Appendix I
Air Quality and GHG Assumptions and Emissions Modeling Results

Table 1
Emissions Calculation Methodology
Rail Bridge & Rail Improvements Project
Stockton, California

Type	Source		Methodology and Formula	Reference
Construction Equipment	Off-Road Equipment[1]		$E_c = \Sigma(EFc * HP * LF * Hr * C)$	OFFROAD2017 and CARB/USEPA Engine Standards
Construction On-Road Mobile Sources[2]	Exhaust and Evaporative Sources	Running Exhaust, Running Loss	$E_R = \Sigma(EF_R * VMT * C)$, where VMT = Trip Length * Trip Number	EMFAC2021
		Idling Exhaust, Starting Exhaust, Diurnal Evaporation, Hotsoak Evaporation, Rest Loss Evaporation	$E_T = \Sigma(EF_T * \text{Trip Number} * C)$	EMFAC2021
	Fugitive Sources	Brakewear/Tirewear	$E_{BWTW} = \Sigma(EF_{BWTW} * VMT * C)$, where VMT = Trip Length * Trip Number	EMFAC2021
		Road Dust	$E_D = \Sigma(EF_D * VMT * C)$, where VMT = Trip Length * Trip Number	CARB Miscellaneous Process Mthodology 7.9
Construction Onsite Truck Activity[3]	Onsite Trucking		Shown in Table 4	--
Rail Sources[4]	On-Site Exhaust - Running		$E_{R\text{-}on}$ = EF * On-Site Running Hours * Number of Locomotives * HP * LF / C	CARB
	On-Site Exhaust - Idling		$E_{I\text{-}on}$ = EF * On-Site Idling Hours * Number of Locomotives * HP * LF / C	CARB

Notes:

1. E_c: off-road equipment exhaust emissions (lb).
   - EF_c: emission factor (g/hp-hr). CalEEMod 2016.3.2 default emission factors used.
   - HP: equipment horsepower. OFFROAD2017.
   - LF: equipment load factor. OFFROAD2017.
   - Hr: equipment hours.
   - C: unit conversion factor.
2. On-road mobile sources include truck and passenger vehicle trips. Emissions associated with mobile sources were calculated using the following formulas. Details about emission factors are included in Table 7.
   - E_R: running exhaust and running losses emissions (lb).
     - EF_R: running-based emission factor (g/mile). From EMFAC2021.
     - VMT: vehicle miles traveled
     - C: unit conversion factor
   - E_T: vehicle trip emissions (lb).
     - EF_T: vehicle emission factor (g/hr-trip). From EMFAC2021.
     - C: unit conversion factor.
   - E_{BWTW}: brakewear and tirewear emissions (lb).
     - EF_{BWTW}: brakewear and tirewear emission factor (g/mile). From EMFAC2021.
     - VMT: vehicle miles traveled
     - C: unit conversion factor
   - E_D: resuspended road dust emissions (lb).
     - EF_D: road dust emission factor, derived in Table 7.
     - C: unit conversion factor.
3. The methodology and formulas for emissions estimated from onsite truck activity are shown in Table 4.
4. Rail sources include on-site running and on-site idling. Emissions associated with rail sources were calculated using the following formulas.
   - $E_{R\text{-}on}$: on-site running exhaust emissions (lb).
     - EF: emission factor (g/gal). From CARB.
     - HP: horsepower. Typical for locomotives in Project area.
     - LF: load factor. From USEPA based on throttle notch position from EPA and typical for Project area movements.
     - C: unit conversion factor (hp-hr/gal). From CARB.

Table 1
Emissions Calculation Methodology
Rail Bridge & Rail Improvements Project
Stockton, California

Notes, continued:

E_{I-on}: on-site idling exhaust emissions (lb).

EF: emission factor (g/gal). From CARB.

HP: horsepower. Typical for locomotives in Project area.

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

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

Abbreviations:

CARB: California Air Resources Board
EF: emission factor
EMFAC: EMission FACtor Model
g: gram
HP: horsepower
lb: pound
LF: load factor
mi: mile
USEPA: United States Environmental Protection Agency
VMT: vehicle miles traveled

References:

CARB. 2017. Line Haul / Class I Documentation. Available at: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road

CARB. 2021. Line Haul / Class I Documentation. Available at: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road

CARB/USEPA. 2017. Table 1: ARB and USEPA Off-Road Compression-Ignition (Diesel) Engine Standards. Available at: https://ww3.arb.ca.gov/msei/ordiesel/ordas_ef_fcf_2017.pdf and https://ww3.arb.ca.gov/msei/ordiesel/ordas_ef_fcf_2017_v7.xlsx.

CARB. 2021. EMission FACtors Model, 2021 (EMFAC2021). Available at: https://arb.ca.gov/emfac/emissions-inventory

CARB. 2018. Miscellaneous Processes Methodologies - Paved Entrained Road Dust. Available online at: https://www.arb.ca.gov/ei/areasrc/fullpdf/full7-9_2018.pdf

California Air Pollution Control Officers Association (CAPCOA). California Emissions Estimator Model (CalEEMod®), Version 2016.3.2. Available online at http://www.caleemod.com/

Table 2
Construction Phasing Schedule
Rail Bridge & Rail Improvements Project
Stockton, California

Construction Project[1]	Construction Phase[1]	Construction Subphase[1]	Start Date	End Date[2]	Number of Work Days	Days per Week	Hours per Day
Rail Bridge Replacement	Main Track 2 Construction	South Temporary Work Platform	7/1/2023	8/11/2023	30	5	10
		MT2 Bridge Foundations	8/5/2023	10/27/2023	60	5	10
		Bridge Piers	7/1/2024	8/14/2024	32	5	10
		Erection of Superstructure on MT2	8/5/2024	8/22/2024	13	5	10
		Removal of South Temporary Work Platform	8/15/2024	9/26/2024	30	5	10
	Main Track 1 Construction	North Temporary Work Platform	7/1/2025	8/12/2025	30	5	10
		Existing Bridge Removal	8/13/2025	9/25/2025	31	5	10
		MT1 Bridge Foundations	8/5/2025	9/18/2025	32	5	10
		Bridge Piers	9/5/2025	10/21/2025	32	5	10
		Erection of Superstructure on MT1	10/22/2025	11/10/2025	13	5	10
		Removal of North Temporary Work Platform	10/10/2025	11/21/2025	30	5	10
Second Lead Tracks	Earthwork	Earthwork, Trackwork, and Underpass Construction	7/1/2023	11/14/2023	97	5	8
		Earthwork and Track Construction - Port	11/15/2023	12/29/2023	32	5	8
	Track Removal & Reconnection	Port Side	1/1/2024	2/20/2024	36	5	8
		SJR Bridge Approaches	2/21/2024	5/22/2024	65	5	8
Port Yard Improvements	McCloy Yard	Earthwork and Trackwork	7/1/2023	4/26/2024	215	5	8
		Track Removal and Track Reconnection	4/29/2024	7/10/2024	52	5	8

Notes:

1. All construction phasing information provided by the Project Sponsor.
2. Per the Project Sponsor, operational improvements are expected to start in 2025.

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Table 3
Construction Equipment
Rail Bridge & Rail Improvements Project
Stockton, California

Construction Project	Construction Phase	Construction Subphase	Equipment[1]	CalEEMod Equipment[2,3,4]	Number[1]	Average Daily Usage over Duration[5,6] (hours/day)	Horsepower[1]
Rail Bridge Replacement	Main Track 2 Construction	South Temporary Work Platform	180-ton Service Crane	Cranes	2	5.2	231
			Pile Driving Hammer	Crushing/Proc. Equipment	1	2.8	85
			Welder	Welders	1	4.3	46
			Plasma Cutter	Concrete/Industrial Saws	1	0.21	81
			Excavator	Excavators	1	0.27	158
			Bulldozer	Rubber Tired Dozers	1	0.083	247
			Roller	Rollers	1	0.083	80
		MT2 Bridge Foundations	180-ton Service Crane	Cranes	1	8.0	231
			Pile Driving Hammer	Crushing/Proc. Equipment	1	2.3	85
			Welder	Welders	1	2.3	46
			300-ton Crane	Cranes	1	5.3	231
			Drill Rig	Bore/Drill Rigs	1	1.3	221
			Excavator	Excavators	1	1.3	158
			Dump Truck	N/A[7]	1	1.3	--
			Concrete Pump Truck	N/A[7]	1	2.1	--
			Concrete Truck	N/A[7]	1	6.0	--
		Bridge Piers	180-ton Service Crane	Cranes	1	6.0	231
			Manlift	Aerial Lifts	2	5.6	63
			Concrete Pump Truck	N/A[7]	1	2.0	--
			Concrete Truck	N/A[7]	1	2.0	--
			Vibration Equipment	Other General Industrial Equipment	1	0.50	88
		Erection of Superstructure on MT2	180-ton Service Crane	Cranes	1	4.3	231
			Welder	Welders	1	0.19	46
			300-ton Crane	Cranes	1	3.7	231
			Manlift	Aerial Lifts	2	6.9	63
		Removal of South Temporary Work Platform	180-ton Service Crane	Cranes	1	8.0	231
			Manlift	Aerial Lifts	1	5.0	63
			Plasma Cutter	Concrete/Industrial Saws	1	0.42	81
			Vibratory Hammer	Other General Industrial Equipment	1	5.0	88
	Main Track 1 Construction	North Temporary Work Platform	180-ton Service Crane	Cranes	2	5.2	231
			Pile Driving Hammer	Crushing/Proc. Equipment	1	2.8	85
			Welder	Welders	1	4.3	46
			Plasma Cutter	Concrete/Industrial Saws	1	0.21	81
			Excavator	Excavators	1	0.27	158
			Bulldozer	Rubber Tired Dozers	1	0.083	247
			Roller	Rollers	1	0.083	80
		Existing Bridge Removal	300-ton Crane	Cranes	1	5.9	231
			Manlift	Aerial Lifts	1	3.1	63
			180-ton Service Crane	Cranes	1	3.1	231
			Plasma Cutter	Concrete/Industrial Saws	1	0.12	81
			Vibratory Hammer	Other General Industrial Equipment	1	2.7	88
			Excavator	Excavators	1	0.65	158
		MT1 Bridge Foundations	180-ton Service Crane	Cranes	1	8.0	231
			Pile Driving Hammer	Crushing/Proc. Equipment	1	2.5	85
			Welder	Welders	1	2.5	46
			Drill Rig	Bore/Drill Rigs	1	1.3	221
			Excavator	Excavators	1	1.3	158
			Dump Truck	N/A[7]	1	1.3	--
			300-ton Crane	Cranes	1	2.0	231
			Concrete Pump Truck	N/A[7]	1	2.0	--
			Concrete Truck	N/A[7]	1	5.6	--
		Bridge Piers	180-ton Service Crane	Cranes	1	6.0	231
			Manlift	Aerial Lifts	2	5.6	63
			Concrete Pump Truck	N/A[7]	1	2.0	--
			Concrete Truck	N/A[7]	1	2.0	--
			Vibration Equipment	Other General Industrial Equipment	1	0.50	88
		Erection of Superstructure on MT1	180-ton Service Crane	Cranes	1	4.3	231
			Welder	Welders	1	0.19	46
			300-ton Crane	Cranes	1	3.7	231
			Manlift	Aerial Lifts	2	6.9	63
		Removal of North Temporary Work Platform	180-ton Service Crane	Cranes	1	8.0	231
			Manlift	Aerial Lifts	1	5.0	63
			Plasma Cutter	Concrete/Industrial Saws	1	0.42	81
			Vibratory Hammer	Other General Industrial Equipment	1	5.0	88

