Concrete/Industrial Saws Composite		0.0337	0.3706	0.2471	0.0007	0.0093	58.5	0.0030
Cranes	50	0.0350	0.2256	0.1644	0.0003	0.0062	23.2	0.0032
Cranes	120	0.0376	0.3384	0.2298	0.0006	0.0120	50.1	0.0034
Cranes	175	0.0462	0.4744	0.2300	0.0009	0.0120	80.3	0.0042
Cranes	250	0.0544	0.2316	0.2705	0.0013	0.0094	112	0.0049
Cranes	500	0.0858	0.3535	0.3977	0.0018	0.0146	180	0.0077
Cranes	750	0.1446	0.5947	0.6821	0.0030	0.0248	303	0.0130
Cranes	9999	0.5219	1.9715	5.5760	0.0098	0.1146	971	0.0471
Cranes Composite		0.0681	0.3738	0.4223	0.0014	0.0143	129	0.0061
Crawler Tractors	50	0.0487	0.2566	0.1842	0.0003	0.0090	24.9	0.0044
Crawler Tractors	120	0.0609	0.4537	0.3562	0.0008	0.0221	65.8	0.0055
Crawler Tractors	175	0.0823	0.7265	0.4447	0.0014	0.0241	121	0.0074
Crawler Tractors	250	0.0924	0.3662	0.5348	0.0019	0.0192	166	0.0083
Crawler Tractors	500	0.1392	0.5877	0.7527	0.0025	0.0280	259	0.0126
Crawler Tractors	750	0.2506	1.0528	1.3878	0.0047	0.0510	465	0.0226
Crawler Tractors	1000	0.3749	1.5618	4.2168	0.0066	0.0958	658	0.0338
Crawler Tractors Composite		0.0789	0.5065	0.4492	0.0013	0.0227	114	0.0071
Crushing/Proc. Equipment	50	0.0508	0.3859	0.2899	0.0006	0.0083	44.0	0.0046
Crushing/Proc. Equipment	120	0.0506	0.5406	0.3289	0.0010	0.0140	83.1	0.0046
Crushing/Proc. Equipment	175	0.0795	0.9556	0.3830	0.0019	0.0177	167	0.0072
Crushing/Proc. Equipment	250	0.0967	0.4768	0.4357	0.0028	0.0134	245	0.0087
Crushing/Proc. Equipment	500	0.1459	0.6977	0.6163	0.0037	0.0200	374	0.0132
Crushing/Proc. Equipment	750	0.2307	1.1003	0.9907	0.0059	0.0316	589	0.0208
Crushing/Proc. Equipment	9999	0.6019	2.5014	6.6977	0.0131	0.1238	1,308	0.0543
Crushing/Proc. Equipment Composite		0.0693	0.6187	0.3763	0.0015	0.0146	132	0.0062
Dumpers/Tenders	25	0.0092	0.0314	0.0581	0.0001	0.0022	7.6	0.0008
Dumpers/Tenders Composite		0.0092	0.0314	0.0581	0.0001	0.0022	7.6	0.0008
Excavators	25	0.0198	0.0677	0.1253	0.0002	0.0047	16.4	0.0018
Excavators	50	0.0297	0.2365	0.1616	0.0003	0.0035	25.0	0.0027
Excavators	120	0.0448	0.4942	0.2638	0.0009	0.0092	73.6	0.0040

