MADERA STATION RELOCATION PROJECT

APPENDIX E
AIR QUALITY, GREENHOUSE GASES,
AND ENERGY CALCULATIONS

SAN JOAQUIN JOINT POWERS AUTHORITY

October 2020

PROJECT-RELATED
AIR QUALITY CALCULATIONS

The following tables present the emissions summaries for the air quality calculations for Phase 1 and Phase 2 of the Project.

Relocated Madera Station Project AQ Construction-Related Emissions Summaries

Construction-Related Unmitigated Maximum Daily Emissions Summary						
Phase 1[1]						
Project Component/Source	ROG	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
	lbs/day					
Off-Road Construction Equipment	8.26	41.81	106.69	0.11	3.17	3.04
On-Road Construction Equipment (Onsite)	0.05	0.24	0.50	0.00	7.19	0.71
On-Road Construction Equipment (Offsite)	0.14	4.14	1.89	0.02	2.49	0.67
Fugitive Dust	-	-	-	-	19.92	10.83
Architectural Coatings	1.97	-	-	-	-	-
Paving Off-Gassing	0.20	-	-	-	-	-
Maximum Daily Emissions (lbs/day)	10.62	46.19	109.08	0.13	32.76	15.25
SJVAPCD Daily Thresholds	100	100	100	100	100	100
Exceeds Thresholds?	No	No	Yes	No	No	No

Notes

1. Per project engineers similar types of equipment will be used for both Phase 1 and Phase 2. Thus, potential maximum daily emissions associated with on-road and off-road equipment exhaust for both scenarios are the same. However, construction subphase durations vary between each phase. Emissions were modeled using the earliest year of construction (2024) for conservative emission estimates.

Construction-Related Mitigated Maximum Daily Emissions Summary						
Phase 1 [1]						
Project Component/Source	ROG	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
	lbs/day					
Off-Road Construction Equipment	4.24	50.88	62.17	0.11	2.13	2.11
On-Road Construction Equipment (Onsite)	0.05	0.24	0.50	0.00	7.19	0.71
On-Road Construction Equipment (Offsite)	0.14	4.14	1.89	0.02	2.49	0.67
Fugitive Dust	-	-	-	-	19.92	10.83
Architectural Coatings	1.97	-	-	-	-	-
Paving Off-Gassing	0.20	-	-	-	-	-
Maximum Daily Emissions (lbs/day)	6.60	55.26	64.56	0.13	31.72	14.32
SJVAPCD Daily Thresholds	100	100	100	100	100	100
Exceeds Thresholds?	No	No	No	No	No	No

Notes

1. Per project engineers similar types of equipment will be used for both Phase 1 and Phase 2. Thus, potential maximum daily emissions associated with on-road and off-road equipment exhaust for both scenarios are the same. However, construction subphase durations vary between each phase. Emissions were modeled using the earliest year of construction (2024) for conservative emission estimates.

Construction-Related Unmitigated Maximum Daily Emissions Summary						
Phase 2[1]						
Project Component/Source	ROG	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
	lbs/day					
Off-Road Construction Equipment	8.26	41.81	106.69	0.11	3.17	3.04
On-Road Construction Equipment (Onsite)	0.05	0.24	0.50	0.00	7.19	0.71
On-Road Construction Equipment (Offsite)	0.14	4.14	1.89	0.02	2.49	0.67
Fugitive Dust	-	-	-	-	20.29	10.88
Architectural Coatings	1.68	-	-	-	-	-
Paving Off-Gassing	0.16	-	-	-	-	-
Maximum Daily Emissions (lbs/day)	10.29	46.19	109.08	0.13	33.13	15.30
SJVAPCD Daily Thresholds	100	100	100	100	100	100
Exceeds Thresholds?	No	No	Yes	No	No	No

Notes

1. Per project engineers similar types of equipment will be used for both Phase 1 and Phase 2. Thus, potential maximum daily emissions associated with on-road and off-road equipment exhaust for both scenarios are the same. However, construction subphase durations vary between each phase. These calculations are shown in Pages 12 and 13 below. Emissions were modeled using the earliest year of construction (2024) for conservative emission estimates.

Construction-Related Mitigated Maximum Daily Emissions Summary						
Phase 2[1]						
Project Component/Source	ROG	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
	lbs/day					
Off-Road Construction Equipment	4.24	50.88	62.17	0.11	2.13	2.11
On-Road Construction Equipment (Onsite)	0.05	0.24	0.50	0.00	7.19	0.71
On-Road Construction Equipment (Offsite)	0.14	4.14	1.89	0.02	2.49	0.67
Fugitive Dust	-	-	-	-	20.29	10.88
Architectural Coatings	1.68	-	-	-	-	-
Paving Off-Gassing	0.16	-	-	-	-	-
Maximum Daily Emissions (lbs/day)	6.27	55.26	64.56	0.13	32.09	14.37
SJVAPCD Daily Thresholds	100	100	100	100	100	100
Exceeds Thresholds?	No	No	No	No	No	No

Notes

1. Per project engineers similar types of equipment will be used for both Phase 1 and Phase 2. Thus, potential maximum daily emissions associated with on-road and off-road equipment exhaust for both scenarios are the same. However, construction subphase durations vary between each phase. These calculations are shown in Pages 12 and 13 below. Emissions were modeled using the earliest year of construction (2024) for conservative emission estimates.

Construction-Related Unmitigated Annual Emissions Summary						
Phase 1						
Project Component/Source	ROG	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
	tons					
Off-Road Construction Equipment	0.66	3.63	7.55	0.01	0.28	0.27
On-Road Construction Equipment (Onsite)	0.00	0.01	0.04	0.00	0.42	0.04
On-Road Construction Equipment (Offsite)	0.01	0.24	0.17	0.00	0.18	0.05
Fugitive Dust	-	-	-	-	0.41	0.22
Architectural Coatings	0.06	-	-	-	-	-
Paving Off-Gassing	0.01	-	-	-	-	-
Annual Emissions (tons)	0.75	3.88	7.76	0.01	1.30	0.58
SJVAPCD Annual Thresholds	10	100	10	27	15	15
Exceeds Thresholds?	No	No	No	No	No	No

Construction-Related Mitigated Annual Emissions Summary						
Phase 1						
Project Component/Source	ROG	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
	tons					
Off-Road Construction Equipment	0.27	4.35	4.36	0.01	0.17	0.17
On-Road Construction Equipment (Onsite)	0.00	0.01	0.04	0.00	0.42	0.04
On-Road Construction Equipment (Offsite)	0.01	0.24	0.17	0.00	0.18	0.05
Fugitive Dust	-	-	-	-	0.41	0.22
Architectural Coatings	0.06	-	-	-	-	-
Paving Off-Gassing	0.01	-	-	-	-	-
Annual Emissions (tons)	0.35	4.60	4.57	0.01	1.18	0.48
SJVAPCD Annual Thresholds	10	100	10	27	15	15
Exceeds Thresholds?	No	No	No	No	No	No

Construction-Related Unmitigated Annual Emissions Summary						
Phase 2						
Project Component/Source	ROG	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
	tons					
Off-Road Construction Equipment	0.89	4.54	10.66	0.01	0.37	0.35
On-Road Construction Equipment (Onsite)	0.01	0.02	0.06	0.00	0.73	0.07
On-Road Construction Equipment (Offsite)	0.02	0.42	0.23	0.00	0.27	0.07
Fugitive Dust	-	-	-	-	0.77	0.41
Architectural Coatings	0.11	-	-	-	-	-
Paving Off-Gassing	0.01	-	-	-	-	-
Annual Emissions (tons)	1.02	4.98	10.95	0.01	2.14	0.91
SJVAPCD Annual Thresholds	10	100	10	27	15	15
Exceeds Thresholds?	No	No	Yes	No	No	No

Construction-Related Mitigated Annual Emissions Summary						
Phase 2						
Project Component/Source	ROG	CO	NOx	SOx	PM_{10}	$PM_{2.5}$
	tons					
Off-Road Construction Equipment	0.37	5.46	5.93	0.01	0.21	0.21
On-Road Construction Equipment (Onsite)	0.01	0.02	0.06	0.00	0.73	0.07
On-Road Construction Equipment (Offsite)	0.02	0.42	0.23	0.00	0.27	0.07
Fugitive Dust	-	-	-	-	0.77	0.41
Architectural Coatings	0.11	-	-	-	-	-
Paving Off-Gassing	0.01	-	-	-	-	-
Annual Emissions (tons)	0.51	5.90	6.21	0.01	1.98	0.77
SJVAPCD Annual Thresholds	10	100	10	27	15	15
Exceeds Thresholds?	No	No	No	No	No	No

PROJECT-RELATED
GREENHOUSE GAS CALCULATIONS

The following tables summarize the greenhouse gas emissions calculations for Phase 1 and Phase 2 of the Project.

Construction-Related GHG Emissions Summary	
Phase 1	
Project Component/Source	CO_2e metric tons/year
Off-Road Construction Equipment	833.39
On-Road Construction Equipment (Onsite)	13.01
On-Road Construction Equipment (Offsite)	123.55
Fugitive Dust	-
Architectural Coatings	-
Paving Off-Gassing	-
Total GHG Emissions (MT CO_2e)	969.95
Amortized GHG Emissions	32.33
Annual Threshold[1]	1,100
Exceeds Thresholds?	No

1. SMAQMD annual threshold for the construction phase of projects used to evaluate construction-related emissions in order to put the project-generated GHG emissions in the appropriate statewide context.

Construction-Related GHG Emissions Summary	
Phase 2	
Project Component/Source	CO_2e metric tons/year
Off-Road Construction Equipment	1378.71
On-Road Construction Equipment (Onsite)	24.85
On-Road Construction Equipment (Offsite)	233.17
Fugitive Dust	-
Architectural Coatings	-
Paving Off-Gassing	-
Total GHG Emissions (MT CO_2e)	1636.72
Amortized GHG Emissions	54.56
Annual Threshold[1]	1,100
Exceeds Thresholds?	No

1. SMAQMD annual threshold for the construction phase of projects used to evaluate construction-related emissions in order to put the project-generated GHG emissions in the appropriate statewide context.

Operational GHG Emissions Summary	
Project Phase	CO_2e metric tons/year
Phase 1	8.48
Phase 2	12.89
Annual Threshold[1]	1,100

1. SMAQMD annual threshold for the construction phase of projects used to evaluate construction-related emissions in order to put the project-generated GHG emissions in the appropriate statewide context.

PROJECT-RELATED
AVOIDED EMISSIONS CALCULATIONS

The following tables summarize the avoided vehicle miles traveled and avoided emissions associated with Phase 1 and Phase 2 of the Project.

Avoided Vehicle Miles Traveled Per Year

Phase	Annual VMT Avoided (mi)	Daily
Phase 1 (2025)	3,189,300	8,737.81
Phase 2 (2029)	8,102,300	22,198.08

Based on annual VMT reduction provided on 09 Oct 2020. See ridership memo for additional information.