Table 3
Construction Equipment
Rail Bridge & Rail Improvements Project
Stockton, California

Construction Project	Construction Phase	Construction Subphase	Equipment[1]	CalEEMod Equipment[2,3,4]	Number[1]	Average Daily Usage over Duration[5,6] (hours/day)	Horsepower[1]
Second Lead Tracks	Earthwork	Earthwork, Trackwork, and Underpass Construction	Bull Dozer	Rubber Tired Dozers	2	3.8	92
			Trucks	N/A[7]	4	2.0	--
			Excavator	Excavators	2	3.8	120
			Crane 90 Ton All terrain	Cranes	1	2.8	225
			Haul/Dump Truck	N/A[7]	20	2.5	--
			Compactor	Plate Compactors	2	3.8	100
			Lincoln Welding Units	Welders	1	2.8	16
			Generators	Generator Sets	1	8.0	16
			Pile Driving Rig	Bore/Drill Rigs	1	0.43	100
			Skid Steer Loader	Skid Steer Loaders	1	2.0	100
			Frontend Loader w/Back Hoe	Tractors/Loaders/Backhoes	1	2.6	120
			Inflator / Diesel / Electric	Other Construction Equipment	2	4.0	100
			Long Reach Fork Lift	Forklifts	2	4.0	150
		Earthwork and Track Construction - Port	Trucks	N/A[7]	4	2.0	--
			Excavator	Excavators	2	2.3	120
			Haul/Dump Truck	N/A[7]	10	1.5	--
			Lincoln Welding Units	Welders	1	3.8	16
			Generators	Generator Sets	1	8.0	16
			Skid Steer Loader	Skid Steer Loaders	1	2.0	100
			Frontend Loader w/Back Hoe	Tractors/Loaders/Backhoes	1	1.5	120
			Inflator / Diesel / Electric	Other Construction Equipment	2	4.0	100
			Long Reach Fork Lift	Forklifts	1	4.0	150
	Track Removal & Reconnection	Port Side	Trucks	N/A[7]	4	2.0	--
			Lincoln Welding Units	Welders	1	3.7	16
			Generators	Generator Sets	1	8.0	16
			Skid Steer Loader	Skid Steer Loaders	1	2.0	100
			Inflator / Diesel / Electric	Other Construction Equipment	2	4.0	100
			Long Reach Fork Lift	Forklifts	1	4.0	150
		SJR Bridge Approaches	Bull Dozer	Rubber Tired Dozers	2	1.8	92
			Trucks	N/A[7]	4	2.0	--
			Excavator	Excavators	2	6.0	120
			Haul/Dump Truck	N/A[7]	20	1.2	--
			Compactor	Plate Compactors	2	1.8	100
			Lincoln Welding Units	Welders	1	3.6	16
			Generators	Generator Sets	1	8.0	16
			Skid Steer Loader	Skid Steer Loaders	1	2.0	100
			Frontend Loader w/Back Hoe	Tractors/Loaders/Backhoes	1	1.5	120
			Inflator / Diesel / Electric	Other Construction Equipment	2	4.0	100
			Long Reach Fork Lift	Forklifts	2	4.0	150
Port Yard Improvements	McCloy Yard	Earthwork and Trackwork	Bull Dozer	Rubber Tired Dozers	4	1.3	92
			Trucks	N/A[7]	4	2.0	--
			Excavator	Excavators	2	2.1	120
			Haul/Dump Truck	N/A[7]	20	0.56	--
			Compactor	Plate Compactors	4	1.3	100
			Lincoln Welding Units	Welders	4	3.9	16
			Generators	Generator Sets	2	8.0	16
			Skid Steer Loader	Skid Steer Loaders	2	2.0	100
			Frontend Loader w/Back Hoe	Tractors/Loaders/Backhoes	2	0.84	120
			Inflator / Diesel / Electric	Other Construction Equipment	2	4.0	100
			Long Reach Fork Lift	Forklifts	2	4.0	150
		Track Removal and Track Reconnection	Trucks	N/A[7]	4	2.0	--
			Lincoln Welding Units	Welders	4	5.5	16
			Generators	Generator Sets	2	8.0	16
			Skid Steer Loader	Skid Steer Loaders	2	2.0	100
			Inflator / Diesel / Electric	Other Construction Equipment	2	4.0	100
			Long Reach Fork Lift	Forklifts	2	4.0	150

Notes:

1. Equipment lists were provided by the Project Sponsor. Where horsepower was not provided, CalEEMod® defaults were assumed.
2. CalEEMod equipment types are assigned using CalEEMod User's Guide Appendix D.
3. All equipment is conservatively assumed to be diesel-fueled.
4. The engine tier is assumed to be consistent with the fleet average tier from CalEEMod®.
5. Construction activities are assumed to occur during 6AM to 9PM hours, consistent with the performance standards in the San Joaquin County Development Title (Section 9-1025.9).
6. Average daily hours of use throughout subphase duration is estimated using the number of days of operation and hours of daily operation provided by the Project Sponsor.
7. Onsite trucks were not estimated as off-road equipment. These emissions are calculated separately using EMFAC2021 in Table 4.

Abbreviations:

CalEEMod - California Emissions Estimator Model
EMFAC2021 - Emission Inventory Model for Onroad Motor Vehicles in California

References:

CalEEMod v2016.3.2 Available online at: http://www.caleemod.com/
California Air Resources Board. EMFAC2021 v1.0.0. Available online at: https://arb.ca.gov/emfac/
San Joaquin County. 2020. Development Title, Section 9-1025-9. Available online at:
https://library.municode.com/ca/san_joaquin_county/codes/development_title?nodeId=TIT9DETI_DIV10DERE_CH9-1025PEST_9-1025.9NO

Table 4
Project Construction On-Site Truck Emissions
Rail Bridge & Rail Improvements Project
Stockton, California

Construction Project	Construction Phase	Construction Subphase	Year	Onsite Truck Use[1]		Onsite Truck Emissions[2,3]									
				Hours	Total Vehicles	ROG	NOx	CO	SOx	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O	CO_2e
						(lbs)						(MT)			
Rail Bridge Replacement	Main Track 2 Construction	MT2 Bridge Foundations	2023	568	180	0.11	7.2	3.0	0.0083	0.016	0.015	0.40	2.2E-06	6.3E-05	0.41
		Bridge Piers	2024	128	64	0.035	2.2	1.0	0.0029	0.0046	0.0044	0.14	7.5E-07	2.2E-05	0.15
	Main Track 1 Construction	MT1 Bridge Foundations	2025	284	96	0.050	3.6	1.6	0.0044	0.0056	0.0054	0.21	1.1E-06	3.3E-05	0.22
		Bridge Piers	2025	128	64	0.033	2.2	1.0	0.0029	0.0037	0.0036	0.14	7.0E-07	2.2E-05	0.15
Second Lead Tracks	Earthwork	Earthwork, Trackwork, and Underpass Construction	2023	5,576	2,328	1.4	87	38	0.11	0.20	0.19	5.1	2.9E-05	8.1E-04	5.4
		Earthwork and Track Construction - Port	2023	736	448	0.27	16	7.4	0.021	0.039	0.037	1.0	5.6E-06	1.6E-04	1.0
	Track Removal & Reconnection	Port Side	2024	288	144	0.080	5.0	2.4	0.0066	0.010	0.010	0.32	1.7E-06	5.0E-05	0.33
		SJR Bridge Approaches	2024	2,120	1,560	0.86	51	26	0.072	0.11	0.11	3.4	1.8E-05	5.4E-04	3.6
Port Yard Improvements	McCloy Yard	Earthwork and Trackwork	2023	2,529	3,168	1.9	100	52	0.15	0.28	0.26	7.0	4.0E-05	0.0011	7.3
		Earthwork and Trackwork	2024	1,591	1,992	1.1	61	33	0.091	0.14	0.14	4.4	2.3E-05	6.9E-04	4.6
		Track Removal and Track Reconnection	2024	416	208	0.12	7.3	3.4	0.010	0.015	0.014	0.46	2.4E-06	7.2E-05	0.48