		(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)
Equipment	**MaxHP**	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**	**CH4**
Excavators	175	0.0518	0.6636	0.1982	0.0013	0.0091	112	0.0047
Excavators	250	0.0647	0.3210	0.2222	0.0018	0.0074	159	0.0058
Excavators	500	0.0946	0.4495	0.3091	0.0023	0.0107	234	0.0085
Excavators	750	0.1569	0.7451	0.5194	0.0039	0.0178	387	0.0142
Excavators Composite		0.0559	0.5086	0.2269	0.0013	0.0086	120	0.0050
Forklifts	50	0.0150	0.1361	0.0904	0.0002	0.0013	14.7	0.0014
Forklifts	120	0.0168	0.2086	0.0997	0.0004	0.0023	31.2	0.0015
Forklifts	175	0.0228	0.3310	0.0732	0.0006	0.0029	56.1	0.0021
Forklifts	250	0.0289	0.1551	0.0746	0.0009	0.0027	77.1	0.0026
Forklifts	500	0.0416	0.2123	0.1038	0.0011	0.0038	111	0.0038
Forklifts Composite		0.0236	0.2148	0.0860	0.0006	0.0025	54.4	0.0021
Generator Sets	15	0.0109	0.0627	0.0768	0.0002	0.0032	10.2	0.0010
Generator Sets	25	0.0216	0.0738	0.1368	0.0002	0.0055	17.6	0.0019
Generator Sets	50	0.0242	0.2034	0.1881	0.0004	0.0051	30.6	0.0022
Generator Sets	120	0.0340	0.4585	0.3022	0.0009	0.0122	77.9	0.0031
Generator Sets	175	0.0469	0.7328	0.3291	0.0016	0.0136	142	0.0042
Generator Sets	250	0.0558	0.3746	0.3885	0.0024	0.0108	213	0.0050
Generator Sets	500	0.0862	0.5820	0.5697	0.0033	0.0167	337	0.0078
Generator Sets	750	0.1401	0.9395	0.9382	0.0055	0.0272	544	0.0126
Generator Sets	9999	0.3235	1.8648	5.2188	0.0105	0.0888	1,049	0.0292
Generator Sets Composite		0.0288	0.2667	0.2329	0.0007	0.0081	61.0	0.0026
Graders	50	0.0382	0.2599	0.1877	0.0004	0.0063	27.5	0.0034
Graders	120	0.0521	0.5009	0.3219	0.0009	0.0153	75.0	0.0047
Graders	175	0.0652	0.7261	0.3117	0.0014	0.0157	124	0.0059
Graders	250	0.0781	0.3549	0.3652	0.0019	0.0129	172	0.0071
Graders	500	0.1023	0.4610	0.4468	0.0023	0.0165	229	0.0092
Graders	750	0.2167	0.9755	0.9628	0.0049	0.0353	486	0.0196
Graders Composite		0.0676	0.5696	0.3314	0.0015	0.0147	133	0.0061
Off-Highway Tractors	120	0.1108	0.6619	0.6362	0.0011	0.0455	93.7	0.0100
Off-Highway Tractors	175	0.1110	0.7932	0.6639	0.0015	0.0370	130	0.0100
Off-Highway Tractors	250	0.0890	0.3179	0.5983	0.0015	0.0227	130	0.0080
Off-Highway Tractors	750	0.3692	1.5358	2.4157	0.0057	0.0918	568	0.0333
Off-Highway Tractors	1000	0.5623	2.3619	6.0896	0.0082	0.1577	814	0.0507
Off-Highway Tractors Composite		0.1134	0.6101	0.7291	0.0017	0.0331	151	0.0102
Off-Highway Trucks	175	0.0622	0.7536	0.2376	0.0014	0.0112	125	0.0056
Off-Highway Trucks	250	0.0730	0.3435	0.2521	0.0019	0.0085	167	0.0066
Off-Highway Trucks	500	0.1183	0.5319	0.3878	0.0027	0.0135	272	0.0107
Off-Highway Trucks	750	0.1921	0.8627	0.6384	0.0044	0.0221	442	0.0173
Off-Highway Trucks	1000	0.2823	1.2403	3.1782	0.0063	0.0546	625	0.0255
Off-Highway Trucks Composite		0.1140	0.5385	0.4769	0.0027	0.0142	260	0.0103
Other Construction Equipment	15	0.0118	0.0617	0.0737	0.0002	0.0029	10.1	0.0011
Other Construction Equipment	25	0.0159	0.0544	0.1008	0.0002	0.0038	13.2	0.0014
Other Construction Equipment	50	0.0244	0.2188	0.1693	0.0004	0.0034	28.0	0.0022
Other Construction Equipment	120	0.0379	0.5045	0.2730	0.0009	0.0087	80.9	0.0034
Other Construction Equipment	175	0.0384	0.5858	0.1729	0.0012	0.0075	107	0.0035
Other Construction Equipment	500	0.0792	0.4606	0.3034	0.0025	0.0099	254	0.0071
Other Construction Equipment Composite		0.0442	0.3474	0.2021	0.0013	0.0069	123	0.0040
Other General Industrial Equipmen	15	0.0066	0.0391	0.0466	0.0001	0.0018	6.4	0.0006
Other General Industrial Equipmen	25	0.0185	0.0632	0.1170	0.0002	0.0044	15.3	0.0017
Other General Industrial Equipmen	50	0.0298	0.2099	0.1491	0.0003	0.0047	21.7	0.0027
Other General Industrial Equipmen	120	0.0436	0.4189	0.2603	0.0007	0.0120	62.0	0.0039
Other General Industrial Equipmen	175	0.0519	0.5684	0.2412	0.0011	0.0115	95.9	0.0047
Other General Industrial Equipmen	250	0.0608	0.2743	0.2679	0.0015	0.0083	136	0.0055
Other General Industrial Equipmen	500	0.1174	0.5103	0.4826	0.0026	0.0157	265	0.0106
Other General Industrial Equipmen	750	0.1939	0.8411	0.8117	0.0044	0.0262	437	0.0175
Other General Industrial Equipmen	1000	0.2627	1.1060	2.9924	0.0056	0.0579	560	0.0237
Other General Industrial Equipmen Composite		0.0747	0.4438	0.3947	0.0016	0.0130	152	0.0067
Other Material Handling Equipment	50	0.0410	0.2893	0.2073	0.0004	0.0065	30.3	0.0037
Other Material Handling Equipment	120	0.0421	0.4076	0.2541	0.0007	0.0117	60.7	0.0038
Other Material Handling Equipment	175	0.0653	0.7197	0.3067	0.0014	0.0146	122	0.0059
Other Material Handling Equipment	250	0.0642	0.2920	0.2863	0.0016	0.0088	145	0.0058
Other Material Handling Equipment	500	0.0837	0.3670	0.3482	0.0019	0.0113	192	0.0075
Other Material Handling Equipment	9999	0.3781	1.4596	3.9555	0.0073	0.0764	741	0.0341
Other Material Handling Equipment Composite		0.0696	0.4355	0.3844	0.0015	0.0124	141	0.0063
Pavers	25	0.0225	0.0768	0.1422	0.0002	0.0053	18.7	0.0020
Pavers	50	0.0574	0.2803	0.2102	0.0004	0.0114	28.0	0.0052
Pavers	120	0.0662	0.4696	0.4003	0.0008	0.0263	69.2	0.0060
Pavers	175	0.0899	0.7543	0.5238	0.0014	0.0286	128	0.0081
Pavers	250	0.1097	0.4287	0.7020	0.0022	0.0254	194	0.0099
Pavers	500	0.1263	0.5374	0.7572	0.0023	0.0284	233	0.0114