2025 Annual Avoided Emissions						
Phase 1						
ROG	CO	NOx	SOx	PM_{10}	$PM_{2.5}$	CO2e
tons/year						MT/year
0.04	2.44	0.15	0.01	0.16	0.07	862.72
lbs/day						
0.20	13.36	0.81	0.05	0.89	0.37	

2029 Annual Avoided Emissions						
Phase 2						
ROG	CO	NOx	SOx	PM_{10}	$PM_{2.5}$	CO2e
tons/year						MT/year
0.06	5.09	0.04	0.02	0.41	0.17	1973.57
lbs/day						
0.32	27.91	0.19	0.12	2.26	0.93	

PROJECT-RELATED
ENERGY CONSUMPTION CALCULATIONS

The following tables summarize the energy requirements and consumption for Phase 1 and Phase 2 of the Project.

Summary of Proposed Project Energy Requirements			
Phase	Energy Requirement	Unit	Annual Energy Consumption (MMBtu)
Phase 1 - Construction			
Diesel	3,013	Gallons/yr	416
Gasoline	194	Gallons/yr	24
		Subtotal	440
Phase 1 - Operations			
Electrical	64,588	KWh/yr	220
		Subtotal	220
Phase 1 Total			661
Phase 2 - Construction			
Diesel	5,041	Gallons/yr	696
Gasoline	376	Gallons/yr	47
		Subtotal	743
Phase 2 - Operations			
Electrical	94,776	KWh/yr	323
		Subtotal	323
Phase 2 Total			1067

Notes:

Totals do not add due to rounding.

Source: Modeled by AECOM in 2020

Conversion Factors		
Category	Amount	Units
kWh per Btu	3,412	Btu/kWh
Diesel (heat content) [1]	5.8	MMBtu/barrel
Motor Gasoline [2]	5.25	MMBtu/barrel
Natural Gas [3]	0.1	MMBtu/therm
Propane [4]	0.0913	MMBtu/gallon
Kerosene [5]	0.135	MMBtu/gallon
Wood [6]	20	MMBtu/cord
Gallons per Barrel	42	gallons/barrel

Sources:	
[1]	https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf
[2]	https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf
[3]	https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references
[4]	https://www.eia.gov/environment/emissions/co2_vol_mass.php
[5]	https://www.eia.gov/environment/emissions/co2_vol_mass.php
[6]	https://www.eia.gov/energyexplained/index.cfm?page=about_btu

Avoided Fuel Consumption Related to Avoided Vehicle Miles Traveled Per Year

Phase	GHG Emissions Reductions/year
Phase 1 (2025)	862.72
Phase 2 (2029)	1973.57

2025	Fleet Mix	MT CO2/Year	MT CO2/gallon	Gallons/year	Annual Avoided Energy Consumption (MMBtu)
Diesel	0.94%	8.13	0.0102	800	110
Gas	99.06%	854.60	0.0089	96163	12,020

2029	Fleet Mix	MT CO2/Year	MT CO2/gallon	Gallons/year	Annual Avoided Energy Consumption (MMBtu)
Diesel	1.03%	20.25	0.0102	1993	275
Gas	98.97%	1953.31	0.0089	219794	27,474

Factor	MT/gallon
Diesel	0.010160
Gasoline	0.008887

Conversion Factors		
Category	Amount	Units
kWh per Btu	3,412	Btu/kWh
Diesel (heat content) [1]	5.8	MMBtu/barrel
Motor Gasoline [2]	5.25	MMBtu/barrel
Natural Gas [3]	0.1	MMBtu/therm
Propane [4]	0.0913	MMBtu/gallon
Kerosene [5]	0.135	MMBtu/gallon
Wood [6]	20	MMBtu/cord
Gallons per Barrel	42	gallons/barrel

Sources:	
[1]	https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf
[2]	https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf
[3]	https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references
[4]	https://www.eia.gov/environment/emissions/co2_vol_mass.php
[5]	https://www.eia.gov/environment/emissions/co2_vol_mass.php
[6]	https://www.eia.gov/energyexplained/index.cfm?page=about_btu

PROJECT-RELATED
EMISSION AND ENERGY BACK-UP CALCULATIONS

The remaining tables and pages detail the methodology and provide the back-up calculations for the air quality, greenhouse gas, and energy summaries presented above.

Phase 1 and Phase 2 - Off-road Equipment Exhaust (Unmitigated)

Equipment Type/Phase[1]	CalEEMod Equivalent	Construction Timing	Hours Per Day	Quantity	Load Factor	Horsepower[2]	Unmitigated Emission Factors (g/bhp-hr)[3]									Daily Emissions (lb/day)										Daily Emissions
							ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e	MT CO_2e
SITE WORK																										
GRADER	Graders	Initial Work	7	1	0.6	187	0.31	1.27	3.89	0.00	0.12	0.11	474.24	0.15	0.07	0.53	2.20	6.73	0.01	0.21	0.20	821.15	0.27	0.12	863.41	0.39
D6 DOZER	Rubber Tired Dozers	Initial Work	7	2	0.7	247	0.48	2.06	5.05	0.00	0.24	0.22	474.62	0.15	0.07	2.56	10.97	26.93	0.03	1.28	1.18	2532.80	0.82	0.37	2663.13	1.21
D 8 DOZER	Rubber Tired Dozers	Initial Work	6	1	0.6	354	0.47	3.89	4.81	0.00	0.22	0.20	479.31	0.16	0.07	1.33	10.94	13.51	0.01	0.62	0.57	1346.66	0.44	0.20	1415.94	0.64
		Phase Total														4.43	24.12	47.17	0.05	2.11	1.94	4700.61	1.52	0.68	4942.48	2.24
COMPACTOR	Plate Compactors	Latter Work	6	2	0.6	8	0.66	3.47	4.14	0.01	0.16	0.16	568.30	0.06	0.03	0.08	0.44	0.53	0.00	0.02	0.02	72.17	0.01	0.00	73.36	0.03
		Phase Total														0.08	0.44	0.53	0.00	0.02	0.02	72.17	0.01	0.00	73.36	0.03
RAIL WORK																										
D6 DOZER	Rubber Tired Dozers	Initial Work	6	1	0.5	247	0.48	2.06	5.05	0.00	0.24	0.22	474.62	0.15	0.07	0.78	3.36	8.24	0.01	0.39	0.36	775.35	0.25	0.11	815.24	0.37
GRADER	Graders	Initial Work	6	1	0.5	187	0.31	1.27	3.89	0.00	0.12	0.11	474.24	0.15	0.07	0.38	1.57	4.81	0.01	0.15	0.14	586.54	0.19	0.09	616.72	0.28
WHEEL LOADER	Rubber Tired Loaders	Initial Work	5	1	0.45	203	0.23	1.19	2.35	0.00	0.08	0.07	469.90	0.15	0.07	0.23	1.20	2.36	0.00	0.08	0.07	473.18	0.15	0.07	497.53	0.23
		Phase Total														1.39	6.13	15.42	0.02	0.62	0.57	1835.06	0.59	0.27	1929.49	0.88
LOCOMOTIVE (switch, 1200-1500 HP)	N/A	Latter Work	5	1	0.4	1500	0.60	1.83	10.60	0.01	0.23	0.22	671.45	0.05	0.02	3.97	12.10	70.11	0.04	1.52	1.48	4440.89	0.35	0.11	4483.30	0.23
TAMPER (max 100 HP)	Other Construction Equipment	Latter Work	4	1	0.4	100	0.44	3.67	4.10	0.00	0.29	0.27	472.32	0.15	0.07	0.16	1.29	1.45	0.00	0.10	0.09	166.61	0.05	0.02	175.18	0.88
ALLIGNER (max 100 HP)	Other Construction Equipment	Latter Work	4	1	0.4	100	0.44	3.67	4.10	0.00	0.29	0.27	472.32	0.15	0.07	0.16	1.29	1.45	0.00	0.10	0.09	166.61	0.05	0.02	175.18	2.03
SWINGER (max 50 HP)	Other Construction Equipment	Latter Work	5	1	0.3	50	0.92	5.17	4.74	0.01	0.35	0.32	529.18	0.17	0.08	0.15	0.85	0.78	0.00	0.06	0.05	87.50	0.03	0.01	92.00	0.08
WELDERS	Welders	Latter Work	5	3	0.6	46	0.76	4.65	4.01	0.01	0.18	0.18	568.30	0.07	0.03	0.69	4.24	3.66	0.01	0.16	0.16	518.69	0.06	0.03	528.57	0.24
35 TON RT CRANE	Cranes	Latter Work	5	1	0.6	231	0.32	1.60	3.54	0.00	0.15	0.14	472.98	0.15	0.07	0.48	2.45	5.41	0.01	0.22	0.21	722.63	0.23	0.11	759.82	0.34
		Phase Total														5.61	22.23	82.85	0.06	2.17	2.08	6102.92	0.78	0.31	6214.05	3.80
FLAT BED TRACTOR (75% onsite/25% offsite)	Off-Highway Trucks	Entire Phase	4	1	0.25	402	0.20	1.25	1.49	0.00	0.05	0.05	474.71	0.15	0.07	0.17	1.10	1.32	0.00	0.05	0.04	420.72	0.14	0.06	442.36	0.20
		Phase Total														0.17	1.10	1.32	0.00	0.05	0.04	420.72	0.14	0.06	442.36	0.20
STRUCTURES																										
GENERATOR	Generator Sets	Entire Phase	9	2	0.8	84	0.30	3.35	2.67	0.01	0.13	0.13	568.30	0.03	0.01	0.80	8.94	7.12	0.02	0.36	0.36	1515.49	0.07	0.03	1526.95	0.69
75 T MOBILE CRANE	Cranes	Entire Phase	5	1	0.6	231	0.32	1.60	3.54	0.00	0.15	0.14	472.98	0.15	0.07	0.48	2.45	5.41	0.01	0.22	0.21	722.63	0.23	0.11	759.82	0.34
CONCRETE PUMP	Pumps	Entire Phase	7	1	0.2	84	0.32	3.40	2.71	0.01	0.14	0.14	568.30	0.03	0.01	0.08	0.88	0.70	0.00	0.04	0.04	147.34	0.01	0.00	148.54	0.07
WHEEL LOADER	Rubber Tired Loaders	Entire Phase	4	4	0.4	203	0.23	1.19	2.35	0.00	0.08	0.07	469.90	0.15	0.07	0.65	3.40	6.72	0.01	0.23	0.21	1345.92	0.44	0.20	1415.19	0.64
WELDERS	Welders	Entire Phase	5	2	0.5	46	0.76	4.65	4.01	0.01	0.18	0.18	568.30	0.07	0.03	0.38	2.36	2.03	0.00	0.09	0.09	288.16	0.03	0.02	293.65	0.13
		Phase Total														2.40	18.03	21.99	0.04	0.93	0.90	4019.54	0.78	0.35	4144.14	1.88