Notes:

1. Onsite Truck (MHDT) usage data were based on the following assumptions:
   - Number of MHDT vehicles and schedule are provided in Table 3.
   - Hours are calculated as number of equipment * number of construction days * hours/day as provided in Table 3.
   - Trips are calculated as hours * 1 trip/hour.
   - Miles are calculated as hours * 15 miles per hour.
   - Total Vehicles are calculated as number of equipment * number of construction days as provided in Table 2.
2. Personnel Trucks, Onsite Dump Trucks and Water Trucks are assumed to be similar to medium heavy duty trucks (MHDT) as defined in EMFAC2021. Emission factors are from EMFAC2021 ("Emission Rates" mode) for MHDT diesel vehicles (aggregated model year) in San Joaquin County. RUNEX emission factors are specific to vehicle speed of 15 mph. All other emission factor types are for aggregated speed. Emission factors were multiplied by the appropriate usage parameter based on the units. Emission factors in units of g/trip, g/mi, and g/vehicle/day, were multiplied by trips, miles, and total vehicles, respectively, in order to obtain mass emissions. Emission factors are shown in Table 6.
3. Global warming potentials used in the calculation of CO_2e are 1, 25, and 298 for CO_2, CH_4, and N_2O, respectively.

Abbreviations:

CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalents
EMFAC2021 - Emission Inventory Model for Onroad Motor Vehicles in California
lb - pound
MT - metric ton
N_2O - nitrous oxide
NO_X - nitrous oxide
$PM_{2.5}$ - particulate matter less than 2.5 microns in diameter
PM_{10} - particulate matter less than 10 microns in diameter
ROG - reactive organic gases
SO_X - sulfur oxide

References:

California Air Resources Board. EMFAC2021 v1.0.0. Available online at: https://arb.ca.gov/emfac/

Table 5
Construction Trips
Rail Bridge & Rail Improvements Project
Stockton, California

Construction Project	Construction Phase	Construction Subphase	Days	Haul Amount (CY)	Construction Trip Rates		Trip Lengths[3] (miles/one way trip)	
					Worker[1] (one way trip/day)	Hauling[2] (one way trip/phase)	Worker Trips	Hauling Trips
Rail Bridge Replacement	Main Track 2 Construction	South Temporary Work Platform	30	N/A[4]	20	3,532	17	20
		MT2 Bridge Foundations	60		23		17	20
		Bridge Piers	32		15		17	20
		Erection of Superstructure on MT2	13		13		17	20
		Removal of South Temporary Work Platform	30		10		17	20
	Main Track 1 Construction	North Temporary Work Platform	30		20		17	20
		Existing Bridge Removal	31		15		17	20
		MT1 Bridge Foundations	32		23		17	20
		Bridge Piers	32		15		17	20
		Erection of Superstructure on MT1	13		13		17	20
		Removal of North Temporary Work Platform	30		10		17	20
Second Lead Tracks	Earthwork	Earthwork, Trackwork, and Underpass Construction	97	30,000	100	3,750	17	20
		Earthwork and Track Construction - Port	32	10,800	58	1,350	17	20
	Track Removal & Reconnection	Port Side	36	--	25	--	17	20
		SJR Bridge Approaches	65	10,000	95	1,250	17	20
Port Yard Improvements	McCloy Yard	Earthwork and Trackwork	215	15,220	120	1,903	17	20
		Track Removal and Track Reconnection	52	--	40	--	17	20

Notes:

1. Worker trips are estimated using CalEEMod® methodology, which assumes 1.25 workers per piece of equipment.
2. Hauling trip rates for the Second Lead Tracks and Port Yard Improvements projects are calculated based on the import and export quantities provided by the Project Sponsor. Import and export quantities are converted from cubic yards to corresponding one-way trips per phase by assuming 16 cubic yards per truck. Default truck capacities are consistent with CalEEMod® User's Guide Appendix A.
3. Worker and hauling trip lengths are based on CalEEMod Appendix D defaults for San Joaquin County.
4. The total number of hauling trips for the Rail Bridge Replacement project was provided by the Project Sponsor and assumed to be a constant rate throughout the project construction.

Abbreviations:

CalEEMod - California Emissions Estimator Model

CY - cubic yard

References:

CalEEMod v2016.3.2 Available online at: http://www.caleemod.com/

Table 6
Mobile Emission Factors for Construction Trips
Rail Bridge & Rail Improvements Project
Stockton, California

Fleet[2]	Year	Process	Units	Emission Factors for Mobile Sources[1]								
				ROG	NOx	CO	SOx	PM_{10} [3]		$PM_{2.5}$ [3]		CO_2e
								Exhaust	Fugitive	Exhaust	Fugitive	
Worker	2023	Brake Wear	g/mile	--	--	--	--	--	0.0093	--	0.0033	--
		Diurnal	g/trip	0.50	--	--	--	--	--	--	--	--
		Hotsoak	g/trip	0.13	--	--	--	--	--	--	--	--
		Running Exhaust	g/mile	0.020	0.088	1.2	0.0031	0.0017	--	0.0016	--	319
		Running Loss	g/mile	0.045	--	--	--	--	--	--	--	--
		Starting Exhaust	g/trip	0.48	0.36	4.5	8.0E-04	0.0025	--	0.0023	--	94
		Tire Wear	g/mile	--	--	--	--	--	0.0080	--	0.0020	--
	2024	Brake Wear	g/mile	--	--	--	--	--	0.0094	--	0.0033	--
		Diurnal	g/trip	0.47	--	--	--	--	--	--	--	--
		Hotsoak	g/trip	0.12	--	--	--	--	--	--	--	--
		Running Exhaust	g/mile	0.017	0.078	1.1	0.0031	0.0016	--	0.0015	--	311
		Running Loss	g/mile	0.042	--	--	--	--	--	--	--	--
		Starting Exhaust	g/trip	0.44	0.34	4.2	7.8E-04	0.0024	--	0.0022	--	91
		Tire Wear	g/mile	--	--	--	--	--	0.0080	--	0.0020	--
	2025	Brake Wear	g/mile	--	--	--	--	--	0.0094	--	0.0033	--
		Diurnal	g/trip	0.45	--	--	--	--	--	--	--	--
		Hotsoak	g/trip	0.12	--	--	--	--	--	--	--	--
		Running Exhaust	g/mile	0.015	0.068	1.0	0.0030	0.0015	--	0.0014	--	304
		Running Loss	g/mile	0.040	--	--	--	--	--	--	--	--
		Starting Exhaust	g/trip	0.41	0.32	3.9	7.6E-04	0.0023	--	0.0021	--	89
		Tire Wear	g/mile	--	--	--	--	--	0.0080	--	0.0020	--

Table 6
Mobile Emission Factors for Construction Trips
Rail Bridge & Rail Improvements Project
Stockton, California

Fleet[2]	Year	Process	Units	Emission Factors for Mobile Sources[1]								
				ROG	NOx	CO	SOx	PM_{10} [3]		$PM_{2.5}$ [3]		CO_2e
								Exhaust	Fugitive	Exhaust	Fugitive	
Hauling	2023	Brake Wear	g/mile	--	--	--	--	--	0.077	--	0.027	--
		Diurnal	g/trip	2.1E-04	--	--	--	--	--	--	--	--
		Hotsoak	g/trip	5.7E-05	--	--	--	--	--	--	--	--
		Idling Exhaust	g/trip	0.38	4.6	5.7	0.0086	0.0022	--	0.0021	--	961
		Running Exhaust	g/mile	0.016	1.8	0.23	0.015	0.029	--	0.027	--	1,673
		Running Loss	g/mile	6.0E-05	--	--	--	--	--	--	--	--
		Starting Exhaust	g/trip	1.5E-07	2.8	0.0010	1.8E-07	9.7E-07	--	8.9E-07	--	0.022
		Tire Wear	g/mile	--	--	--	--	--	0.035	--	0.0089	--
	2024	Brake Wear	g/mile	--	--	--	--	--	0.077	--	0.027	--
		Diurnal	g/trip	1.3E-04	--	--	--	--	--	--	--	--
		Hotsoak	g/trip	3.5E-05	--	--	--	--	--	--	--	--
		Idling Exhaust	g/trip	0.38	4.6	5.7	0.0084	0.0021	--	0.0020	--	938
		Running Exhaust	g/mile	0.016	1.7	0.22	0.015	0.028	--	0.027	--	1,646
		Running Loss	g/mile	3.7E-05	--	--	--	--	--	--	--	--
		Starting Exhaust	g/trip	1.2E-07	2.8	9.0E-04	1.2E-07	5.6E-07	--	5.1E-07	--	0.014
		Tire Wear	g/mile	--	--	--	--	--	0.035	--	0.0089	--
	2025	Brake Wear	g/mile	--	--	--	--	--	0.077	--	0.027	--
		Diurnal	g/trip	1.0E-04	--	--	--	--	--	--	--	--
		Hotsoak	g/trip	2.8E-05	--	--	--	--	--	--	--	--
		Idling Exhaust	g/trip	0.38	4.5	5.6	0.0082	0.0020	--	0.0019	--	915
		Running Exhaust	g/mile	0.015	1.6	0.21	0.015	0.028	--	0.026	--	1,617
		Running Loss	g/mile	3.1E-05	--	--	--	--	--	--	--	--
		Starting Exhaust	g/trip	1.2E-07	2.8	8.4E-04	9.8E-08	4.6E-07	--	4.2E-07	--	0.011
		Tire Wear	g/mile	--	--	--	--	--	0.035	--	0.0089	--