		(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)
Equipment	**MaxHP**	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**	**CH4**
Pavers Composite		0.0717	0.4745	0.3858	0.0009	0.0220	77.9	0.0065
Paving Equipment	25	0.0152	0.0520	0.0963	0.0002	0.0036	12.6	0.0014
Paving Equipment	50	0.0469	0.2355	0.1789	0.0003	0.0095	23.9	0.0042
Paving Equipment	120	0.0503	0.3671	0.3092	0.0006	0.0200	54.5	0.0045
Paving Equipment	175	0.0687	0.5900	0.4021	0.0011	0.0219	101	0.0062
Paving Equipment	250	0.0672	0.2648	0.4289	0.0014	0.0154	122	0.0061
Paving Equipment Composite		0.0548	0.3993	0.3281	0.0008	0.0190	68.9	0.0049
Plate Compactors	15	0.0050	0.0263	0.0314	0.0001	0.0012	4.3	0.0005
Plate Compactors Composite		0.0050	0.0263	0.0314	0.0001	0.0012	4.3	0.0005
Pressure Washers	15	0.0052	0.0301	0.0368	0.0001	0.0015	4.9	0.0005
Pressure Washers	25	0.0087	0.0299	0.0555	0.0001	0.0022	7.1	0.0008
Pressure Washers	50	0.0079	0.0810	0.0843	0.0002	0.0019	14.3	0.0007
Pressure Washers	120	0.0082	0.1351	0.0897	0.0003	0.0031	24.1	0.0007
Pressure Washers Composite		0.0066	0.0531	0.0561	0.0001	0.0019	9.4	0.0006
Pumps	15	0.0089	0.0456	0.0560	0.0001	0.0024	7.4	0.0008
Pumps	25	0.0244	0.0816	0.1512	0.0002	0.0061	19.5	0.0022
Pumps	50	0.0299	0.2394	0.2138	0.0004	0.0061	34.3	0.0027
Pumps	120	0.0365	0.4656	0.3062	0.0009	0.0129	77.9	0.0033
Pumps	175	0.0499	0.7342	0.3301	0.0016	0.0142	140	0.0045
Pumps	250	0.0572	0.3604	0.3745	0.0023	0.0107	201	0.0052
Pumps	500	0.0959	0.6034	0.5922	0.0034	0.0178	345	0.0087
Pumps	750	0.1593	0.9975	0.9991	0.0057	0.0297	571	0.0144
Pumps	9999	0.4488	2.4388	6.8114	0.0136	0.1186	1,355	0.0405
Pumps Composite		0.0270	0.2617	0.2079	0.0006	0.0078	49.6	0.0024
Rollers	15	0.0074	0.0386	0.0461	0.0001	0.0018	6.3	0.0007
Rollers	25	0.0161	0.0549	0.1017	0.0002	0.0038	13.3	0.0015
Rollers	50	0.0345	0.2258	0.1776	0.0003	0.0068	26.0	0.0031
Rollers	120	0.0392	0.3801	0.2647	0.0007	0.0137	59.0	0.0035
Rollers	175	0.0553	0.6096	0.3030	0.0012	0.0156	108	0.0050
Rollers	250	0.0656	0.3037	0.3629	0.0017	0.0127	153	0.0059
Rollers	500	0.0920	0.4189	0.4752	0.0022	0.0174	219	0.0083
Rollers Composite		0.0410	0.3763	0.2501	0.0008	0.0122	67.0	0.0037
Rough Terrain Forklifts	50	0.0381	0.3041	0.2193	0.0004	0.0054	33.9	0.0034
Rough Terrain Forklifts	120	0.0369	0.4106	0.2316	0.0007	0.0087	62.4	0.0033
Rough Terrain Forklifts	175	0.0569	0.7229	0.2450	0.0014	0.0112	125	0.0051