	Maximum Unmitigated Daily Emissions (lbs/day)						MT/day
	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Phase 1	8.26	41.81	106.69	0.11	3.17	3.04	5.91

	Maximum Unmitigated Annual Emissions (tons/year)						MT
	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Phase 1	0.66	3.63	7.55	0.01	0.28	0.27	833.39

	Maximum Unmitigated Daily Emissions (lbs/day)						MT/day
	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Phase 2	8.26	41.81	106.69	0.11	3.17	3.04	5.91

	Maximum Unmitigated Annual Emissions (tons/year)						MT
	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Phase 2 Max Annual Scenario	0.89	4.54	10.66	0.01	0.37	0.35	1137.67
Phase 2 Remaining Construction	0.16	1.16	1.42	0.00	0.06	0.06	241.04

Phase 1	Activity Duration (months)	Years
Site Work	10	0.83
Rail Work	3	0.25
Structures	6	0.50
Total	12	
Site Work Duration (Prior to Rail/Structures Work)	6	0.50

Phase 2	Max Annual Scenario (months	Rest of Construction Duration (months)
Site Work	6	6
Rail Work	6	0
Structures	6	6
Total		
Site Work Duration (Prior to Rail/Structures Work)	6	0

Notes/Sources

1. Equipment list is based on project-specific list of anticipated equipment requirements provided by project engineers. Equipment type, number of each equipment, operational hours per day, and load factor are all project-specific.
2. CalEEMod equipment default horsepower unless indicated otherwise by horsepower in equipment type description.
3. Emission factors based on CalEEMod for year 2024 (earliest year of construction) for equipment equivalent and specific horsepower noted.

4. Locomotive emission factors based upon the following for switch:
   > PM10, HC, NOx, CO: Table 2 of EPA 2009 Emission Factors for Locomotives Technical Highlights
   > PM2.5 assumed to be 97% of PM10.
   > VOC (presented as ROG) = 1.053 * HC emissions
   > SO2 Emission Factor (g/gal) = (fuel density) * (64 g SO2 / 32 g S) * (S content of fuel);
   Sulfur Content of Fuel (ppm) (per CARB regulations in CA) = 15
   SO2 EF = 0.096 g/gal * conversion factor of 1/15.2 = 0.0063 g/hp-hr
   > CO2 is defined by U.S. EPA as 10,206 g CO2/gal fuel * conversion factor of 1/15.2 = 671.45 g/hp-hr
   > CH4 and N20 Emission Factors per EPA: Table 5 in https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf
   *CH4 EF = 0.8 g/gal * 1/15.2 conversion factor = 0.05263158 g/bhp-hr
   *N2O EF = 0.26 g/gal * 1/15.2 conversion factor = 0.01710526 g/bhp-hr

Phase 1 and Phase 2 - Off-road Equipment Exhaust (Mitigated)

Equipment Type/Phase[1]	CalEEMod Equivalent	Construction Timing	Hours Per Day	Quantity	Load Factor	Horsepower[2]	Mitigated Emission Factors (g/bhp-hr)[3]									Daily Emissions (lb/day)									Daily Emissions
							ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e	MT CO_2e
SITE WORK																									
GRADER	Graders	Initial Work	7	1	0.6	187	0.12	2.60	2.32	0.00	0.09	0.09	474.24	0.15	0.07	0.21	4.50	4.02	0.01	0.15	0.15	821.15	0.27	0.12	863.41	0.39
D6 DOZER	Rubber Tired Dozers	Initial Work	7	2	0.7	247	0.12	2.60	2.32	0.00	0.09	0.09	474.62	0.15	0.07	0.64	13.87	12.38	0.03	0.47	0.47	2532.92	0.82	0.37	2663.13	1.21
D 8 DOZER	Rubber Tired Dozers	Initial Work	6	1	0.6	354	0.12	2.60	2.32	0.00	0.09	0.09	479.31	0.16	0.07	0.34	7.30	6.52	0.01	0.25	0.25	1346.66	0.44	0.20	1415.94	0.64
		Phase Total														1.19	25.68	22.92	0.05	0.87	0.87	4700.61	1.52	0.68	4942.48	2.24
COMPACTOR	Plate Compactors	Latter Work	6	2	0.6	8	0.66	3.47	4.14	0.01	0.16	0.16	568.30	0.06	0.03	0.08	0.44	0.53	0.00	0.02	0.02	72.17	0.01	0.00	73.36	0.03
		Phase Total														0.08	0.44	0.53	0.00	0.02	0.02	72.17	0.01	0.00	73.36	0.03
RAIL WORK																									
D6 DOZER	Rubber Tired Dozers	Initial Work	6	1	0.5	247	0.12	2.60	2.32	0.00	0.09	0.09	474.62	0.15	0.07	0.20	4.25	3.79	0.01	0.14	0.14	775.35	0.25	0.11	815.24	0.37
GRADER	Graders	Initial Work	6	1	0.5	187	0.12	2.60	2.32	0.00	0.09	0.09	474.24	0.15	0.07	0.15	3.22	2.87	0.01	0.11	0.11	586.54	0.19	0.09	616.72	0.28
WHEEL LOADER	Rubber Tired Loaders	Initial Work	5	1	0.45	203	0.12	2.60	2.32	0.00	0.09	0.09	469.90	0.15	0.07	0.12	2.62	2.34	0.00	0.09	0.09	473.18	0.15	0.07	497.53	0.23
		Phase Total														0.47	10.08	9.00	0.02	0.34	0.34	1835.06	0.59	0.27	1929.49	0.88
LOCOMOTIVE (switch, 1200-1500 HP)	N/A	Latter Work	5	1	0.4	1500	0.27	1.83	4.50	0.01	0.08	0.08	671.45	0.05	0.02	1.81	12.10	29.76	0.04	0.53	0.51	4440.89	0.35	0.11	4483.30	0.23
TAMPER (max 100 HP)	Other Construction Equipmer	Latter Work	4	1	0.4	100	0.12	3.70	2.74	0.00	0.19	0.19	472.32	0.15	0.07	0.04	1.31	0.97	0.00	0.07	0.07	166.61	0.05	0.02	175.18	0.88
ALLIGNER (max 100 HP)	Other Construction Equipmer	Latter Work	4	1	0.4	100	0.12	3.70	2.74	0.00	0.19	0.19	472.32	0.15	0.07	0.04	1.31	0.97	0.00	0.07	0.07	166.61	0.05	0.02	175.18	2.03
SWINGER (max 50 HP)	Other Construction Equipmer	Latter Work	5	1	0.3	50	0.12	3.70	2.74	0.01	0.19	0.19	529.18	0.17	0.08	0.02	0.61	0.45	0.00	0.03	0.03	87.50	0.03	0.01	92.00	0.08
WELDERS	Welders	Latter Work	5	3	0.6	46	0.76	4.65	4.01	0.01	0.18	0.18	568.30	0.07	0.03	0.69	4.24	3.66	0.01	0.16	0.16	518.69	0.06	0.03	528.57	0.24
35 TON RT CRANE	Cranes	Latter Work	5	1	0.6	231	0.12	2.60	2.32	0.00	0.09	0.09	472.98	0.15	0.07	0.18	3.97	3.54	0.01	0.13	0.13	722.63	0.23	0.11	759.82	0.34
		Phase Total														2.79	23.54	39.35	0.06	0.99	0.97	6102.92	0.78	0.31	6214.05	3.80
FLAT BED TRACTOR (75% onsite/25% offsite)	Off-Highway Trucks	Entire Phase	4	1	0.25	402	0.12	2.60	2.32	0.00	0.09	0.09	474.71	0.15	0.07	0.11	2.30	2.06	0.00	0.08	0.08	420.72	0.14	0.06	442.36	0.20
		Phase Total														0.11	2.30	2.06	0.00	0.08	0.08	420.72	0.14	0.06	442.36	0.20
STRUCTURES																									
GENERATOR	Generator Sets	Entire Phase	9	2	0.8	84	0.12	3.70	2.74	0.01	0.19	0.19	568.30	0.03	0.01	0.32	9.87	7.31	0.02	0.51	0.51	1515.49	0.07	0.03	1526.95	0.69
75 T MOBILE CRANE	Cranes	Entire Phase	5	1	0.6	231	0.12	2.60	2.32	0.00	0.09	0.09	472.98	0.15	0.07	0.18	3.97	3.54	0.01	0.13	0.13	722.63	0.23	0.11	759.82	0.34
CONCRETE PUMP	Pumps	Entire Phase	7	1	0.2	84	0.12	3.70	2.74	0.01	0.19	0.19	568.30	0.03	0.01	0.03	0.96	0.71	0.00	0.05	0.05	147.34	0.01	0.00	148.54	0.07
WHEEL LOADER	Rubber Tired Loaders	Entire Phase	4	4	0.4	203	0.12	2.60	2.32	0.00	0.09	0.09	469.90	0.15	0.07	0.34	7.45	6.65	0.01	0.25	0.25	1345.92	0.44	0.20	1415.19	0.64
WELDERS	Welders	Entire Phase	5	2	0.5	46	0.76	4.65	4.01	0.01	0.18	0.18	568.30	0.07	0.03	0.38	2.36	2.03	0.00	0.09	0.09	288.16	0.03	0.02	293.65	0.13
		Phase Total														1.26	24.60	20.24	0.04	1.04	1.04	4019.54	0.78	0.35	4144.14	1.88

	Maximum Mitigated Daily Emissions (lbs/day)						MT/day
	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Phase 1	4.24	50.88	62.17	0.11	2.13	2.11	5.91

	Maximum Mitigated Annual Emissions (tons/year)						MT
	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Phase 1	0.27	4.35	4.36	0.01	0.17	0.17	833.39

	Maximum Mitigated Daily Emissions (lbs/day)						MT/day
	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Phase 2	4.24	50.88	62.17	0.11	2.13	2.11	5.91

	Maximum Mitigated Annual Emissions (tons/year)						MT
	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Phase 2 Max Annual Scenario	0.37	5.46	5.93	0.01	0.21	0.21	1137.67
Phase 2 Remaining Construction	0.08	1.58	1.31	0.00	0.07	0.07	241.04

Phase 1	Activity Duration (months)
Site Work	10
Rail Work	3
Structures	6
Total	12
Site Work Duration (Prior to Rail/Structures Work)	6

Phase 2	Max Annual Scenario (month	Rest of Construction Duration (months)
Site Work	6	6
Rail Work	6	0
Structures	6	6
Total		
Site Work Duration (Prior to Rail/Structures Work)	6	0

Notes/Sources
1. Equipment list is based on project-specific list of anticipated equipment requirements provided by project engineers. Equipment type, number of each equipment, operational hours per day, and load factor are all project-specific.
2. CalEEMod equipment default horsepower unless indicated otherwise by horsepower in equipment type description.
3. Tier 3 Mitigated emission factors for equipment >50 hp, based on Carl Moyer for ROG, CO, NOx, PM10 and PM2.5. Other EFs based on CalEEMod for year 2024.