Table 6
Mobile Emission Factors for Construction Trips
Rail Bridge & Rail Improvements Project
Stockton, California

Fleet[2]	Year	Process	Units	Emission Factors for Mobile Sources[1]								
				ROG	NOx	CO	SOx	PM_{10} [3]		$PM_{2.5}$ [3]		CO_2e
								Exhaust	Fugitive	Exhaust	Fugitive	
Onsite Trucks[4]	2023	Brake Wear	g/mile	--	--	--	--	--	0.061	--	0.022	--
		Idling Exhaust	g/vehicle/day	0.27	13	7.5	0.02	0.039	--	0.038	--	2,305
		Running Exhaust	g/mile	0.11	2.3	0.30	0.0150	0.035	--	0.033	--	1,647
		Starting Exhaust	g/trip	--	1.6	--	--	--	--	--	--	--
		Tire Wear	g/mile	--	--	--	--	--	0.012	--	0.0030	--
	2024	Brake Wear	g/mile	--	--	--	--	--	0.061	--	0.022	--
		Idling Exhaust	g/vehicle/day	0.25	13	7.4	0.02	0.033	--	0.031	--	2,290
		Running Exhaust	g/mile	0.093	2.2	0.27	0.0149	0.029	--	0.028	--	1,637
		Starting Exhaust	g/trip	--	1.6	--	--	--	--	--	--	--
		Tire Wear	g/mile	--	--	--	--	--	0.012	--	0.0030	--
	2025	Brake Wear	g/mile	--	--	--	--	--	0.061	--	0.022	--
		Idling Exhaust	g/vehicle/day	0.24	12	7.4	0.02	0.027	--	0.025	--	2,273
		Running Exhaust	g/mile	0.079	2.1	0.25	0.0148	0.024	--	0.023	--	1,626
		Starting Exhaust	g/trip	--	1.6	--	--	--	--	--	--	--
		Tire Wear	g/mile	--	--	--	--	--	0.012	--	0.0030	--

Notes:

1. Emission factors for construction trips were estimated using EMFAC2021 for San Joaquin county.
2. Construction fleet definitions are consistent with CalEEMod®: the worker fleet assumes 50% passenger cars (LDA), 25% light-duty trucks smaller than 3,750 lbs (LDT1), and 25% light duty trucks between 3,751 lbs and 5,750 lbs (LDT2); the hauling fleet assumes 100% heavy-heavy-duty trucks (HHDT).
3. Consistent with CalEEMod®, emissions of particulate matter are quantified separately for exhaust sources (running, idling, and starting exhaust) and fugitive sources (brake and tire wear).
4. Onsite trucks are assumed to be diesel-fueled and 100% Medium Heavy-Duty Trucks (MHDT).

Abbreviations:

CAP - criteria air pollutant
CalEEMod® - California Emissions Estimate Model
CH_4 - methane
CO - carbon monoxide
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
EMFAC2021 - Emission Inventory Model for Onroad Motor Vehicles in California
GHG - greenhouse gas
lb - pound
MT- metric tons
N_2O - nitrous oxide
NO_X - nitrous oxide
$PM_{2.5}$ - particulate matter less than 2.5 microns in diameter
PM_{10} - particulate matter less than 10 microns in diameter
ROG - reactive organic gases
SO_X - sulfur oxide

Table 7
Fugitive Road Dust Emission Factors
Rail Bridge & Rail Improvements Project
Stockton, California

Silt Loading Factor Derivation[1]

Entrained Roadway Dust Constants for San Joaquin County		
Roadway Category	**Silt Loading (g/m^2)**	**Travel Fraction**
Freeway	0.015	45.6%
Major	0.032	35.1%
Collector	0.032	11.7%
Local	0.32	7.8%
Weighted Silt Loading Factor	0.047	100%

Road Dust Equation[2]

E [lb/VMT] = k*(sL)^0.91 * (W)^1.02 * (1-P/4N)

Parameter[3]	**Value**
E = annual average emission factor in the same units as k	[calculated]
k = particle size multiplier for particle size range and units of interest	
PM_{10} (lb/VMT)	0.0022
$PM_{2.5}$ (lb/VMT)	3.3E-04
sL = road surface silt loading (grams per square meter) (g/m^2)	0.047
W = average weight (tons) of all the vehicles traveling the road	2.4
P = number of "wet" days with at least 0.01 in of precipitation during averaging period[4]	51
N number of days in the averaging period	365

Scenario	**Fugitive PM_{10}**	**Fugitive $PM_{2.5}$**	**Units**
Emission Factor	3.20E-04	4.79E-05	lb/VMT

Notes:

1. Travel fraction by roadway category and silt loading are from the ARB's Entrained Road Travel Emission Inventory Source Methodology, Tables 6 and 7, respectively.
2. The road dust equation for paved roads is from the California Air Resources Board's (ARB) 2018 Miscellaneous Process Methodology 7.9 for Entrained Road Travel, Paved Road Dust.
3. Silt loading emission factor calculated above using roadway travel fractions. Other parameters are from ARB 2016. $PM_{2.5}$ is assumed to be 15% of PM_{10} based on paved road dust sampling in California (ARB Speciation Profile #471), which is a more representative fraction than provided in the older AP-42 fugitive dust methodology as discussed in ARB 2018 (page 10).
4. The number of "wet" days for San Joaquin County is from CalEEMod® Appendix D Table 1.1 (51 days).

Abbreviations:

ARB - Air Resources Board
CalEEMod® - California Emissions Estimator Model
g - grams
lb - pounds
m - meter
PM - particulate matter
VMT - vehicle miles traveled

References:

California ARB. 2018. Miscellaneous Processes Methodologies - Paved Entrained Road Dust. Available online at: https://www.arb.ca.gov/ei/areasrc/fullpdf/full7-9_2018.pdf

USEPA. 1996. AP 42. Compilation of Air Pollutant Emission Factors, Volume 1. Fifth Edition. Chapter 13.2.1, Paved Roads. Available online at: http://www3.epa.gov/ttn/chief/ap42/ch13/final/c13s0201.pdf. Accessed January 2016.

Table 8
Summary of Construction Emissions
Rail Bridge & Rail Improvements Project
Stockton, California

Construction Project	Construction Phase	Construction Subphase	Year	Construction Emissions[1]								
				CAPs								GHGs[2]
				ROG	NOx	CO	SOx	PM_{10}		$PM_{2.5}$		CO_2e
								Exhaust	Fugitive	Exhaust	Fugitive	
				lb/year								MT/year
Rail Bridge Replacement	Main Track 2 Construction	South Temporary Work Platform	2023	27	242	192	0.64	9.5	7.2	9.0	1.4	30
		MT2 Bridge Foundations	2023	61	611	437	1.8	23	17	21	3.0	68
		Bridge Piers	2024	13	155	129	0.57	4.6	7.0	4.3	1.3	24
		Erection of Superstructure on MT2	2024	6.1	71	59	0.22	2.3	2.5	2.1	0.51	11
		Removal of South Temporary Work Platform	2024	16	176	137	0.51	6.6	5.4	6.1	1.1	24
	Main Track 1 Construction	North Temporary Work Platform	2025	24	209	182	0.63	7.8	7.2	7.3	1.4	29
		Existing Bridge Removal	2025	16	165	132	0.53	6.1	6.5	5.6	1.3	25
		MT1 Bridge Foundations	2025	25	237	200	0.85	8.2	8.9	7.7	1.6	32
		Bridge Piers	2025	12	144	126	0.56	4.3	7.0	4.0	1.3	23
		Erection of Superstructure on MT1	2025	5.8	66	58	0.22	2.1	2.5	2.0	0.51	10
		Removal of North Temporary Work Platform	2025	15	162	134	0.51	5.9	5.4	5.5	1.1	24
Second Lead Tracks	Earthwork	Earthwork, Trackwork, and Underpass Construction	2023	253	2,439	2,123	9.0	90	114	84	19	280
		Earthwork and Track Construction - Port	2023	37	409	361	1.9	14	28	13	5.3	71
	Track Removal & Reconnection	Port Side	2024	25	196	218	0.52	10	6.1	9.0	0.90	16
		SJR Bridge Approaches	2024	121	1,066	1,192	3.9	41	56	38	9.4	129
Port Yard Improvements	McCloy Yard	Earthwork and Trackwork	2023	306	2,216	2,569	6.8	94	115	89	19	239
			2024	183	1,322	1,567	4.3	54	72	51	12	149
		Track Removal and Track Reconnection	2024	62	444	487	1.1	21	14	19	2.1	39

Summary of Emissions by Year							
Year	ROG	NOx	CO	SOx	PM_{10}	$PM_{2.5}$	CO_2e
	ton/year						MT/year
2023	0.34	3.0	2.8	0.010	0.26	0.13	689
2024	0.21	1.7	1.9	0.0056	0.15	0.079	392
2025	0.049	0.49	0.42	0.0017	0.036	0.020	144
Threshold[3]	10	10	100	27	15	15	--

Notes:

1. Emissions were estimated using on-road emission factors from EMFAC2021 and off-road construction equipment emission factors from OFFROAD. On-road trips and off-road construction equipment use were provided by the Project Sponsor. Off-road equipment assume a fleet-average tier. Emission sources also include on-road fugitive dust.
2. Carbon dioxide equivalent emissions were determined using IPCC 5th Assessment Report Global Warming Potentials for CH_4 and N_2O.
3. Annual emissions are compared to the SJVAPCD Thresholds of Significance.