Rough Terrain Forklifts	250	0.0671	0.3372	0.2625	0.0019	0.0084	171	0.0061
Rough Terrain Forklifts	500	0.0999	0.4838	0.3682	0.0025	0.0123	257	0.0090
Rough Terrain Forklifts Composite		0.0396	0.4430	0.2336	0.0008	0.0090	70.3	0.0036
Rubber Tired Dozers	175	0.1163	0.8019	0.6895	0.0015	0.0386	129	0.0105
Rubber Tired Dozers	250	0.1329	0.4624	0.8841	0.0021	0.0340	183	0.0120
Rubber Tired Dozers	500	0.1817	0.7490	1.1543	0.0026	0.0448	265	0.0164
Rubber Tired Dozers	750	0.2747	1.1262	1.7818	0.0040	0.0684	399	0.0248
Rubber Tired Dozers	1000	0.4321	1.7954	4.5523	0.0060	0.1202	592	0.0390
Rubber Tired Dozers Composite		0.1672	0.6620	1.0824	0.0025	0.0419	239	0.0151
Rubber Tired Loaders	25	0.0204	0.0697	0.1291	0.0002	0.0048	16.9	0.0018
Rubber Tired Loaders	50	0.0418	0.2904	0.2109	0.0004	0.0069	31.1	0.0038
Rubber Tired Loaders	120	0.0397	0.3916	0.2476	0.0007	0.0115	58.9	0.0036
Rubber Tired Loaders	175	0.0546	0.6199	0.2592	0.0012	0.0130	106	0.0049
Rubber Tired Loaders	250	0.0661	0.3041	0.3040	0.0017	0.0107	149	0.0060
Rubber Tired Loaders	500	0.1034	0.4654	0.4455	0.0023	0.0164	237	0.0093
Rubber Tired Loaders	750	0.2119	0.9532	0.9273	0.0049	0.0338	486	0.0191
Rubber Tired Loaders	1000	0.2701	1.1927	3.2272	0.0060	0.0615	594	0.0244
Rubber Tired Loaders Composite		0.0559	0.4311	0.2835	0.0012	0.0121	109	0.0050
Scrapers	120	0.0887	0.6472	0.5218	0.0011	0.0330	93.9	0.0080
Scrapers	175	0.1025	0.8864	0.5654	0.0017	0.0307	148	0.0092
Scrapers	250	0.1187	0.4642	0.7040	0.0024	0.0254	209	0.0107
Scrapers	500	0.1755	0.7332	0.9727	0.0032	0.0364	321	0.0158
Scrapers	750	0.3043	1.2657	1.7266	0.0056	0.0638	555	0.0275
Scrapers Composite		0.1495	0.7187	0.8387	0.0027	0.0335	262	0.0135
Signal Boards	15	0.0072	0.0377	0.0450	0.0001	0.0018	6.2	0.0006
Signal Boards	50	0.0332	0.2686	0.2268	0.0005	0.0063	36.2	0.0030
Signal Boards	120	0.0394	0.4898	0.3076	0.0009	0.0127	80.2	0.0036
Signal Boards	175	0.0587	0.8292	0.3433	0.0017	0.0152	155	0.0053
Signal Boards	250	0.0794	0.4676	0.4435	0.0029	0.0132	255	0.0072
Signal Boards Composite		0.0111	0.0909	0.0718	0.0002	0.0029	16.7	0.0010
Skid Steer Loaders	25	0.0167	0.0568	0.1055	0.0002	0.0040	13.8	0.0015
Skid Steer Loaders	50	0.0194	0.1977	0.1446	0.0003	0.0015	25.5	0.0017
Skid Steer Loaders	120	0.0175	0.2665	0.1240	0.0005	0.0022	42.8	0.0016
Skid Steer Loaders Composite		0.0186	0.2104	0.1354	0.0004	0.0019	30.3	0.0017
Surfacing Equipment	50	0.0171	0.1105	0.0934	0.0002	0.0035	14.1	0.0015