4. Tier 3 Locomotive emission factors based upon the following for switch:
> PM10, HC, NOx, CO: Table 2 of EPA 2009 Emission Factors for Locomotives Technical Highlights
> PM2.5 assumed to be 97% of PM10.
> VOC (presented as ROG) = 1.053 * HC emissions
> SO2 Emission Factor (g/gal) = (fuel density) * (64 g SO2 / 32 g S) * (S content of fuel);
Sulfur Content of Fuel (ppm) (per CARB regulations in CA) = 15
SO2 EF = 0.096 g/gal * conversion factor of 1/15.2 = 0.0063 g/hp-hr
> CO2 is defined by U.S. EPA as 10,206 g CO2/gal fuel * conversion factor of 1/15.2 = 671.45 g/hp-hr
> CH4 and N20 Emission Factors per EPA: Table 5 in https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf
*CH4 EF = 0.8 g/gal * 1/15.2 conversion factor = 0.05263158 g/bhp-hr
*N2O EF = 0.26 g/gal * 1/15.2 conversion factor = 0.01710526 g/bhp-hr

Phase 1 and Phase 2 - On-road Vehicle Equipment Onsite Emissions

Vehicle Type	Quantity[1]	Onsite Mi/Day[2]	Emission Factors (g/mile)[3]									Daily Emissions (lb/day)									Daily Emissions
			ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e	MT CO_2e
SITE WORK																						
Water Truck (100% on-site)	1	3	0.5852951	1.4800106	7.9651372	0.0228806	57.256365	5.666856	2421.8693	0.0271854	0.3806841	0.0038711	0.0097886	0.0526804	0.0001513	0.3786863	0.0374799	16.017937	0.0001798	0.0025178	16.772735	0.007607994
RENTAL DUMP TRUCKS (50% onsite/50% offsite)	4	2	0.5852951	1.4800106	7.9651372	0.0228806	57.256365	5.666856	2421.8693	0.0271854	0.3806841	0.0103228	0.0261029	0.1404811	0.0004035	1.0098302	0.0999463	42.714497	0.0004795	0.0067141	44.727293	0.020287983
Phase Total												0.0141939	0.0358915	0.1931615	0.0005549	1.3885166	0.1374262	58.732434	0.0006593	0.0092319	61.500028	0.027895977
RAIL WORK																						
Water Truck (100% on-site)	1	3	0.5852951	1.4800106	7.9651372	0.0228806	57.256365	5.666856	2421.8693	0.0271854	0.3806841	0.0038711	0.0097886	0.0526804	0.0001513	0.3786863	0.0374799	16.017937	0.0001798	0.0025178	16.772735	0.007607994
FLAT BED TRUCK (75% onsite/25% offsite)	1	2	0.1567006	2.3262563	0.221947	0.0101333	57.169567	5.5834449	1024.913	0.0363976	0.0199293	0.0006909	0.010257	0.0009786	4.468E-05	0.2520748	0.0246188	4.5190966	0.0001605	8.787E-05	4.549295	0.002063528
PICKUPS (50% onsite/50% offsite)	3	3	0.1905899	2.2270731	0.3963288	0.0093604	57.176142	5.5897522	950.55391	0.0325805	0.030717	0.0037816	0.0441887	0.0078638	0.0001857	1.1344673	0.1109097	18.860529	0.0006465	0.0006095	19.058314	0.008644716
SUV (100% onsite)	2	3	0.1905899	2.2270731	0.3963288	0.0093604	57.176142	5.5897522	950.55391	0.0325805	0.030717	0.0025211	0.0294592	0.0052425	0.0001238	0.7563115	0.0739398	12.573686	0.000431	0.0004063	12.705543	0.005763144
FLAT BED TRUCK (75% onsite/25% offsite)	1	2	0.1567006	2.3262563	0.221947	0.0101333	57.169567	5.5834449	1024.913	0.0363976	0.0199293	0.0006909	0.010257	0.0009786	4.468E-05	0.2520748	0.0246188	4.5190966	0.0001605	8.787E-05	4.549295	0.002063528
Phase Total												0.0115556	0.1039506	0.067744	0.0005502	2.7736148	0.271567	56.490345	0.0015782	0.0037093	57.635182	0.02614291
STRUCTURES																						
Water Truck (100% on-site)	1	3	0.5852951	1.4800106	7.9651372	0.0228806	57.256365	5.666856	2421.8693	0.0271854	0.3806841	0.0038711	0.0097886	0.0526804	0.0001513	0.3786863	0.0374799	16.017937	0.0001798	0.0025178	16.772735	0.007607994
FLAT BED TRUCK (75% onsite/25% offsite)	1	2	0.1567006	2.3262563	0.221947	0.0101333	57.169567	5.5834449	1024.913	0.0363976	0.0199293	0.0006909	0.010257	0.0009786	4.468E-05	0.2520748	0.0246188	4.5190966	0.0001605	8.787E-05	4.549295	0.002063528
PICKUPS (50% onsite/50% offsite)	3	3	0.1905899	2.2270731	0.3963288	0.0093604	57.176142	5.5897522	950.55391	0.0325805	0.030717	0.0037816	0.0441887	0.0078638	0.0001857	1.1344673	0.1109097	18.860529	0.0006465	0.0006095	19.058314	0.008644716
Concrete Mixer Delivery (100% onsite)	5	2	0.5852951	1.4800106	7.9651372	0.0228806	57.256365	5.666856	2421.8693	0.0271854	0.3806841	0.0129036	0.0326287	0.1756014	0.0005044	1.2622878	0.1249329	53.393122	0.0005993	0.0083927	55.909117	0.025359979
Phase Total												0.0212472	0.0968631	0.2371242	0.0008862	3.0275163	0.2979413	92.790684	0.0015861	0.0116078	96.28946	0.043676216

	Maximum Daily Emissions (lbs/day)						MT/day
	ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Phase 1	0.05	0.24	0.50	0.00	7.19	0.71	0.10

	Maximum Annual Emissions (tons/year)						MT
	ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Phase 1	0.003	0.013	0.037	0.000	0.424	0.042	13.008

	Maximum Daily Emissions (lbs/day)						MT/day
	ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Phase 2	0.05	0.24	0.50	0.00	7.19	0.71	0.10

	Maximum Annual Emissions (tons/year)						MT
	ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Phase 2 Max Annual Scenario[4]	0.005	0.023	0.058	0.000	0.731	0.072	21.33
Phase 2 Remaining Construction	0.001	0.002	0.012	0.000	0.087	0.009	3.51

Phase 1	Activity Duration (months)
Site Work	10
Rail Work	3
Structures	6
Total	12

Phase 2	Max Annual Scenario (months)	Rest of Construction Duration (months)
Site Work	12	6
Rail Work	6	0
Structures	12	0
Total		

Notes

1. Project specific truck trips.
2. Miles per day for on-road construction equipment is based on on-road off-site activity estimate in Data Tab.

3. Emission factors based on EMFAC2017 aggregate fleet for year 2024 (earliest year of construction) and includes SAFE adjustment factors for gasoline powered LDA, LDT1, LDT2, and MD per 2019 CARB (https://ww3.arb.ca.gov/msei/emfac_off_model_adjustment_factors_final_draft.pdf). Assumes all onsite travel occurs on unpaved roads. PM EFs include fugitive re-entrained road dust emissions for unpaved roads (AP-42,Section 13.2.1)
4. Buildout phase for maximum annual scenario conservatively assumes all onsite work occurs in one year for maximum annual emissions.

Phase 1 and Phase 2 - On-road Vehicle Equipment Offsite Emissions

Vehicle Type	Trips/Day[1]	Offsite Mi/Day[2]	Emission Factors (g/mile) [3]									Daily Emissions (lb/day)									Daily Emissions
			ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e	MT CO_2e
SITE WORK																						
RENTAL DUMP TRUCKS (50% onsite/50% offsite)	8	252	0.0839542	0.2805985	2.3889834	0.009802	1.6696372	0.4572778	1037.5263	0.0038995	0.1630847	0.0466421	0.1558908	1.3272364	0.0054457	0.9275926	0.2540477	576.41369	0.0021664	0.0906042	577.87602	0.262120464
Workers	14	235.2	0.0157356	0.8773879	0.0639451	0.0029296	0.3358848	0.0903987	296.12129	0.003822	0.0061476	0.0081593	0.4549499	0.0331573	0.0015191	0.1741656	0.0468742	153.54708	0.0019818	0.0031877	153.59415	0.069669215
Phase Total												0.0548014	0.6108407	1.3603937	0.0069647	1.1017582	0.300922	729.96077	0.0041482	0.0937919	731.47016	0.331789679
RAIL WORK																						
FLAT BED TRUCK (75% onsite/25% offsite)	2	22	0.0295971	1.2920152	0.1335667	0.0043998	1.5408091	0.3862187	445.04522	0.0067856	0.011396	0.0014274	0.0623089	0.0064414	0.0002122	0.0743073	0.0186258	21.462822	0.0003272	0.0005496	21.464161	0.009735991
PICKUPS (50% onsite/50% offsite)	6	105	0.0497758	1.199634	0.4676486	0.0042857	0.3485915	0.0978797	436.28591	0.0070399	0.0196919	0.0115224	0.277698	0.1082539	0.0009921	0.0806939	0.0226577	100.99389	0.0016296	0.0045584	101.04923	0.045835215
FLAT BED TRACTOR (75% onsite/25% offsite)	2	9	0.0295971	1.2920152	0.1335667	0.0043998	1.5408091	0.3862187	445.04522	0.0067856	0.011396	0.0005709	0.0249236	0.0025766	8.487E-05	0.0297229	0.0074503	8.5851286	0.0001309	0.0002198	8.585343	0.003894251
Workers	38	638	0.0157356	0.8773879	0.0639451	0.0029296	0.3358848	0.0903987	296.12129	0.003822	0.0061476	0.0221468	1.2348641	0.0899984	0.0041231	0.4727352	0.12723	416.77064	0.0053793	0.0086524	417.11739	0.189201492
Phase Total												0.0356675	1.5997945	0.2072703	0.0054123	0.6574593	0.175964	547.81248	0.007467	0.0139802	548.21613	0.248666949
STRUCTURES																						
FLAT BED TRUCK (75% onsite/25% offsite)	2	18	0.0295971	1.2920152	0.1335667	0.0043998	1.5408091	0.3862187	445.04522	0.0067856	0.011396	0.0011419	0.0498471	0.0051531	0.0001697	0.0594458	0.0149007	17.170257	0.0002618	0.0004397	17.171115	0.007788696
PICKUPS (50% onsite/50% offsite)	6	221	0.0497758	1.199634	0.4676486	0.0042857	0.3485915	0.0978797	436.28591	0.0070399	0.0196919	0.024197	0.5831657	0.2273332	0.0020834	0.1694572	0.0475813	212.08717	0.0034222	0.0095726	212.33123	0.096311939
Workers	40	672	0.0157356	0.8773879	0.0639451	0.0029296	0.3358848	0.0903987	296.12129	0.003822	0.0061476	0.0233124	1.2998569	0.0947352	0.0043402	0.497616	0.1339263	438.70594	0.0056624	0.0091078	439.09015	0.199168179
Phase Total												0.0486513	1.9328698	0.3272215	0.0065933	0.726519	0.1964083	667.96337	0.0093464	0.0191201	668.59249	0.303268814