Abbreviations:

CAP - criteria air pollutant
CalEEMod® - California Emissions Estimate Model
CH_4 - methane
CO - carbon monoxide
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
GHG - greenhouse gas
IPCC - Intergovernmental Panel on Climate Change
lb - pound
MT- metric tons
N_2O - nitrous oxide
NO_X - oxides of nitrogen
$PM_{2.5}$ - particulate matter less than 2.5 microns in diameter
PM_{10} - particulate matter less than 10 microns in diameter
ROG - reactive organic gases
SO_X - sulfur oxide

References:

Intergovernmental Panel on Climate Change. 2014. IPCC 5th Assessment Report (AR5). Available online at: https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf

Table 9
Operational Inputs
Rail Bridge & Rail Improvements Project
Stockton, California

Rail Activity Detail

Destination of Train[1]	Number of Trains[1]		Locomotive Type[2]	Trips[2]		Distance Travelled[1,3]		Running Time[4]	Idle Time[5]		
									General	700-Yard Block	Lead Block
	Trains/week	%		trips/train	trips/week	feet/trip	feet/week	Hours			
Future Without Project											
East Complex	23	82%	Class I	2	46	10,728	493,480	69	24	28	62
			Class III	1.9	43	16,770	721,120	101	23	26	58
West Complex	5	18%	Class I	2	10	35,825	358,250	50	5.3	6.2	13
			Class III	1	5	15,300	76,500	11	2.6	3.1	6.7
Total[1]	**28**	**100%**	**All**	**--**	**104**	**--**	**1,649,350**	**231**	**55**	**64**	**140**
Future With Project											
East Complex	25	74%	Class I	2	50	10,728	536,391	71	27	--	31
			Class III	1.9	47	16,770	783,826	104	25	--	29
West Complex	9	26%	Class I	2	18	35,825	644,850	86	10	--	11
			Class III	1	9	15,300	137,700	18	4.9	--	5.5
Total[1]	**34**	**100%**	**All**	**--**	**124**	**--**	**2,102,767**	**280**	**67**	**--**	**76**

Rail Activity Summary

Locomotive Type	Future Without Project		Future With Project	
	Running	Idling	Running	Idling
	Hours/Week			
Class I	119	139	157	79
Class III	112	120	123	64
Total	231	259	280	143

Notes:

1. Weekly trains to east/west complexes, total engine use times, and travel distance for "Future Without Project" and "Future With Project" scenarios were provided by JMA. Hours were allocated to the destination location and locomotive type by number of trips and distance traveled within the Port of Stockton. The "Future With Project" scenario assumes there will be an additional 6 trains, with 2 going to the East Complex and 4 going to the West Complex.
2. There are two types of locomotives in the Port of Stockton: Class I locomotives and Class III locomotives. Class I locomotives are assumed to have 2 engines while Class III locomotives are assumed to have 1 engine. Class I locomotives are assumed to make two trips while in the Port area, 1 inbound and 1 outbound trip. Class III locomotives are assumed to take 1-2 trips within the Port area to sort and deliver rail cars to customers. The average trips/train is assumed to stay constant between the two scenarios. Trips/week are calculated by trains/week * trips/train.
3. The average travel distance per trip is assumed to stay constant between the two scenarios. The total travel distance is the trains/week * average trips/train * average trip distance (feet/trip).
4. The total running time was provided by JMA. Total running time was split between locations and locomotive type by percent of total distance travelled.
5. The total idling time by category (general, 700-yard block, and lead block) was provided by JMA. The total idling time was split between locations and locomotive type by the percentage of overall trips.

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Table 10
Percent Time Running and Idling
Rail Bridge & Rail Improvements Project
Stockton, California

Class I Percent Time Running/Idling

Scenario	Destination of Train	Running	Idling		
			General	700-Yard Block	Lead Block
Future Without Project	East Complex	58%	17%	20%	44%
	West Complex	42%	3.8%	4.4%	10%
Future With Project	East Complex	45%	34%	0%	39%
	West Complex	55%	12%	0%	14%

Class III Percent Time Running/Idling

Scenario	Destination of Train	Running	Idling		
			General	700-Yard Block	Lead Block
Future Without Project	East Complex	90%	19%	22%	48%
	West Complex	10%	2.2%	2.6%	5.6%
Future With Project	East Complex	85%	39%	0%	45%
	West Complex	15%	7.6%	0%	8.6%

Notes:
1. The table above shows the percentage of overall running and idling time for each location and locomotive type, based on the operational activity in Table 9. This is used to spatially allocate emissions in the health risk assessment.

Table 11
Class I (Line Haul) Emission Factors
Rail Bridge & Rail Improvements Project
Stockton, California

Line Haul Emission Factors[1]

Tier	U.S. EPA Emission Factors (g/gal)					
	PM_{10}	$PM_{2.5}$	HC	ROG	NOx	CO
Pre-Tier	6.7	6.1	10	12	270	27
Tier 0	6.7	6.1	10	12	179	27
Tier 0+	4.2	3.8	6.2	7.6	150	27
Tier 1	6.7	6.1	9.8	12	139	27
Tier 1+	4.2	3.8	6.0	7.3	139	27
Tier 2	3.7	3.4	5.4	6.5	103	27
Tier 2+	1.7	1.5	2.7	3.3	103	27
Tier 3	1.7	1.5	2.7	3.3	103	27
Tier 4	0.31	0.29	0.83	1.0	21	27

Conversion Factors

Tier	Conversion Factor
	bhp-hr/gal fuel
Pre-Tier	15.2
Tier 0	15.2
Tier 0+	18.2
Tier 1	18.2
Tier 1+	18.2
Tier 2	20.8
Tier 2+	20.8
Tier 3	20.8
Tier 4	20.8

Line Haul Locomotives Tier Distribution[2]

Year	Pre-Tier	Tier 0	Tier 0+	Tier 1	Tier 1+	Tier 2	Tier 2+	Tier 3	Tier 4
2025	0.032%	2.0%	2.2%	0.093%	30%	2.5%	35%	21%	7.6%

Fleet Average Line Haul Project Emission Factors[3]

Year	Emission Factors (g/gal)				
	PM_{10}	$PM_{2.5}$	ROG	NOx	CO
2025	2.5	2.3	4.7	110	27

Fleet Average Conversion Factor[4]

Conversion Factor
bhp-hr/gal fuel
19.9

Rail Bridge Manifest Train Emission Factors[5,6]

Year	Emissions Factors (lb/gal)						
	ROG	NOx	PM_{10}	$PM_{2.5}$	CO	SOx	CO_2e
2025	0.0103	0.2428	0.0055	0.0051	0.0587	0.0002	23

EPA Default Power Distribution for Line-Haul Locomotives[7]

Throttle Position	Rated Horsepower (bhp)	Percent Run Time in Notch (%)	Power in Notch (bhp)	Load Factor
Idle	4000	--	22	0.0056
Dynamic Brake	4000	--	110	0.027
1	4000	45%	167	0.042
2	4000	40%	412	0.10
3	4000	8.4%	894	0.22
4	4000	2.4%	1,340	0.33
5	4000	1.0%	1,947	0.49
6	4000	0.0%	2,613	0.65
7	4000	0.0%	3,408	0.85
8	4000	0.2%	4,006	1.0

Idling LF[8]	**0.0056**
Running LF[8]	**0.10**

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Table 11
Class I (Line Haul) Emission Factors
Rail Bridge & Rail Improvements Project
Stockton, California

Notes:

1. Line haul emission factors are based on the CARB 2017 Line Haul / Class I Documentation, Table 4-8. The $PM_{2.5}$ emission factor is 92% of PM_{10} for locomotive operations, and the emission factor for PM and PM_{10} are equivalent. The emission factor for reactive organic gases is estimated as 1.21 times the emission factor for hydrocarbons (HC).
2. Line haul locomotives tier distribution is from the CARB 2021 Emissions Inventory Aggregated at County/Air Basin/State.
3. Fleet average emission factors were calculated by applying CARB Tier distributions to the line haul emission factors for each operational year.
4. A fleet average conversion factor was determined using CARB tier distributions and bhp-hr/gal fuel conversion factors based on CARB 2017 Short Line / Class III Documentation, Table 5.2.
5. The SO_2 emission factor was calculated based on the methodology described in the CARB 2017 Line Haul / Class I Documentation, Equation 4.5. See Table 13 for this calculation.
6. The CO_2e emission factor was calculated using individual GHG emission factors for diesel fuel provided by the Climate Registry. See Table 13 for this calculation.
7. The percent time in notch for running throttle positions was calculated based on Table 3-4 in the Stockton Railyard TAC Emissions Inventory, which shows hourly activity by throttle position for BNSF trains at Stockton. The power in notch was calculated using data from Appendix B of US EPA's Locomotive Emission Standards Regulatory Support Document. Data for locomotives with a rated horsepower of 4000 was not available, so power in notch was derived by interpolating between data provided for 3800 and 4100 HP engines.
8. The load factor for Class I locomotives in "idling" mode was assumed to be equal to the load factor in the Idle throttle notch postion. The load factor for Class I locomotives in "running" mode was calculated by taking the weighted average of percent time in notch and load factors for throttle positions 1 through 8.

Abbreviations:

bhp - brake horsepower
CARB - California Air Resources Board
CO - carbon monoxide
g - gram
gal - gallon
GHG - greenhouse gas
HC - hydrocarbons
HP - horsepower
hr - hour
lb - pound
MW - molecular weight
NOx - nitrogen oxides
PM - particulate matter
ppm - parts per million
ROG - reactive organic gases
SOx - sulfur oxides
TAC - toxic air contaminant
US EPA - United States Environmental Protection Agency

References:

CARB. 2017 Line Haul / Class I Documentation. Last accessed on 4/5/2021 at: https://www.arb.ca.gov/msei/ordiesel.htm.