		(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)
Equipment	**MaxHP**	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**	**CH4**
Surfacing Equipment	120	0.0385	0.3950	0.2869	0.0007	0.0146	63.8	0.0035
Surfacing Equipment	175	0.0386	0.4642	0.2429	0.0010	0.0119	85.8	0.0035
Surfacing Equipment	250	0.0504	0.2604	0.3275	0.0015	0.0111	135	0.0045
Surfacing Equipment	500	0.0800	0.4236	0.4893	0.0022	0.0174	221	0.0072
Surfacing Equipment	750	0.1260	0.6643	0.7833	0.0035	0.0275	347	0.0114
Surfacing Equipment Composite		0.0638	0.3590	0.3924	0.0017	0.0142	166	0.0058
Sweepers/Scrubbers	15	0.0124	0.0729	0.0870	0.0002	0.0034	11.9	0.0011
Sweepers/Scrubbers	25	0.0237	0.0808	0.1495	0.0002	0.0056	19.6	0.0021
Sweepers/Scrubbers	50	0.0308	0.2762	0.1942	0.0004	0.0033	31.6	0.0028
Sweepers/Scrubbers	120	0.0395	0.4895	0.2530	0.0009	0.0068	75.0	0.0036
Sweepers/Scrubbers	175	0.0565	0.8005	0.2201	0.0016	0.0084	139	0.0051
Sweepers/Scrubbers	250	0.0587	0.3179	0.1898	0.0018	0.0062	162	0.0053
Sweepers/Scrubbers Composite		0.0410	0.4840	0.2255	0.0009	0.0061	78.5	0.0037
Tractors/Loaders/Backhoes	25	0.0191	0.0653	0.1209	0.0002	0.0045	15.9	0.0017
Tractors/Loaders/Backhoes	50	0.0316	0.2678	0.1895	0.0004	0.0037	30.3	0.0029
Tractors/Loaders/Backhoes	120	0.0281	0.3379	0.1761	0.0006	0.0055	51.7	0.0025
Tractors/Loaders/Backhoes	175	0.0420	0.5839	0.1613	0.0011	0.0072	101	0.0038
Tractors/Loaders/Backhoes	250	0.0633	0.3389	0.2157	0.0019	0.0073	172	0.0057
Tractors/Loaders/Backhoes	500	0.1263	0.6506	0.4127	0.0039	0.0144	345	0.0114
Tractors/Loaders/Backhoes	750	0.1896	0.9760	0.6256	0.0058	0.0216	517	0.0171
Tractors/Loaders/Backhoes Composite		0.0336	0.3586	0.1857	0.0008	0.0059	66.8	0.0030
Trenchers	15	0.0099	0.0517	0.0617	0.0001	0.0024	8.5	0.0009
Trenchers	25	0.0397	0.1355	0.2509	0.0004	0.0094	32.9	0.0036
Trenchers	50	0.0687	0.3197	0.2467	0.0004	0.0140	32.9	0.0062
Trenchers	120	0.0625	0.4341	0.3863	0.0008	0.0259	64.9	0.0056
Trenchers	175	0.1009	0.8327	0.6152	0.0016	0.0338	144	0.0091
Trenchers	250	0.1247	0.4925	0.8480	0.0025	0.0309	223	0.0112
Trenchers	500	0.1661	0.7370	1.0663	0.0031	0.0400	311	0.0150
Trenchers	750	0.3147	1.3882	2.0666	0.0059	0.0766	587	0.0284
Trenchers Composite		0.0674	0.4085	0.3481	0.0007	0.0215	58.7	0.0061
Welders	15	0.0075	0.0381	0.0468	0.0001	0.0020	6.2	0.0007
Welders	25	0.0141	0.0473	0.0876	0.0001	0.0035	11.3	0.0013
Welders	50	0.0280	0.2077	0.1684	0.0003	0.0053	26.0	0.0025
Welders	120	0.0223	0.2476	0.1601	0.0005	0.0073	39.5	0.0020
Welders	175	0.0430	0.5400	0.2396	0.0011	0.0111	98.2	0.0039
Welders	250	0.0423	0.2236	0.2294	0.0013	0.0069	119	0.0038
Welders	500	0.0585	0.3040	0.2969	0.0016	0.0095	168	0.0053
Welders Composite		0.0214	0.1745	0.1373	0.0003	0.0052	25.6	0.0019