	Maximum Daily Emissions (lbs/day)						MT/day
	ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Phase 1	0.14	4.14	1.89	0.02	2.49	0.67	0.88

	Maximum Annual Emissions (tons/year)						MT	Worker MT
	ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO_2e	CO_2e
Phase 1	0.010	0.236	0.170	0.001	0.182	0.050	123.554	51.645

	Maximum Daily Emissions (lbs/day)						MT/day
	ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO_2e
Phase 2	0.14	4.14	1.89	0.02	2.49	0.67	0.88

	Maximum Annual Emissions (tons/year)						MT	Worker MT
	ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$	CO_2e	CO_2e
Phase 2 Max Annual Scenario[4]	0.015	0.421	0.226	0.002	0.272	0.074	191.37	91.59
Phase 2 Remaining Construction	0.003	0.038	0.086	0.000	0.069	0.019	41.81	8.78

Phase 1	Activity Duration (months)
Site Work	10
Rail Work	3
Structures	6
Total	12

Phase 2	Max Annual Scena	Rest of Construction Duration (months)
Site Work	12	6
Rail Work	6	0
Structures	12	0
Total		

Notes

1. Project specific truck trips. Number of worker trips is based upon the number of workers listed in the Data Tab for each phase subtract the workers accounted for in driving the other on-road equipment to/from the site.
2. Miles per day for on-road construction equipment is based on on-road off-site activity estimate in Data Tab. Default worker trip length (based on CalEEMod default Madera County H-W trip length in rural area)

3. Emission factors based on EMFAC2017 aggregate fleet for year 2024 (earliest year of construction) and includes SAFE adjustment factors for gasoline powered LDA, LDT1, LDT2, and MD per 2019 CARB (https://ww3.arb.ca.gov/msei/emfac_off_model_adjustment_factors_final_draft.pdf). Assumes all offsite travel occurs on paved roads. PM EFs include fugitive re-entrained road dust emissions for paved roads (AP-42,Section 13.2.1)
4. Phase 2 for maximum annual scenario conservatively assumes all onsite work occurs in one year for maximum annual emissions.

Madera Station Relocation Project: Construction Fuel Consumption, Total and Amortized over 30 Years					
Phase	Source	MT CO_2e/yr [a]	Fuel Type	Factor (MT CO_2/gallon) [b]	Gallons/year
Phase 1	Offroad Equip	833	Diesel	0.01016	82,026
	Hauling	85	Diesel	0.01016	8,358
	Vendor	0	Diesel	0.01016	-
	Worker	52	Gas	0.008887	5,811
Total Gallons				Diesel	90,384
				Gasoline	5,811
Amortized Demands (over 30 years)				Diesel	3,013
				Gasoline	194
Phase 2	Offroad Equip	1,379	Diesel	0.01016	135,699
	Hauling	158	Diesel	0.01016	15,517
	Vendor	0	Diesel	0.01016	-
	Worker	100	Gas	0.008887	11,293
Total Gallons				Diesel	151,216
				Gasoline	11,293
Amortized Demands (over 30 years)				Diesel	5,041
				Gasoline	376

Notes:

Assumed amortization period is 30 years.

Sources:

[a] Modeled by AECOM in 2020;

[b] U.S. Energy Information Administration 2016 (https://www.eia.gov/environment/emissions/co2_vol_mass.php)

Phase 1 and Phase 2 - Earth Moving Emissions

								Emission (total tons)								Emission (lbs/day)							
								Earth Moving		Grading		Cut & Fill		Total		Earth Moving		Grading		Cut & Fill		Total	
Phase	Maximum Phase Duration (Months)	% Time for Earthwork	Earthwork Days of Activity	# of Bulldozers	Use per Day (hrs)	Graded Area (acres)	Cut/Fill (cy)	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5
Phase 1	13	15%	41	4	6.5	14.2	41,260	0.4007	0.2208	0.0037	0.0003	0.0033	0.0005	0.4078	0.2217	19.57	10.79	0.18	0.02	0.16	0.02	19.92	10.83
Phase 2	24	15%	76	4	6.5	35.3	222,250	0.7398	0.4077	0.0093	0.0008	0.0179	0.0027	0.7670	0.4112	19.57	10.79	0.25	0.02	0.47	0.07	20.29	10.88

Emission Factors					
Earth Moving		Grading		Cut & Fill	
PM10 (lb/hr)	PM2.5 (lb/hr)	PM10 (lb/acre)	PM2.5 (lb/acre)	PM10 (lb/cy)	PM2.5 (lb/cy)
0.75276	0.41482	0.52594	0.04766	0.00016	0.00002

Days of work per week:	5
Average Workdays per Month:	21

Conversion Factors	
ton	lbs
1	2000

Architectural Coatings	VOC Emissions	
	Daily (lbs)	Total (tons)
Phase 1	1.97	0.06
Phase 2	1.68	0.11

	Total Sq. Ft.	Source/Note
Buildings and Structures - Phase 1	1,800	1
Buildings and Structures - Phase 2	3,600	1

		Architectural Coatings		
	sq. ft.	VOC Emissions (lbs)	Daily VOC Emissions (lbs/day)	Total VOC Emissions (tons)
Phase 1 Interior Surface Area (A)	2,700	31.30	0.50	0.02
Phase 1 Exterior Surface Area (A)	900	6.26	0.10	0.00
Phase 2 Interior Surface Area (A)	5,400	62.59	0.50	0.03
Phase 2 Exterior Surface Area (A)	1,800	12.52	0.10	0.01

Assumptions: Total surface for painting is 2 times the nonresidential square footage
Default values based on SCAQMD methods used in coating rules are 75% for interior surface area and 25% for exterior shell

CalEEMod Default Assumptions		Unit	Sources/Notes:
NonResidential Interior	250	g/L	CalEEMod Appendix D
NonResidential Exterior	150	g/L	CalEEMod Appendix D

Interior EF_{AC} (lb/sq.ft) 0.011590844
Exterior EF_{AC} (lb/sq.ft) 0.006954506

Painting of Stripes, Handicap Symbols, Directional Arrows, etc.

			Sources/Notes
Phase 1	208,180	square feet	2
Phase 2	327,725	square feet	2

		Daily VOC Emissions (lbs/day)		
	square feet	Daily VOC Emissions (lbs)	Daily VOC Emissions (lbs/day)	Total VOC Emissions (tons)
A_{Paint} Phase 1	12,491	86.87	1.38	0.04
A_{Paint} Phase 2	19,664	136.75	1.09	0.07

CalEEMod Default Assumptions
Parking Lot Paint 150 g/L

Parking EF AC (lb/sq.ft) 0.006954506

Conversion Factors	
tons	pounds
1	2000
sq. ft.	acre
43560	1
grams	lb
453.592	1
L	gal
3.78541	1

Sources/Notes
1. Buildings and square footage
2. Construction Input Data

Structures Phase Durations	months	total days	% time for paving/painting	Arch Coatings Days of Activity
Phase 1	6	126	50%	63
Phase 2	12	252	50%	126

Asphalt Paving Off-Gassing Emissions

	VOC Emissions		
	lbs VOC	Daily (lbs/day)	tons VOC
Phase 1	12.5213866	0.198752168	0.006260693
Phase 2	19.7116506	0.156441671	0.009855825

Project Information

Phase	Paving Area	Units	Acres	Source/Notes
Phase 1	208180	sq. ft.	4.779	1
Phase 2	327725	sq. ft.	7.524	1

CalEEMod Assumption (lb VOC/acre) 2.62
Source: CalEEMod User's Guide Appendix A

Conversion Factors	
tons	pounds
1	2000
sq. ft.	acre
43560	1

Structures Phase Durations	months	total days	% time for paving/painting	Paving Days of Activity
Phase 1	6	126	50%	63
Phase 2	12	252	50%	126

$$E_{AP} = EF_{AP} \times A_{Parking}$$

Where:

E = emissions (lb)

EF = emission factor (lb/acre). The SMAQMD default emission factor is 2.62 lb/acre[16].

A = area of the parking lot (acre)

The size (acre) of the parking lot is calculated by multiplying the paved area associated with each parking stall with the capacity of the parking lot, or the number of parking stalls.

$$A_{Parking\_lot} = A_{Parking\_Stall} \times Capacity$$

Operational Indirect GHG Emissions (Electricity)

					Emissions (metric tons per year)			
Phase	kWh/acre/month	Station Acreage	Total Annual Consumption (MWh)	Electricity Provider	CO2	CH4	N2O	CO2e
Phase 1	718	7.5	64.59	PG&E	6.15	0.0010	0.0001	6.21
Phase 2	718	11	94.776	PG&E	9.03	0.0014	0.0002	9.11

Notes: Station acreages include station area and access road in order to account for potential lighting.

Emission Factors

	CO2 (lb/MWh)	CH4 (lb/MWh)	N2O (lb/MWh)
PG&E[1]	210.00	0.033	0.004

Notes:
1. PG&E CO2 emission factor based upon PG&E 2019 Corporate Responsibility and Sustainability Report for delivered electricity in 2017 (http://www.pgecorp.com/corp_responsibility/reports/2018/assets/PGE_CRSR_2018.pdf). Emission factors for CH4 and N2O based upon U.S. EPA eGrid (https://www.epa.gov/sites/production/files/2018-02/documents/egrid2016_summarytables.pdf)

Conversion Factors	
kWh to MWh	0.001
pounds per ton	2000
pounds per metric ton	2204.62262
months per year	12
days per year	365
Global Warming Potential	
CO2	1
CH4	25
N20	298

Note: GWP are the 100-year GWPs from the IPCC fourth assessment report (AR4), consistent with the California Air Resources Board 2019 GHG emissions inventory.

Operational Indirect GHG Emissions (Waste)

				Emissions (metric tons per year)			
Station	waste (tons)/acre/month	Station Acreage	Average Annual Tonnage	CO2	CH4	N2O	CO2e
Phase 1	0.13534	3	4.87	1.01	0.05	0.00	2.27
Phase 2	0.13534	5	8.12	1.69	0.08	0.00	3.78

Notes: Station acreage includes station area acreage to account for waste generated by building facilities.