CARB. 2017 Short Line/ Class III Documentation. Last accessed on 03/31/2021 at: https://www.arb.ca.gov/msei/ordiesel.htm.

CARB. 2021 Emissions Inventory Aggregated at County/Air Basin/State. Last accessed on 4/19/2021 at: https://www.arb.ca.gov/msei/ordiesel.htm.

EPA, 1998. Locomotive Emissions Standards: Regulatory Support Document. Available online at: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100F9QT.PDF?Dockey=P100F9QT.PDF

The Climate Registry, April 2020. Available online at: https://www.theclimateregistry.org/wp-content/uploads/2020/04/The-Climate-Registry-2020-Default-Emission-Factor-Document.pdf

Stockton Railyard TAC Emissions Inventory, December 2006. Available online at: https://ww2.arb.ca.gov/sites/default/files/classic/railyard/hra/env_stock_ei_122006.pdf?_ga=2.201048109.260582392.1618188240-1022049123.1542235619

Table 12
Summary of Class I Rail Emissions
Rail Bridge & Rail Improvements Project
Stockton, California

Inputs

Parameter	Class I Locomotive Engine Mode		Units
	Running	Idling	
# Engines[1]	2		--
Engine HP[2]	4,000		bhp
Load Factor[3]	10%	0.56%	--
Fuel Usage[4]	19	1.1	gal/hr
Future Without Project Operating Schedule	119	139	Hours/Week
	52		Weeks/Year
Future With Project Operating Schedule	157	79	Hours/Week
	52		Weeks/Year

Line Haul Emission Factors[5]

Engine Type	ROG	NOx	PM_{10}	$PM_{2.5}$	CO	SOx	CO_2e
	lb/gal						
2025 Fleet Average	0.010	0.24	0.0055	0.0051	0.059	2.1E-04	23

Line Haul Emission Rates[6]

Scenario	Engine Mode	ROG	NOx	PM_{10}	$PM_{2.5}$	CO	SOx	CO_2e
		ton/year						MT/year
Future Without Project	Running	0.62	15	0.33	0.31	3.5	0.013	1,245
	Idling	0.042	1.0	0.023	0.021	0.24	8.7E-04	84
	Total	0.66	16	0.36	0.33	3.8	0.014	1,329
Future With Project	Running	0.82	19	0.44	0.41	4.7	0.017	1,641
	Idling	0.024	0.56	0.013	0.012	0.13	4.9E-04	47
	Total	0.84	20	0.45	0.42	4.8	0.017	1,689
Net Change	Running	0.20	4.7	0.11	0.10	1.1	0.0041	397
	Idling	-0.018	-0.43	-0.010	-0.0091	-0.10	-3.8E-04	-37
	Total	0.18	4.2	0.10	0.089	1.0	0.0037	360

Notes:
1. The number of locomotives per train was provided by the Project sponsor.
2. Engine horsepower is based on the average horsepower for on-site line-haul activity specified in the Port of Los Angeles DSEIR, which represents a mix of UPPR and BNSF locomotives.
3. Load factor is derived from US EPA's Locomotive Emission Standards Regulatory Support Document as shown in Table 11.
4. Fuel usage is calculated using the rated brake horsepower, load factor, and tier-specific conversion factor between bhp-hr and gallons of fuel. See Table 11 for conversion factor.
5. Emission factor derivations are shown in Table 11.
6. Line-haul locomotive emission rates calculated using operating schedule, fuel consumption rate, and emission factors.

Abbreviations:

CO - carbon monoxide
CO2e - carbon dioxide equivalent
bhp - brake horse power
gal - gallon
hr - hour
lb - pound
MT - metric ton
NOx - nitrogen oxides
PM - particulate matter
ROG - reactive organic gases
SOx - sulfur oxides
UPPR - Union Pacific Railroad
BNSF- Burlington Northern Santa Fe Railway

References:

Port of Los Angeles. 2018 Recirculated Draft Supplemental EIR. Last accessed on 04/15/2021 at: https://kentico.portoflosangeles.org/getmedia/c94cd0dd-7b69-47b8-a1a1-5dc5795a5fcc/Appendix_B1_Air_Emissions_CS_DRSEIR

Table 13
Class III (Switcher) Emission Factor Derivation
Rail Bridge & Rail Improvements Project
Stockton, California

Diesel SO_2 Emission Factor Derivation[1]

Parameter	Value	Units
Diesel Density	7.1	lb/gal
Fraction of fuel sulfur converted to SO_2	100	%
Sulfur (S) Content	15	ppm
	1.1E-04	lb/gal
Sulfur Molecular Weight	32	lb/lbmol
SO_2 Molecular Weight	64	lb/lbmol
SO_2 Content	2.1E-04	lb/gal

Greenhouse Gas Emission Factors[2]

Pollutant	Value	Units
CO_2	23	lb/gal
CH_4	0.0018	lb/gal
N_2O	5.6E-04	lb/gal

Switching Emission Factors[3]

Tier	PM_{10}	HC	NOx	CO
	g/bhp-hr			
Pre-Tier	0.32	0.48	13	1.28
Tier 0	0.32	0.48	8.6	1.28
Tier 0+	0.2	0.3	7.2	1.28
Tier 1	0.32	0.47	6.7	1.28
Tier 1+	0.2	0.29	6.7	1.28
Tier 2	0.18	0.26	5.0	1.28
Tier 2+	0.08	0.13	5.0	1.28
Tier 3	0.08	0.13	5.0	1.28
Tier 4	0.02	0.04	1.0	1.28

Conversion Factors

Tier	Conversion Factor
	bhp-hr/gal fuel
Pre-Tier	15.2
Tier 0	15.2
Tier 0+	18.2
Tier 1	18.2
Tier 1+	18.2
Tier 2	20.8
Tier 2+	20.8
Tier 3	20.8
Tier 4	20.8

Switching Emission Factors

Tier	PM_{10}	HC	NOx	CO
	g/gal			
Pre-Tier	4.9	7.3	198	19
Tier 0	4.9	7.3	131	19
Tier 0+	3.6	5.5	131	23
Tier 1	5.8	8.6	122	23
Tier 1+	3.6	5.3	122	23
Tier 2	3.7	5.4	103	27
Tier 2+	1.7	2.7	103	27
Tier 3	1.7	2.7	103	27
Tier 4	0.42	0.83	21	27

EPA Default Power Distribution for Switcher Locomotives[4]

Throttle Position	Rated Horsepower (bhp)	Percent Time in Notch (%)	Power in Notch (bhp)	Load Factor
Idle	1500	59.8%	15	0.010
Dynamic Brake	1500	0.0%	70	0.047
1	1500	12.4%	72	0.048
2	1500	12.3%	233	0.16
3	1500	5.8%	440	0.29
4	1500	3.6%	569	0.38
5	1500	3.6%	885	0.59
6	1500	1.5%	1109	0.74
7	1500	0.2%	1372	0.91
8	1500	0.8%	1586	1.1

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Table 13
Class III (Switcher) Emission Factor Derivation
Rail Bridge & Rail Improvements Project
Stockton, California

Calculation of Weighted Average Load Factor for Switcher Locomotives in Running Mode

Throttle Position	Percent Time in Running Notch (%)	Load Factor
1	31%	0.048
2	31%	0.16
3	14%	0.29
4	9%	0.38
5	9%	0.59
6	4%	0.74
7	0%	0.91
8	2%	1.1
Running Mode Weighted Average:		0.24

Notes:

1. The SO_2 emission factor was calculated based on the methodology described in the CARB 2017 Line Haul / Class I Documentation, Equation 4.5
2. Greenhouse gas emissions factors are based on default values provided by The Climate Registry.
3. Line haul emission factors are based on the CARB 2017 Short Line / Class III Documentation, Table 5-1 and Table 5-2. The $PM_{2.5}$ emission factor is 92% of PM_{10} for locomotive operations, and the emission factors for PM and PM_{10} are equivalent. The emission factor for reactive organic gases is estimated as 1.21 times the emission factor for hydrocarbons (HC).
4. Percent time in notch and power in notch values based on US EPA's Locomotive Emission Standards Regulatory Support Document, Table 4-3 and Appendix B.

Abbreviations:

bhp - brake horsepower
CARB - California Air Resources Board
CH_4 - methane
CO - carbon monoxide
CO_2 - carbon dioxide
g - gram
gal - gallon
HC - hydrocarbons
hr - hour
lb - pound
lbmol - pound-mole
MT - metric ton
N2O - nitrous oxide
NOx - nitrogen oxides
PM - particulate matter
ROG - reactive organic gases
SO_2 - sulfur dioxide
US EPA - United States Environmental Protection Agency

References:

The Climate Registry, April 2020. Available online at: https://www.theclimateregistry.org/wp-content/uploads/2020/04/The-Climate-Registry-2020-Default-Emission-Factor-Document.pdf

CARB. 2017 Short Line/ Class III Documentation. Last accessed on 03/31/2021 at: https://www.arb.ca.gov/msei/ordiesel.htm.