Nonroad Compression-Ignition Engines: Exhaust Emission Standards (kW-hr)

						NMHC	NMHC + NOx	NOx	PM	CO			
	Rated Power (kW)	**Rated Power (kW) Lower Bound**	**Rate Power (kW) Upper Bound**	**Tier**	**Model Year**	**NMHC (g/kW-hr)**	**NMHC + NOx (g/kW-hr)**	**NOx (g/kW-hr)**	**PM (g/kW-hr)**	**CO (g/kW-hr)**	**Smoke [a] (Percentage)**	**Useful Life (hours /years) [b]**	**Warranty Period (hours /years) [b]**
Federal	kW < 8	0	8	1	2000-2004	-	10.5	-	1.0	8.0	20/15/50	3,000/5	1,500/2
		0	8	2	2005-2007	-	7.5	-	0.80	8.0			
		0	8	4	2008+	-	7.5	-	0.4	8.0			
	8 ≤ kW < 19	9	19	1	2000-2004	-	9.5	-	0.80	6.6		3,000/5	1,500/2
		9	19	2	2005-2007	-	7.5	-	0.80	6.6			
		9	19	4	2008+	-	7.5	-	0.40	6.6			
	19 ≤ kW < 37	19	37	1	1999-2003	-	9.5	-	0.80	5.5		5,000/7 [d]	3,000/5 [e]
		19	37	2	2004-2007	-	7.5	-	0.60	5.5			
		19	37	4	2008-2012	-	7.5	-	0.30	5.5			
		19	37		2013+	-	4.7	-	0.03	5.5			
	37 ≤ kW < 56	37	56	1	1998-2003	-	-	9.2	-	-		8,000/10	3,000/5
		37	56	2	2004-2007	-	7.5	-	0.40	5.0			
		37	56	3 [f]	2008-2011	-	4.7	-	0.40	5.0			
		37	56	4 (Option 1) [g]	2008-2012	-	4.7	-	0.30	5.0			
		37	56	4 (Option 2) [g]	2012	-	4.7	-	0.03	5.0			
		37	56	4	2013+	-	4.7	-	0.03	5.0			
	56 ≤ kW < 75	56	75	1	1998-2003	-	-	9.2	-	-			
		56	75	2	2004-2007	-	7.5	-	0.40	5.0			
		56	75	3	2008-2011	-	4.7	-	0.40	5.0			
		56	75	4	2012-2013 [h]	-	4.7	-	0.02	5.0			
		56	75		2014+ [i]	0.19	-	0.40	0.02	5.0			
	75 ≤ kW < 130	75	130	1	1997-2002	-	-	9.2	-	-			
		75	130	2	2003-2006	-	6.6	-	0.30	5.0			
		75	130	3	2007-2011	-	4.0	-	0.30	5.0			
		75	130	4	2012-2013 [h]	-	4.0	-	0.02	5.0			
		75	130		2014+	0.19	-	0.40	0.02	5.0			
	130 ≤ kW < 225	130	225	1	1996-2002	1.3	-	9.2	0.54	11.4			
		130	225	2	2003-2005	-	6.6	-	0.20	3.5			
		130	225	3	2006-2010	-	4.0	-	0.20	3.5			
		130	225	4	2011-2013 [h]	-	4.0	-	0.02	3.5			
		130	225		2014+ [i]	0.19	-	0.40	0.02	3.5			
	225 ≤ kW < 450	225	450	1	1996-2000	1.3	-	9.2	0.54	11.4			
		225	450	2	2001-2005	-	6.4	-	0.20	3.5			
		225	450	3	2006-2010	-	4.0	-	0.20	3.5			
		225	450	4	2011-2013 [h]	-	4.0	-	0.02	3.5			
		225	450		2014+ [i]	0.19	-	0.40	0.02	3.5			
	450 ≤ kW	450	560	1	1996-2001	1.3	-	9.2	0.54	11.4	20/15/50	8,000/10	3,000/5
		450	560	2	2002-2005	-	6.4	-	0.20	3.5			

1 kw-hr = 1.34 hp-hr

Nonroad Compression-Ignition Engines: Exhaust Emission Standards (hp-hr)