Emission Factors

CO2 (tons/ton waste)	CH4 (tons/ton waste)	N2O (tons/ton waste)
0.22890970	0.011350894	0

Source: CalEEMod

Conversion Factors	
tons to metric tons	0.907185
pounds per ton	2000
pounds per metric ton	2204.62262
months per year	12
days per year	365
Global Warming Potential	
CO2	1
Ch4	25
N20	298

Note: GWP are the 100-year GWPs from the IPCC fourth assessment report (AR4), consistent with the California Air Resources Board 2019 GHG emissions inventory.

Fugitive Dust Emission Factors

Truck Loading Fugitive Dust Emission Factors

$EF_D = k \times (0.0032) \times ((U/5)^{1.3})/((M/2)^{1.4})$

Variable	Amount	Units	
EF (PM_{10})	0.0001	lb/ton	
EF ($PM_{2.5}$)	0.00002	lb/ton	
k (PM_{10})	0.35	factor	
k ($PM_{2.5}$)	0.053	factor	
U (mean wind speed)	6.49	miles/hr	CalEEMod default value for Madera County (2.9 m/s)
M (moisture content)	12	percent	USEPA, AP-42, July 1998, Table 11.9-3 Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations
Soil density	1.26	tons/cy	CalEEMod default
Rip rap density	0.05	tons/sf	

E (lbs) = EF (lb/ton) x TP (tons)

Cut/Fill Truck Loading Emissions:	0.000161133	EF (PM10) as lb/cy
	2.44001E-05	EF (PM2.5) as lb/cy

Bulldozing, Scraping

PM10 Emission Factor [lb/hr] = 0.75 x (silt content [%])$^{1.5}$ / (moisture)$^{1.4}$

PM2.5 Emission Factor [lb/hr] = 0.60 x (silt content [%])$^{1.2}$ / (moisture)$^{1.3}$

Reference: AP-42, Table 11.9-1, July 1998

Parameter	Value	Basis
Silt Content	6.9	USEPA, AP-42, July 1998, Table 11.9-3 Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations
Moisture	7.9	USEPA, AP-42, July 1998, Table 11.9-3 Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations

PM10 Emission Factor	0.75276 lb/hr
PM2.5 Emission Factor	0.41 lb/hr

Emissions [pounds per day] = Controlled emission factor [pounds per hour] x Bulldozing, scraping or grading time [hours/day]

Grading

AP-42, Section 11.9

$EF_{PM15} = 0.051 * (S)^2$

$EF_{TSP} = 0.04 * (S^2.5)$

$EF_{PM10} = EF_{PM15} * F_{PM10}$

$EF_{PM2.5} = EF_{TSP} * F_{PM2.5}$

	5	S: mean vehicle speed (mph)	Per Data Sheet
	1.275	EF_{PM15}	
VMT = (Site Acres/12 ft) * (43,560 sq.ft./acre) / (5280 ft / mile)	2.236067977	EF_{TSP}	
	0.6	F_{PM10}	default AP-42 value
	0.031	$F_{PM2.5}$	default AP-42 value
	0.765	**EF_{PM10} (lb/VMT)**	
	0.069318107	**$EF_{PM2.5}$ (lb/VMT)**	
	0.0833	VMT Calculation Factor (site acres / 12 ft)	
	43560	sq. ft. per acre	
	5280	ft. per mile	
	0.5259375	**EF_{PM10} (lb/acre)**	calculated
	0.047656199	**$EF_{PM2.5}$ (lb/acre)**	calculated

Paved Road Dust $EF_{DUST} = [(k(sL)^{0.91} \times (W)^{1.02})(1 - P/4N))$

Source: AP-42 Section 13.2.1 (Paved Roads) - http://www.epa.gov/ttnchie1/ap42/ch13/final/c13s0201.pdf

Variable	Value	Description	
k (PM10)	0.0022	particle size multiplier for particle size rangeand units of interest (lb/VMT)	
k (PM2.5)	0.00054	particle size multiplier for particle size rangeand units of interest (lb/VMT)	
sL	0.1	road surface silt loading (g/m^2)	
W	2.4	average weight (tons) of vehicles (2.4 tons)	
W	12	haul truck tons	
P	51	number of "wet" days with at least 0.254 mm (0.1 inches) of precipitation during the averaging period	CalEEMod data for Madera County
N	365	number of days in averaging period	
Pickup and Worker			
EF (PM10)	0.000637964	lb/VMT	
EF (PM2.5)	0.000156591	lb/VMT	
Haul Truck			
EF (PM10)	0.003294168	lb/VMT	
EF (PM2.5)	0.000808568	lb/VMT	

Unpaved Road Dust

Equations: EF (unpaved) = ((k * (s/12)a * (S/30)d)/(M/0.5)c) - C			
Ref: AP-42, Section 13.2.2, "Unpaved Roads," November 2006			
Constants:			
k_s =	1.8	(Particle size multiplier for PM10)	
	0.18	(Particle size multiplier for PM2.5)	
s	3.9	Unpaved surface material silt content (%)	Source: spreadsheet link at 4th bullet: https://www3.epa.gov/ttnchie1/ap42/ch13/related/c13s02-2.html; used by EPA for National Emissions Inventory.
S	5	mean vehicle speed	
a =	1	for PM10 and PM2.5	
c =	0.2	for PM10 and PM2.5	
d =	0.5	for PM10 and PM2.5	
C	0.00047	for PM10	
c	0.00036	for PM2.5	
M	12	Moisture Content	
EF (PM10)	0.126014699	lb/VMT	
EF (PM2.5)	0.01228847	lb/VMT	

[c] Uncontrolled emissions [lb/day] = Emission factor [lb/mi] x Number x Daily miles traveled [mi/vehicle-day]

[d] Control efficiency from watering unpaved road twice a day (55%) and limiting maximum speed to 15 mph (57%), from Table XI-A, Mitigation Measure Examples, Fugitive Dust from Construction & Demolition, http://www.aqmd.gov/ceqa/handbook/mitigation/fugitive/MM_fugitive.html

[e] Controlled emissions [lb/day] = Uncontrolled emissions [lb/day] x (1 - Control efficiency [%])

CalEEMod
Equipment HP and Load Factors

OFFROAD Equipment Type	Horsepower	Load Factor
Aerial Lifts	63	0.31
Air Compressors	78	0.48
Bore/Drill Rigs	221	0.50
Cement and Mortar Mixers	9	0.56
Concrete/Industrial Saws	81	0.73
Cranes	231	0.29
Crawler Tractors	212	0.43
Crushing/Proc. Equipment	85	0.78
Dumpers/Tenders	16	0.38
Excavators	158	0.38
Forklifts	89	0.201
Generator Sets	84	0.74
Graders	187	0.41
Off-Highway Tractors	124	0.44
Off-Highway Trucks	402	0.38
Other Construction Equipment	171	0.42
Other General Industrial Equipme	88	0.34
Other Material Handling Equipme	168	0.40
Pavers	130	0.42
Paving Equipment	132	0.36
Plate Compactors	8	0.43
Pressure Washers	13	0.3
Pumps	84	0.74
Rollers	80	0.38
Rough Terrain Forklifts	100	0.40
Rubber Tired Dozers	247	0.4
Rubber Tired Loaders	203	0.36
Scrapers	367	0.48
Signal Boards	6	0.82
Skid Steer Loaders	65	0.37
Surfacing Equipment	263	0.30
Sweepers/Scrubbers	64	0.46
Tractors/Loaders/Backhoes	97	0.37
Trenchers	78	0.50
Welders	46	0.45

Table 3.5 OFFROAD Emission Factor Based on Engine Tier

Tier	Low HP	High HP	ROG, g/bhp-hr	CO, g/bhp-hr	NOx, g/bhp-hr	PM10, g/bhp-hr	PM2.5, g/bhp-hr
Tier 1	25	49	1.74	4.10	5.26	0.48	0.48
	50	74	1.19	6.90	6.54	0.55	0.55
	75	119	1.19	6.90	6.54	0.55	0.55
	120	174	0.82	6.90	6.54	0.27	0.27
	175	299	0.38	6.90	5.93	0.11	0.11
	300	599	0.38	6.90	5.93	0.11	0.11
	600	750	0.38	6.90	5.93	0.11	0.11
	751	2000	0.38	6.90	5.93	0.11	0.11
Tier 2	25	49	0.29	4.10	4.63	0.28	0.28
	50	74	0.23	3.70	4.75	0.19	0.19
	75	119	0.23	3.70	4.75	0.19	0.19
	120	174	0.19	3.70	4.17	0.13	0.13
	175	299	0.12	2.60	4.15	0.09	0.09
	300	599	0.12	2.60	3.79	0.09	0.09
	600	750	0.12	2.60	3.79	0.09	0.09
	751	2000	0.12	2.60	3.79	0.09	0.09
Tier 3	25	49	0.29	4.10	4.63	0.28	0.28
	50	74	0.12	3.70	2.74	0.19	0.19
	75	119	0.12	3.70	2.74	0.19	0.19
	120	174	0.12	3.70	2.32	0.11	0.11
	175	299	0.12	2.60	2.32	0.09	0.09
	300	599	0.12	2.60	2.32	0.09	0.09
	600	750	0.12	2.60	2.32	0.09	0.09
	751	2000	0.12	2.60	2.32	0.09	0.09
Tier 4 Interim	25	49	0.12	4.10	4.55	0.13	0.13
	50	74	0.12	3.70	2.74	0.11	0.11
	75	119	0.11	3.70	2.14	0.01	0.01
	120	174	0.06	3.70	2.15	0.01	0.01
	175	299	0.08	2.60	1.29	0.01	0.01
	300	599	0.08	2.60	1.29	0.01	0.01
	600	750	0.08	2.60	1.29	0.01	0.01
	751	2000	0.12	2.60	2.24	0.05	0.05
Tier 4 Final	25	49	0.12	4.10	2.75	0.01	0.01
	50	74	0.12	3.70	2.74	0.01	0.01
	75	119	0.06	3.70	0.26	0.01	0.01
	120	174	0.06	3.70	0.26	0.01	0.01
	175	299	0.06	2.20	0.26	0.01	0.01
	300	599	0.06	2.20	0.26	0.01	0.01
	600	750	0.06	2.20	0.26	0.01	0.01
	751	2000	0.06	2.60	2.24	0.02	0.02

Source:

ARB. 2011. The Carl Moyer Program Guidelines. Available at: http://www.arb.ca.gov/msprog/moyer/guidelines/2011gl/2011cmpgl_3_27_13.pdf

EMFAC2017 (v1.0.2) Emission Rates
Region Type: County
Region: MADERA
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HTSK and RUNLS, g/vehicle/day for IDLEX, RESTL and DIURN. Note 'day' in the unit is operation day.