EPA, 1998. Locomotive Emissions Standards: Regulatory Support Document. Available online at: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100F9QT.PDF?Dockey=P100F9QT.PDF

Table 14
Class III (Switcher) Emission Factors
Rail Bridge & Rail Improvements Project
Stockton, California

Switching Emission Factors[1,2]

Engine Model	Engine Tier	# at Port	ROG	NOx	PM_{10}	$PM_{2.5}$	CO	SOx	CO_2e
			lb/gal						
SW1500	Tier 0	4	0.019	0.29	0.011	0.010	0.043	2.1E-04	23
Brookville Genset	Tier 4	3	0.0022	0.046	9.2E-04	8.4E-04	0.059	2.1E-04	23
Weighted Average	--	All	0.012	0.18	0.0065	0.0060	0.050	2.1E-04	23

Port Switcher Engine Inputs

Parameter	Switch Locomotive Engine Mode		Switch Locomotive Engine Mode		Units
	Running	Idling	Running	Idling	
Engine Model	SW 1500		Brookville Genset		--
Engine Tier[3]	Tier 0		Tier 4		--
# Engines	4		3		--
Engine HP	1,500		1,200		bhp
Load Factor[4]	24%	1.0%	24%	1.0%	--
Fuel Usage[5]	24	1.0	14	0.6	gal/hr

Notes:

1. The CO_2e emission factor was calculated using global warming potentials and individual GHG emission factors for diesel fuel provided by the Climate Registry.
2. Emission factor derivations are shown in Table 13.
3. Engine tier based on Lehigh Southwest Stockton Terminal Project DEIR.
4. Load factor is derived from US EPA's Locomotive Emission Standards Regulatory Support Document as shown in Table 13.
5. Fuel usage is calculated using the rated brake horsepower, load factor, and tier-specific conversion factor between bhp-hr and gallons of fuel. See Table 13 for conversion factor.

Abbreviations:

CO - carbon monoxide
CO2e - carbon dioxide equivalent
DEIR - Draft Environmental Impact Report
gal - gallon
HP - horsepower
hr - hour
lb - pound
NOx - nitrogen oxides
PM - particulate matter
ROG - reactive organic gases
SO_2 - sulfur dioxide

References:

Lehigh Southwest Stockton Terminal Project DEIR, available online at: https://www.portofstockton.com/wp-content/uploads/2020/05/LehighSWStocktonTerminal_2019100510_DEIR_small.pdf

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Table 15
Summary of Class III Rail Emissions
Rail Bridge & Rail Improvements Project
Stockton, California

Inputs

Parameter	Average Port Switch Locomotive Engine Mode		Units
	Running	Idling	
# Engines/Train	1		--
Average Fuel Usage[1]	20	0.81	gal/hr
Future Without Project Operating Schedule	111.7	119.54	Hours/Week
	52		Weeks/Year
Future With Project Operating Schedule	122.7	64.42	Hours/Week
	52		Weeks/Year

Switching Emissions[2]

Scenario	Engine Mode	ROG	NOx	PM_{10}	$PM_{2.5}$	CO	SOx	CO_2e
		ton/year						MT/year
Future Without Project	Running	0.70	11	0.38	0.35	2.9	0.012	1,188
	Idling	0.030	0.46	0.016	0.015	0.13	5.4E-04	52
	Total	0.73	11	0.39	0.36	3.0	0.013	1,240
Future With Project	Running	0.76	12	0.41	0.38	3.1	0.013	1,305
	Idling	0.016	0.25	0.0089	0.0081	0.067	2.9E-04	28
	Total	0.78	12	0.42	0.39	3.2	0.014	1,333
Net Change	Running	0.069	1.0	0.037	0.034	0.28	0.0012	117
	Idling	-0.014	-0.21	-0.0076	-0.0070	-0.058	-2.5E-04	-24
	Total	0.054	0.83	0.029	0.027	0.22	0.0010	93

Notes:

1. A weighted average fuel usage is calculated based on the average Port Switch Locomotive from Table 14.
2. Switcher locomotive emission are calculated using the fuel consumption rate above, the operating schedule from Table 9, and the emissions fractors from Table 14.

Abbreviations:

CO - carbon monoxide
CO2e - carbon dioxide equivalent
gal - gallon
hr - hour
MT - metric ton
NOx - nitrogen oxides
PM - particulate matter
ROG - reactive organic gases
SO_2 - sulfur dioxide

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Table 16
Summary of Operational Rail Emissions
Rail Bridge & Rail Improvements Project
Stockton, California

Scenario	Engine Type	Engine Mode	CAP Emissions ton/year						GHG Emissions MT/yr
			ROG	NO_x	PM_{10}	$PM_{2.5}$	CO	SOx	CO_2e
Future Without Project	Class I Engine	Running	0.62	15	0.33	0.31	3.5	0.013	1,245
		Idling	0.042	1.0	0.023	0.021	0.24	8.7E-04	84
	Class III Engine	Running	0.70	11	0.38	0.35	2.9	0.012	1,188
		Idling	0.030	0.46	0.016	0.015	0.13	5.4E-04	52
		Total	1.4	27	0.75	0.69	6.8	0.027	2,569
Future With Project	Class I Engine	Running	0.82	19	0.44	0.41	4.7	0.017	1,641
		Idling	0.024	0.56	0.013	0.012	0.13	4.9E-04	47
	Class III Engine	Running	0.76	12	0.41	0.38	3.1	0.013	1,305
		Idling	0.016	0.25	0.0089	0.0081	0.067	2.9E-04	28
		Total	1.6	32	0.88	0.81	8.0	0.031	3,022
Net Change	Class I Engine	Running	0.20	4.7	0.11	0.10	1.1	0.0041	397
		Idling	-0.018	-0.43	-0.010	-0.0091	-0.10	-3.8E-04	-37
	Class III Engine	Running	0.069	1.0	0.037	0.034	0.28	0.0012	117
		Idling	-0.014	-0.21	-0.0076	-0.0070	-0.058	-2.5E-04	-24
		Total[1]	0.23	5.1	0.13	0.12	1.2	0.0047	453

SJVAPCD Air Quality Thresholds of Significance

Source Designation	ROG	NO_x	PM_{10}	$PM_{2.5}$	CO	SOx
	tons/year					
Non-Permitted Equipment and Activities	10	10	15	15	100	27

Notes:

1. There are no GHG emissions thresholds in the CEQA Guidelines.

Abbreviations:

CAP - Criteria Air Pollutant
CO - carbon monoxide
CO_2e - carbon dioxide equivalent
GHG - greenhouse gas
lb - pounds
NOx - nitrogen oxides
PM - particulate matter
ROG - reactive organic gases
SJVAPCD - San Joaquin Valley Air Pollution Control District
SOx - sulfur oxide

Table 17
Construction HRA Emissions
Rail Bridge & Rail Improvements Project
Stockton, California

Year	Construction Source			DPM Emissions (g/s)[1]
2023	Rail Bridge Replacement	Off-Road Equipment Exhaust		6.6E-04
		Truck Hauling		4.3E-06
	Second Lead Tracks	Off-Road Equipment Exhaust[2]	Port Side Tracks	0.0021
		Truck Hauling		1.3E-05
	Port Yard Improvements	Off-Road Equipment Exhaust		0.0020
		Truck Hauling		6.0E-06
2024	Rail Bridge Replacement	Off-Road Equipment Exhaust		2.7E-04
		Truck Hauling		3.3E-06
	Second Lead Tracks	Off-Road Equipment Exhaust[2]	Port Side Tracks	2.1E-04
			Bridge Approaches	8.4E-04
		Truck Hauling		4.2E-06
	Port Yard Improvements	Off-Road Equipment Exhaust		0.0016
		Truck Hauling		4.1E-06
2025	Rail Bridge Replacement	Off-Road Equipment Exhaust		6.9E-04
		Truck Hauling		7.4E-06

Notes:

1. All PM_{10} exhaust emissions from diesel-fueled equipment and vehicles were assumed to be DPM. The emission rate is estimated by annualizing emissions over the course of the year. Annual emission rates were converted to grams per second rates using modeled construction activity hours (16 hours/day of potential activity).
2. The off-road equipment for the Second Lead Tracks project was divided into two modeled sources to capture the spatial distribution of emissions.
3. All worker trucks were assumed to be diesel-fueled.

Abbreviations:

DPM - diesel particulate matter
g/s - gram per second
PM_{10} - particulate matter less than 10 microns in diameter

Table 18
Operational HRA Emissions
Rail Bridge & Rail Improvements Project
Stockton, California