Rated Power (HP) Lower Bound	**Rate Power (HP) Upper Bound**	**Tier**	**Model Year**	**NMHC**	**NMHC + NOx**	**NOx**	**PM**	**CO**
				g/hp-hr	g/hp-hr	g/hp-hr	g/hp-hr	g/hp-hr
0	10.72	1	2000-2004	0.0	7.8	0.0	0.7	6.0
0	10.72	2	2005-2007	0.0	5.6	0.0	0.6	6.0
0	10.72	4	2008+	0.0	5.6	0.0	0.3	6.0
12.06	25.46	1	2000-2004	0.0	7.1	0.0	0.6	4.9
12.06	25.46	2	2005-2007	0.0	5.6	0.0	0.6	4.9
12.06	25.46	4	2008+	0.0	5.6	0.0	0.3	4.9
25.46	49.58	1	1999-2003	0.0	7.1	0.0	0.6	4.1
25.46	49.58	2	2004-2007	0.0	5.6	0.0	0.4	4.1
25.46	49.58	4	2008-2012	0.0	5.6	0.0	0.2	4.1
25.46	49.58	0	2013+	0.0	3.5	0.0	0.0	4.1
49.58	75.04	1	1998-2003	0.0	0.0	6.9	0.0	0.0
49.58	75.04	2	2004-2007	0.0	5.6	0.0	0.3	3.7
49.58	75.04	3 f	2008-2011	0.0	3.5	0.0	0.3	3.7
49.58	75.04	4(Option 1)	2008-2012	0.0	3.5	0.0	0.2	3.7
49.58	75.04	4(Option 2)	2012	0.0	3.5	0.0	0.0	3.7
49.58	75.04	4	2013+	0.0	3.5	0.0	0.0	3.7
75.04	100.5	1	1998-2003	0.0	0.0	6.9	0.0	0.0
75.04	100.5	2	2004-2007	0.0	5.6	0.0	0.3	3.7
75.04	100.5	3	2008-2011	0.0	3.5	0.0	0.3	3.7
75.04	100.5	4	2012-2013	0.0	3.5	0.0	0.0	3.7
75.04	100.5	0	2014+ i	0.1	0.0	0.3	0.0	3.7
100.5	174.2	1	1997-2002	0.0	0.0	6.9	0.0	0.0
100.5	174.2	2	2003-2006	0.0	4.9	0.0	0.2	3.7
100.5	174.2	3	2007-2011	0.0	3.0	0.0	0.2	3.7
100.5	174.2	4	2012-2013	0.0	3.0	0.0	0.0	3.7
100.5	174.2	0	2014+	0.1	0.0	0.3	0.0	3.7
174.2	301.5	1	1996-2002	1.0	0.0	6.9	0.4	8.5
174.2	301.5	2	2003-2005	0.0	4.9	0.0	0.1	2.6
174.2	301.5	3	2006-2010	0.0	3.0	0.0	0.1	2.6
174.2	301.5	4	2011-2013	0.0	3.0	0.0	0.0	2.6
174.2	301.5	0	2014+ i	0.1	0.0	0.3	0.0	2.6
301.5	603	1	1996-2000	1.0	0.0	6.9	0.4	8.5
301.5	603	2	2001-2005	0.0	4.8	0.0	0.1	2.6
301.5	603	3	2006-2010	0.0	3.0	0.0	0.1	2.6
301.5	603	4	2011-2013	0.0	3.0	0.0	0.0	2.6
301.5	603	0	2014+ i	0.1	0.0	0.3	0.0	2.6
603	750.4	1	1996-2001	1.0	0.0	6.9	0.4	8.5
603	750.4	2	2002-2005	0.0	4.8	0.0	0.1	2.6

Nonroad Compression-Ignition Engines: Exhaust Emission Standards (kW-hr)													
						NMHC	NMHC + NOx	NOx	PM	CO			
	Rated Power (kW)	Rated Power (kW) Lower Bound	Rate Power (kW) Upper Bound	Tier	Model Year	NMHC (g/kW-hr)	NMHC + NOx (g/kW-hr)	NOx (g/kW-hr)	PM (g/kW-hr)	CO (g/kW-hr)	Smoke [a] (Percentage)	Useful Life (hours /years) [b]	Warranty Period (hours /years) [b]
	450 ≤ kW < 560	450	560	3	2006-2010	-	4.0	-	0.20	3.5			
		450	560	4	2011-2013 [h]	-	4.0	-	0.02	3.5			
		450	560		2014+ [i]	0.19	-	0.40	0.02	3.5			
	560 ≤ kW < 900	560	900	1	2000-2005	1.3	-	9.2	0.54	11.4			
		560	900	2	2006-2010	-	6.4	-	0.20	3.5			
		560	900	4	2011-2014	0.40	-	3.5	0.10	3.5			
		560	900		2015+ [i]	0.19	-	3.5	0.04	3.5			
	kW > 900	900	1000	1	2000-2005	1.3	-	9.2	0.54	11.4			
		900	1000	2	2006-2010	-	6.4	-	0.20	3.5			
		900	1000	4	2011-2014	0.40	-	3.5	0.10	3.5			
		900	1000		2015+ [i]	0.19	-	3.5	0.04	3.5			

Notes:

- For Tier 1, 2, and 3 standards, exhaust emissions of nitrogen oxides (NOx), carbon monoxide (CO), hydrocarbons (HC), and non-methane hydrocarbons (NMHC) are measured using the procedures in 40 Code of Federal Regulations (CFR) Part 89 Subpart E. For Tier 1, 2, and 3 standards, particulate matter (PM) exhaust emissions are measured using the California Regulations for New 1996 and Later Heavy-Duty Off-Road Diesel Cycle Engines.
- For Tier 4 standards, engines are tested for transient and steady-state exhaust emissions using the procedures in 40 CFR Part 1039 Subpart F. Transient standards do not apply to engines below 37 kilowatts (kW) before the 2013 model year, constant-speed engines, engines certified to Option 1, and engines above 560 kW.
- Tier 2 and later model naturally aspirated nonroad engines shall not discharge crankcase emissions into the atmosphere unless these emissions are permanently routed into the exhaust. This prohibition does not apply to engines using turbochargers, pumps, blowers, or superchargers.
- In lieu of the Tier 1, 2, and 3 standards for NOX, NMHC + NOX, and PM, manufacturers may elect to participate in the averaging, banking, and trading (ABT) program described in 40 CFR Part 89 Subpart C.

a Smoke emissions may not exceed 20 percent during the acceleration mode, 15 percent during the lugging mode, and 50 percent during the peaks in either mode. Smoke emission standards do not apply to single-cylinder engines, constant- speed engines, or engines certified to a PM emission stan- dard of 0.07 grams per kilowatt-hour (g/kW-hr) or lower. Smoke emissions are measured using procedures in 40 CFR Part 86 Subpart I.

b Useful life and warranty period are expressed hours and years, whichever comes first.

c Hand-startable air-cooled direct injection engines may option- ally meet a PM standard of 0.60 g/kW-hr. These engines may optionally meet Tier 2 standards through the 2009 model years. In 2010 these engines are required to meet a PM standard of 0.60 g/kW-hr.

d Useful life for constant speed engines with rated speed 3,000 revolutions per minute (rpm) or higher is 5 years or 3,000 hours, whichever comes first.

e Warranty period for constant speed engines with rated speed 3,000 rpm or higher is 2 years or 1,500 hours, whichever comes first.

f These Tier 3 standards apply only to manufacturers selecting Tier 4 Option 2. Manufacturers selecting Tier 4 Option 1 will be meeting those standards in lieu of Tier 3 standards.

g A manufacturer may certify all their engines to either Option 1 or Option 2 sets of standards starting in the indicated model year. Manufacturers selecting Option 2 must meet Tier 3 standards in the 2008-2011 model years.

h These standards are phase-out standards. Not more than 50 percent of a manufacturer's engine production is allowed to meet these standards in each model year of the phase out period. Engines not meeting these standards must meet the final Tier 4 standards.

i These standards are phased in during the indicated years. At least 50 percent of a manufacturer's engine production must meet these standards during each year of the phase in. Engines not meeting these standards must meet the applicable phase-out standards.

j For Tier 1 engines the standard is for total hydrocarbons.

k The NOx standard for generator sets is 0.67 g/kW-hr.

l The PM standard for generator sets is 0.03 g/kW-hr.

Citations: Code of Federal Regulations (CFR) citations:

- 40 CFR 89.112 = Exhaust emission standards
- 40 CFR 1039.101 = Exhaust emission standards for after 2014 model year
- 40 CFR 1039.102 = Exhaust emission standards for model year 2014 and earlier
- 40 CFR 1039 Subpart F = Exhaust emissions transient and steady state test procedures
- 40 CFR 86 Subpart I = Smoke emission test procedures
- 40 CFR 1065 = Test equipment and emissions measurement procedures

Nonroad Compression-Ignition Engines: Exhaust Emission Standards (hp-hr)								
Rated Power (HP) Lower Bound	Rate Power (HP) Upper Bound	Tier	Model Year	NMHC	NMHC + NOx	NOx	PM	CO
				g/hp-hr	g/hp-hr	g/hp-hr	g/hp-hr	g/hp-hr
603	750.4	3	2006-2010	0.0	3.0	0.0	0.1	2.6
603	750.4	4	2011-2013	0.0	3.0	0.0	0.0	2.6
603	750.4	0	2014+ i	0.1	0.0	0.3	0.0	2.6
750.4	1206	1	2000-2005	1.0	0.0	6.9	0.4	8.5
750.4	1206	2	2006-2010	0.0	4.8	0.0	0.1	2.6
750.4	1206	4	2011-2014	0.3	0.0	2.6	0.1	2.6
750.4	1206	0	2015+ i	0.1	0.0	2.6	0.0	2.6
1206	1340	1	2000-2005	1.0	0.0	6.9	0.4	8.5
1206	1340	2	2006-2010	0.0	4.8	0.0	0.1	2.6
1206	1340	4	2011-2014	0.3	0.0	2.6	0.1	2.6
1206	1340	0	2015+ i	0.1	0.0	2.6	0.0	2.6

When the non-methane hydrocarbon (NMHC) and nitrogen oxide (NOx) emission factor is combined, assume a breakdown of 5% and 95%, respectively.
Source: https://www.baaqmd.gov/~/media/Files/Engineering/policy_and_procedures/Engines/EmissionFactorsforDieselEngines.ashx

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