Region	Vehicle Category	Model Year	Speed	Fuel	Population	VMT	%VMT	Trips	ROG_RUNEX	CO_RUNEX	NOx_RUNEX	SOx_RUNEX	PM10_Total	PM2.5_Total	CO2_RUNEX	CH4_RUNEX	N2O_RUNEX	PM2.5_RUN	PM2.5_PMT	PM2.5_PMB	PM10_RUN	PM10_PMT	PM10_PMBW
MADERA	LDA	Aggregated	Aggregated	GAS	69097.5847	2828000.948	68.85%	324274.616	0.011011003	0.72644607	0.041464857	0.002763976	0.046394923	0.019262456	279.3077035	0.002872713	0.004781575	0.0015125	0.002	0.01575	0.0016449	0.008	0.03675
MADERA	LDA	Aggregated	Aggregated	DSL	664.633151	28108.03058	0.68%	3137.74772	0.019059632	0.296410215	0.082735662	0.001968898	0.052425067	0.02509304	208.2697715	0.000885283	0.032737108	0.007343	0.002	0.01575	0.0076751	0.008	0.03675
MADERA	LDA	Aggregated	Aggregated	ELEC	1183.23849	50239.59591	1.22%	5903.5167	0	0	0	0	0.044750013	0.017750005	0	0	0	0	0.002	0.01575	0	0.008	0.03675
MADERA	LDT1	Aggregated	Aggregated	GAS	7758.46469	269527.1356	6.56%	34691.1366	0.035701938	1.5561908	0.131529142	0.003262695	0.047193728	0.019997007	329.704677	0.007944125	0.009662194	0.002247	0.002	0.01575	0.0024437	0.008	0.03675
MADERA	LDT1	Aggregated	Aggregated	DSL	10.0668523	208.0190725	0.01%	37.1721898	0.10896868	0.798570411	0.798827431	0.004219479	0.120301046	0.090032734	446.3358461	0.005061387	0.070157779	0.0722827	0.002	0.01575	0.075551	0.008	0.03675
MADERA	LDT1	Aggregated	Aggregated	ELEC	34.9368098	1586.951735	0.04%	177.971106	0	0	0	0	0.044750013	0.017750005	0	0	0	0	0.002	0.01575	0	0.008	0.03675
MADERA	LDT2	Aggregated	Aggregated	GAS	25405.6331	918171.7433	22.35%	115860.581	0.025253528	1.220400416	0.116647695	0.003557497	0.046543795	0.019399365	359.495239	0.00588365	0.008652577	0.0016494	0.002	0.01575	0.0017938	0.008	0.03675
MADERA	LDT2	Aggregated	Aggregated	DSL	127.948254	5556.612605	0.14%	622.119654	0.022991511	0.191808649	0.063149589	0.002662294	0.051573026	0.024277857	281.6170314	0.001067912	0.044266276	0.0065279	0.002	0.01575	0.006823	0.008	0.03675
MADERA	LDT2	Aggregated	Aggregated	ELEC	181.106604	6164.190041	0.15%	915.456986	0	0	0	0	0.044750013	0.017750005	0	0	0	0	0.002	0.01575	0	0.008	0.03675
Emission Factor/Total						4107563.227			0.015735606	0.877387939	0.063945103	0.002929551	0.046509405	0.019370173	296.121288187	0.003822038	0.006147639						
MADERA	LDT2	Aggregated	Aggregated	GAS	25405.6331	918171.7433	79.54%	115860.581	0.025253528	1.220400416	0.116647695	0.003557497	0.046543795	0.019399365	359.495239	0.00588365	0.008652577	0.0016494	0.002	0.01575	0.0017938	0.008	0.03675
MADERA	LDT2	Aggregated	Aggregated	DSL	127.948254	5556.612605	0.48%	622.119654	0.022991511	0.191808649	0.063149589	0.002662294	0.051573026	0.024277857	281.6170314	0.001067912	0.044266276	0.0065279	0.002	0.01575	0.006823	0.008	0.03675
MADERA	LDT2	Aggregated	Aggregated	ELEC	181.106604	6164.190041	0.53%	915.456986	0	0	0	0	0.044750013	0.017750005	0	0	0	0	0.002	0.01575	0	0.008	0.03675
MADERA	LHD1	Aggregated	Aggregated	GAS	2325.51377	76126.28108	6.59%	34646.6902	0.091099655	1.672665344	0.370483003	0.010119352	0.087199179	0.037296951	1022.58951	0.017902132	0.020809189	0.0025369	0.002	0.03276	0.0027592	0.008	0.07644
MADERA	LHD1	Aggregated	Aggregated	DSL	3070.51737	102561.2318	8.88%	38623.2458	0.199931745	0.94466128	3.115542521	0.005430622	0.124145654	0.06992103	574.4504036	0.009286447	0.090295604	0.034161	0.003	0.03276	0.0357056	0.012	0.07644
MADERA	LHD2	Aggregated	Aggregated	GAS	331.432145	11115.16588	0.96%	4937.84513	0.047988463	0.873576561	0.299685762	0.011573303	0.099379873	0.042242688	1169.515409	0.010467464	0.018380944	0.0020227	0.002	0.03822	0.0021998	0.008	0.08918
MADERA	LHD2	Aggregated	Aggregated	DSL	998.905949	34626.3294	3.00%	12564.9802	0.178149956	0.844184904	2.347778648	0.006063552	0.132312132	0.071005354	641.4016262	0.008274725	0.100819404	0.0297853	0.003	0.03822	0.0311321	0.012	0.08918
Emission Factor/Total						1154321.554			0.049775761	1.199633992	0.467648637	0.004285724	0.059216086	0.026851201	436.285907104	0.007039857	0.019691904						
MADERA	MDV	Aggregated	Aggregated	GAS	24463.8909	815823.9307	97%	109500.298	0.029987699	1.322141707	0.135542595	0.004436055	0.046479579	0.019340467	448.276012	0.006964858	0.01016021	0.0015905	0.002	0.01575	0.0017296	0.008	0.03675
MADERA	MDV	Aggregated	Aggregated	DSL	520.87801	21051.17457	3%	2484.46909	0.019016414	0.32335348	0.077550213	0.003671212	0.051591487	0.02429552	388.340276	0.000883276	0.061041683	0.0065455	0.002	0.01575	0.0068415	0.008	0.03675
MADERA	MDV	Aggregated	Aggregated	ELEC	91.8548741	3240.238298	0%	469.767157	0	0	0	0	0.044750013	0.017750005	0	0	0	0	0.002	0.01575	0	0.008	0.03675
Emission Factor/Total						840115.3436			0.029597127	1.292015225	0.133566678	0.004399780	0.046601000	0.019458494	445.045219002	0.006785606	0.011395985						
MADERA	T6 instate heavy	Aggregated	Aggregated	DSL	243.216785	27787.27028		2806.68797	0.083954229	0.280598489	2.388983427	0.009802034	0.175429132	0.090517688	1037.526348	0.003899456	0.163084693	0.0316577	0.003	0.05586	0.0330891	0.012	0.13034
MADERA	T7 Single	Aggregated	Aggregated	DSL	163.489974	10921.92938		1886.65164	0.096393498	0.404445795	3.121646187	0.014274808	0.130942869	0.067226511	1510.960753	0.004477228	0.237501989	0.0317665	0.009	0.02646	0.0332028	0.036	0.06174

	Emission Factors (g/mile)								
Vehicle Category	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
Worker Vehicles	0.015735606	0.877387939	0.063945103	0.002929551	0.046509405	0.019370173	296.121288187	0.003822038	0.006147639
Pickup Truck/SUV[1]	0.049775761	1.199633992	0.467648637	0.004285724	0.059216086	0.026851201	436.285907104	0.007039857	0.019691904
Flatbed Truck[2]	0.029597127	1.292015225	0.133566678	0.004399780	0.046601000	0.019458494	445.045219002	0.006785606	0.011395985
Dump, Water, Cement Truck	0.08395423	0.280598489	2.38898343	0.00980203	0.17542913	0.09051769	1037.526348	0.00389946	0.16308469
Haul Truck	0.0963935	0.404445795	3.12164619	0.01427481	0.13094287	0.06722651	1510.960753	0.00447723	0.23750199

EMFAC SAFE Adjustment Factors for Light Duty Vehicle Emissions in EMFAC2017				
Year	NOx Exhaust	PM Exhaust	CO Exhaust	TOG Exhaust
2024	1.0004	1.0018	1.0014	1.0003

Notes: To be applied to gas light duty vehicles (LDA, LDT1, LDT2, and MDV)
Source: CARB 2019

EMFAC2017 (v1.0.2) Emission Rates
Region Type: County
Region: MADERA for all except San Joaquin Valley Unitfied APCD for LDT2 and MDV
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/day for VMT, g/mile for RUNEX, PMBW and PMTW. Note 'day' in the unit is operation day.

Region	Calendar Year	Vehicle Category	Model Year	Speed	Fuel	VMT	%VMT	ROG_RUNEX	CO_RUNEX	NOx_RUNEX	SOx_RUNEX	PM10_RUNEX	PM2.5_RUNEX	CO2_RUNEX	CH4_RUNEX	N2O_RUNEX
MADERA		LHD1	Aggregated		5 GAS	2160.407907	7%	0.280926947	3.251613715	0.510372858	0.019031397	0.009365606	0.008611329	1923.177141	0.056277084	0.029447671
MADERA		LHD1	Aggregated		5 DSL	1803.492157	6%	0.809401566	3.461391369	2.66440165	0.011935698	0.097295336	0.093086383	1262.556308	0.037595156	0.198456269
MADERA		LHD2	Aggregated		5 GAS	315.4402386	1%	0.160045133	1.438776802	0.442309739	0.021758349	0.007636261	0.00702126	2198.743474	0.035313402	0.027359394
MADERA		LHD2	Aggregated		5 DSL	608.8880994	2%	0.788520877	3.445782348	2.133570967	0.012534781	0.080383074	0.076905738	1325.927255	0.036625288	0.2084173
SAN JOAQUIN VALLEY UNIFIED APCD		LDT2	Aggregated		5 GAS	25503.44341	84%	0.124850116	2.033481207	0.185621324	0.008147064	0.010412958	0.009574525	823.2841433	0.030208694	0.014308283
SAN JOAQUIN VALLEY UNIFIED APCD		LDT2	Aggregated		5 DSL	150.9614945	0%	0.26322864	2.255921971	0.162117989	0.006454374	0.01994633	0.01908346	682.7426914	0.012226467	0.107317643
		Emission Factor/Total				30542.63331		0.190589889	2.227073143	0.396328819	0.009360352	0.016882480	0.015800555	950.553906658	0.032580538	0.030716988
SAN JOAQUIN VALLEY UNIFIED APCD		MDV	Aggregated		5 GAS	23493.935	98%	0.155617201	2.291739161	0.223477979	0.010173026	0.010139109	0.00932322	1028.01341	0.037030163	0.017106202
SAN JOAQUIN VALLEY UNIFIED APCD		MDV	Aggregated		5 DSL	550.9233758	2%	0.20290039	3.798228113	0.15665864	0.00843921	0.017499926	0.016742887	892.6983643	0.009424335	0.140319751
		Emission Factor/Total				24044.85838		0.156700568	2.326256311	0.221946994	0.010133300	0.010307762	0.009493221	1024.913029012	0.036397650	0.019929310
MADERA		T6 instate heavy	Aggregated		5 DSL	427.3718543		0.585295135	1.480010587	7.965137174	0.02288062	0.097105062	0.09290434	2421.869292	0.027185443	0.380684126
MADERA		T7 Single	Aggregated		5 DSL	147.3604371		0.697191864	2.53663092	11.39286409	0.033634849	0.086789758	0.083035272	3560.183535	0.032382756	0.559611273

	Emission Factors (g/mile)								
Vehicle Category	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
Pickup Truck/SUV[1]	0.190589889	2.227073143	0.396328819	0.009360352	0.016882480	0.015800555	950.553906658	0.032580538	0.030716988
Flatbed Truck[2]	0.156700568	2.326256311	0.221946994	0.010133300	0.010307762	0.009493221	1024.913029012	0.036397650	0.019929310
Dump, Water, Cement Truck	0.585295135	1.480010587	7.965137174	0.02288062	0.097105062	0.09290434	2421.869292	0.027185443	0.380684126
Haul Truck	0.697191864	2.53663092	11.39286409	0.033634849	0.086789758	0.083035272	3560.183535	0.032382756	0.559611273

Notes
1. Pickup Truck/SUV category conservatively includes LHD1 and LHD2 vehicle categories as no 5mph speed bin data available for LDT2 categories in Madera County.
2. Flatbed Truck assumed to be a MDV category

EMFAC SAFE Adjustment Factors for Light Duty Vehicle Emissions in EMFAC2017				
Year	NOx Exhaust	PM Exhaust	CO Exhuast	TOG Exhuast
2024	1.0004	1.0018	1.0014	1.0003

Notes: To be applied to gas light duty vehicles (LDA, LDT1, LDT2, and MDV)
Source: CARB 2019

EMFAC2017 (v1.0.2) Emission Rates
Region Type: County
Region: MADERA
Calendar Year: 2025
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HTSK and RUNLS, g/vehicle/day for IDLEX, RESTL and DIURN. Note 'day' in the unit is operation day.

Region	Calendar Yea	Vehicle Category	Model Year	Speed	Fuel	Population	VMT	%VMT	Trips	ROG_RUNEX	CO_RUNEX	NOx_RUNEX	SOx_RUNEX	PM10_Total	PM2.5_Total	CO2_RUNEX	CH4_RUNEX	N2O_RUNEX	PM2.5_RUN	PM2.5_PMT	PM2.5_PMB	PM10_RUNE	PM10_PMT	PM10_PMBW
MADERA	2025	LDA	Aggregated	Aggregated	GAS	75302.4117	3059817.255	69.13%	353784.418	0.00722369	0.605699454	0.029386495	0.002561372	0.046290124	0.019166081	258.8339898	0.002028194	0.003928073	0.0014161	0.002	0.01575	0.0015401	0.008	0.03675
MADERA	2025	LDA	Aggregated	Aggregated	DSL	799.508196	33472.0241	0.76%	3781.14245	0.015342679	0.293913041	0.046918178	0.001853456	0.049615789	0.02240529	196.0582809	0.000712638	0.030817631	0.0046553	0.002	0.01575	0.0048658	0.008	0.03675
MADERA	2025	LDA	Aggregated	Aggregated	ELEC	2061.7353	94390.49733	2.13%	10221.9072	0	0	0	0	0.044750013	0.017750005	0	0	0	0	0.002	0.01575	0	0.008	0.03675
MADERA	2025	LDT1	Aggregated	Aggregated	GAS	8030.40368	282409.6225	6.38%	36210.4332	0.022325659	1.109182889	0.083002208	0.003025248	0.046774147	0.019611122	305.7099706	0.005121355	0.006858089	0.0018611	0.002	0.01575	0.0020241	0.008	0.03675
MADERA	2025	LDT1	Aggregated	Aggregated	DSL	7.93379918	158.7838705	0.00%	28.9123937	0.093684522	0.706400067	0.64262958	0.004170409	0.10687481	0.077187311	441.1452712	0.004351467	0.069341893	0.0594373	0.002	0.01575	0.0621248	0.008	0.03675
MADERA	2025	LDT1	Aggregated	Aggregated	ELEC	85.8983087	4158.407073	0.09%	433.517078	0	0	0	0	0.044750013	0.017750005	0	0	0	0	0.002	0.01575	0	0.008	0.03675
MADERA	2025	LDT2	Aggregated	Aggregated	GAS	25888.8066	933019.0665	21.08%	118316.63	0.017359103	0.955154791	0.076777087	0.003223749	0.046411088	0.019277302	325.7690421	0.004194951	0.006368728	0.0015273	0.002	0.01575	0.0016611	0.008	0.03675
MADERA	2025	LDT2	Aggregated	Aggregated	DSL	166.197356	7017.634418	0.16%	805.901278	0.022900541	0.214521352	0.046696555	0.00248967	0.049799782	0.022581324	263.3569272	0.001063686	0.041396041	0.0048313	0.002	0.01575	0.0050498	0.008	0.03675
MADERA	2025	LDT2	Aggregated	Aggregated	ELEC	366.557552	11974.5619	0.27%	1835.9759	0	0	0	0	0.044750013	0.017750005	0	0	0	0	0.002	0.01575	0	0.008	0.03675
Emission Factor/Total							4426417.853			0.010232577	0.693383851	0.042244678	0.002661222	0.046340933	0.019214551	269.009743233	0.002620223	0.004796466						

	Total VMT	% Fleet
Diesel	40648.4424	0.94%
Gas	4275245.94	99.06%
	4315894.39	

	Emission Factors (g/mile)									
Vehicle Category	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO2e (g/mi)
Passenger Vehicles (2025)	0.010232577	0.693383851	0.042244678	0.002661222	0.046340933	0.019214551	269.009743233	0.002620223	0.004796466	270.5045956

EMFAC SAFE Adjustment Factors for Light Duty Vehicle Emissions in EMFAC2017				
Year	NOx Exhaust	PM Exhaust	CO Exhaust	TOG Exhuast
2025	1.0018	1.0074	1.0065	1.0016

Notes: To be applied to gas light duty vehicles (LDA, LDT1, LDT2, and MDV)
Source: CARB 2019

Conversion Factors	
lbs	grams
1	453.592
GWP	CH4
1	25
GWP	N2O
1	298

EMFAC2017 (v1.0.2) Emission Rates
Region Type: County
Region: MADERA
Calendar Year: 2029
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HTSK and RUNLS, g/vehicle/day for IDLEX, RESTL and DIURN. Note 'day' in the unit is operation day.

Region	Calendar Yea	Vehicle Category	Model Year	Speed	Fuel	Population	VMT	%VMT	Trips	ROG_RUNEX	CO_RUNEX	NOx_RUNEX	SOx_RUNEX	PM10_Total	PM2.5_Total	CO2_RUNEX	CH4_RUNEX	N2O_RUNEX	PM2.5_RUN	PM2.5_PMT	PM2.5_PMB	PM10_RUN	PM10_PMT	PM10_PMBW
MADERA	2029	LDA	Aggregated	Aggregated	GAS	83478.7098	3321644.398	69.05%	391427.947	0.004820034	0.531451587	0.00346967	0.002356823	0.046084471	0.01897699	238.1636972	0.001459903	0.003455847	0.001227	0.002	0.01575	0.0013345	0.008	0.03675
MADERA	2029	LDA	Aggregated	Aggregated	DSL	942.514573	38883.69978	0.81%	4474.93715	0.012307564	0.296687933	0.028846433	0.001734903	0.047332148	0.020220438	183.5177398	0.000571663	0.028846433	0.0024704	0.002	0.01575	0.0025821	0.008	0.03675
MADERA	2029	LDA	Aggregated	Aggregated	ELEC	3418.4177	148062.0337	3.08%	16734.9405	0	0	0	0	0.044750013	0.017750005	0	0	0	0	0.002	0.01575	0	0.008	0.03675
MADERA	2029	LDT1	Aggregated	Aggregated	GAS	8535.29015	300613.4834	6.25%	38763.8658	0.012387629	0.779063011	0.004905355	0.002782424	0.046333757	0.019206199	281.1718667	0.003006647	0.004885811	0.0014562	0.002	0.01575	0.0015837	0.008	0.03675
MADERA	2029	LDT1	Aggregated	Aggregated	DSL	4.97423488	108.925323	0.00%	18.9006202	0.064231369	0.568639685	0.066868205	0.004021635	0.076928489	0.048536455	425.4079453	0.002983424	0.066868205	0.0307864	0.002	0.01575	0.0321785	0.008	0.03675
MADERA	2029	LDT1	Aggregated	Aggregated	ELEC	163.844103	7369.002604	0.15%	812.057461	0	0	0	0	0.044750013	0.017750005	0	0	0	0	0.002	0.01575	0	0.008	0.03675
MADERA	2029	LDT2	Aggregated	Aggregated	GAS	27026.5152	965242.5966	20.07%	123723.704	0.011084943	0.7563027	0.00473235	0.002880089	0.046178844	0.019063762	291.0412794	0.002834092	0.004713496	0.0013138	0.002	0.01575	0.0014288	0.008	0.03675
MADERA	2029	LDT2	Aggregated	Aggregated	DSL	213.809741	8570.346674	0.18%	1025.04091	0.025035101	0.249893148	0.038793519	0.002333147	0.049464109	0.022260172	246.7999746	0.001162833	0.038793519	0.0045102	0.002	0.01575	0.0047141	0.008	0.03675
MADERA	2029	LDT2	Aggregated	Aggregated	ELEC	649.022374	19846.11895	0.41%	3197.0454	0	0	0	0	0.044750013	0.017750005	0	0	0	0	0.002	0.01575	0	0.008	0.03675
Emission Factor/Total							4810340.605			0.006472329	0.570280937	0.003955833	0.002397510	0.046087167	0.018980588	242.361622298	0.001771438	0.003941283						

	Total VMT	% Fleet
Diesel	47562.9718	1.03%
Gas	4587500.48	98.97%
	4635063.45	

	Emission Factors (g/mile)									
Vehicle Category	ROG	CO	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO2e (g/mi)
Passenger Vehicles (2029)	0.006472329	0.570280937	0.003955833	0.002397510	0.046087167	0.018980588	242.361622298	0.001771438	0.003941283	243.5804107

EMFAC SAFE Adjustment Factors for Light Duty Vehicle Emissions in EMFAC2017				
Year	NOx Exhaust	PM Exhaust	CO Exhaust	TOG Exhuast
2029	1.004	1.0129	1.0138	1.0032

Notes: To be applied to gas light duty vehicles (LDA, LDT1, LDT2, and MDV)
Source: CARB 2019

Conversion Factors	
lbs	grams
1	453.592
GWP	CH4
1	25
GWP	N2O
1	298