Scenario	Location	Locomotive Type	Process	DPM Total[1]	DPM Day	DPM Night	DPM Total[2]	DPM Day	DPM Night
				lbs/yr			g/s		
Future Without Project	East	Class I Engine	Running	0.19	0.15	0.048	--	4.2E-06	4.2E-06
			General Idling	0.0039	--	--	8.5E-08	--	--
			700 Yard Block Idling	0.0046	--	--	9.9E-08	--	--
			Lead Block Idling	0.010	--	--	2.2E-07	--	--
		Class III Engine	Running	0.34	0.25	0.085	--	7.3E-06	7.3E-06
			General Idling	0.0031	--	--	6.7E-08	--	--
			700 Yard Block Idling	0.0036	--	--	7.9E-08	--	--
			Lead Block Idling	0.0080	--	--	1.7E-07	--	--
	West	Class I Engine	Running	0.14	0.11	0.035	--	3.0E-06	3.0E-06
			General Idling	8.6E-04	--	--	1.8E-08	--	--
			700 Yard Block Idling	0.0010	--	--	2.2E-08	--	--
			Lead Block Idling	0.0022	--	--	4.7E-08	--	--
		Class III Engine	Running	0.036	0.027	0.0090	--	7.8E-07	7.8E-07
			General Idling	3.6E-04	--	--	7.8E-09	--	--
			700 Yard Block Idling	4.2E-04	--	--	9.1E-09	--	--
			Lead Block Idling	9.3E-04	--	--	2.0E-08	--	--
Future with Project	East	Class I Engine	Running	0.20	0.15	0.050	--	4.3E-06	4.3E-06
			General Idling	0.0044	--	--	9.5E-08	--	--
			700 Yard Block Idling	--	--	--	--	--	--
			Lead Block Idling	0.0050	--	--	1.1E-07	--	--
		Class III Engine	Running	0.35	0.26	0.088	--	7.6E-06	7.6E-06
			General Idling	0.0035	--	--	7.5E-08	--	--
			700 Yard Block Idling	--	--	--	--	--	--
			Lead Block Idling	0.0039	--	--	8.5E-08	--	--
	West	Class I Engine	Running	0.24	0.18	0.060	--	5.2E-06	5.2E-06
			General Idling	0.0016	--	--	3.4E-08	--	--
			700 Yard Block Idling	--	--	--	--	--	--
			Lead Block Idling	0.0018	--	--	3.9E-08	--	--
		Class III Engine	Running	0.062	0.046	0.015	--	1.3E-06	1.3E-06
			General Idling	6.7E-04	--	--	1.4E-08	--	--
			700 Yard Block Idling	--	--	--	--	--	--
			Lead Block Idling	7.6E-04	--	--	1.6E-08	--	--
Net Change	East	Class I Engine	Running	0.0065	0.0049	0.0016	--	1.4E-07	1.4E-07
			General Idling	4.4E-04	--	--	9.6E-09	--	--
			700 Yard Block Idling	-0.0046	--	--	-9.9E-08	--	--
			Lead Block Idling	-0.0051	--	--	-1.1E-07	--	--
		Class III Engine	Running	0.011	0.0085	0.0028	--	2.5E-07	2.5E-07
			General Idling	3.5E-04	--	--	7.6E-09	--	--
			700 Yard Block Idling	-0.0036	--	--	-7.9E-08	--	--
			Lead Block Idling	-0.0040	--	--	-8.7E-08	--	--
	West	Class I Engine	Running	0.10	0.075	0.025	--	2.2E-06	2.2E-06
			General Idling	7.2E-04	--	--	1.6E-08	--	--
			700 Yard Block Idling	-0.0010	--	--	-2.2E-08	--	--
			Lead Block Idling	-3.9E-04	--	--	-8.4E-09	--	--
		Class III Engine	Running	0.026	0.019	0.0064	--	5.5E-07	5.5E-07
			General Idling	3.1E-04	--	--	6.6E-09	--	--
			700 Yard Block Idling	-4.2E-04	--	--	-9.1E-09	--	--
			Lead Block Idling	-1.7E-04	--	--	-3.6E-09	--	--

Notes:

1. Running emissions were split between day and night to line up with modeling parameters. Port activity generally occurs from 6AM-10PM. The model used daytime hours of 7AM-7PM and nighttime hours of 7PM-7AM. Based off of this assumption, 75% of running emissions were assumed to occur in the day timeframe.
2. Annual emission rates converted to grams per second rates using port activity hours (12 hours/day for daytime and 4 hours/day for nighttime).

Abbreviations:

DPM - diesel particulate matter
g - gram
HRA - health risk assessment
lbs - pounds
s - second
yr - year

Table 19
Construction Model Source Parameters
Rail Bridge & Rail Improvements Project
Stockton, California

Source[1]	Source Type	Number of Sources[2]	Release Height[3]	Initial Lateral Dimension[4]	Initial Vertical Dimension[5]
			(m)	(m)	(m)
Construction Equipment	Area	9	5	--	1.16
On-Road Trucks	Volume	375	2.55	Varies	2.37

Notes:

1. Construction activities are assumed to occur from 6am to 10pm, consistent with the Port of Stockton operating schedule.
2. The number of modeled construction equipment sources was based on the number of distinct construction work areas. These areas include the McCloy Yard, Bridge Replacement, and seven rail track improvement areas. The number of on-road vehicle sources was based on the geometry of the truck or traffic routes, with the sources comprising three distinct routes. In the first route, trucks enter the Port from the Port of Stockton Expressway and continue onto McCloy Avenue near the MCloy Yard construction area. In the second route, trucks enter the Port from Navy Drive and travel west across the bridge to the intersection with W. Charter Way. In the third route, trucks enter the Port from W. Washington Street and then continue south along S. Fresno Avenue.
3. SJVAPCD does not have guidance on construction modeling, therefore construction equipment parameters used were based on BAAQMD's San Francisco Community Risk Reduction Plan-Health Risk Assessment (CRRP-HRA). According to the CRRP-HRA methodology, release height of a modeled area source representing construction equipment is set to 5 meters. On-road truck release height was based on USEPA haul road guidance, assuming vehicle heights of 3 meters for heavy-duty vehicles.
4. Initial lateral dimension for on-road trucks calculated based on USEPA haul road guidance and varies with road width.
5. According to USEPA's AERMOD guidance, initial vertical dimension of the modeled construction equipment area sources is the release height divided by 4.3. According to the USEPA Haul Road Guidance, the initial vertical dimension for volume sources is the top of plume height divided by 2.15, where the top of the plume is equal to 2*Release Height.

Abbreviations:

AERMOD - Atmospheric Dispersion MODeling
BAAQMD - Bay Area Air Quality Management District
m - meter
SJVAPCD - San Joaquin Valley Air Pollution Control District
USEPA - United States Environmental Protection Agency

References:

San Francisco Department of Public Health. February 2020. San Francisco Citywide Health Risk Assessment: Technical Support Documentation. Available online at: https://www.sfdph.org/dph/files/EHSdocs/AirQuality/Air_Pollutant_Exposure_Zone_Technical_Documentation_2020.pdf

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United States Environmental Protection Agency (USEPA). 2012. Haul Road Workgroup Final Report Submission to EPA-OAQPS. U.S. EPA Office of Air Quality and Planning Standards, Research Triangle Park, North Carolina. Available at: https://www3.epa.gov/scram001/reports/Haul_Road_Workgroup-Final_Report_Package-20120302.pdf

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Table 20
Operational Model Source Parameters
Rail Bridge & Rail Improvements Project
Stockton, California

Source[1,2]	Source Type	Number of Sources[3]	Release Height	Initial Lateral Dimension	Initial Vertical Dimension
			(m)	(m)	(m)
Rail Running Onsite - East - Day[1,2]	Volume	291	5.60	4.28	2.60
Rail Running Onsite - East - Night[1,2]	Volume	291	14.60	4.28	6.79
Rail Running Onsite - West - Day[1,2]	Volume	808	5.60	4.28	2.60
Rail Running Onsite - West - Night[1,2]	Volume	808	14.60	4.28	6.79
Rail Idling[1]	Area	4	4.78	--	2.22

Notes:

1. Rail source parameters were derived from the Roseville Rail Yard Study (CARB, 2004). The plume heights vary by day and night due to differences in atmospheric stability conditions.
2. Rail Running – Day (East and West) are modeled from 7am – 7pm. Rail Running – Night (East and West) are modeled from 6am – 7am and 7pm – 10pm.
3. The number of rail running sources was based on the geometry of the routes. The east route starts at the entrance of the Port and ends at the East Complex, and the west route starts at the entrance of the Port and ends at the West Complex. The number of modeled rail idling sources was based on the number of distinct idling areas. These areas include the Port Lead, 700 Yard, East (general), and West (general) areas.

Abbreviations:

AERMOD - Atmospheric Dispersion MODeling

m - meter

References:

CARB. 2004. Roseville Rail Yard Study. Available online at: https://ww2.arb.ca.gov/sites/default/files/classic/diesel/documents/rrstudy/rrstudy101404.pdf

USEPA. 2019. User's Guide for the AMS/EPA Regulatory Model (AERMOD). U.S. EPA Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. Available at: https://www3.epa.gov/ttn/scram/models/aermod/aermod_userguide.pdf

Table 21
AERMOD Input Parameters
Rail Bridge & Rail Improvements Project
Stockton, California

Parameter	Assumptions
Model Control Options	
Use Regulatory Default	Yes
Urban or Rural Option	Rural
Flagpole Receptor Height	0 meters
Source Options	
Include Building Downwash	No
Receptor Information	
Classifications	Residential, Worker, Recreational
Spacing	20 x 20 meter grid
Meteorological Information	
Meteorological Station[1]	Stockton
Station Base Elevation	10
Meteorological Data Years	2013 - 2017
Output	
Averaging Times	Annual

Notes:

1. Five complete years of pre-processed meteorological data for Stockton was obtained from the San Joaquin Valley Air Pollution Control District.

References:

San Joaquin Valley Air Pollution Control District. September 2020. Meteorological data for Stockton. Available online at: http://www.valleyair.org/busind/pto/Tox_Resources/Modeling-Sites/stockton.htm

Table 22
Exposure Parameters
Rail Bridge & Rail Improvements Project
Stockton, California

Construction + Operation Scenario

Receptor Type	Year	Age Group	Daily Breathing Rate[1,2,3] [L/kg-day]	Exposure Duration[4] [years]	Fraction of Time at Home[5] [unitless]	Exposure Frequency[6] [days/year]	Age Sensitivity Factor[7]	Averaging Time [days]	ASF-Weighted Intake Factor, Inhalation [m³/kg-day]	Cumulative Intake Factor, Inhalation [m³/kg-day]
Residential	2023	3rd Trimester	361	0.50	1	350	10	25,550	0.025	0.10
		0-<2	1,090	0.50					0.074	
	2024			1					0.15	0.15
	2025			0.75					0.11	0.12
		2-<16	572	0.25			3		0.0059	
	2026			1					0.024	0.024
	2027			1					0.024	0.024
	2028			1					0.024	0.024
	2029			1					0.024	0.024
	2030			1					0.024	0.024
	2031			1					0.024	0.024
	2032			1					0.024	0.024
	2033			1					0.024	0.024
	2034			1					0.024	0.024
	2035			1					0.024	0.024
	2036			1					0.024	0.024
	2037			1					0.024	0.024
	2038			1					0.024	0.024
	2039			0.75					0.018	0.018
		16-30	261	0.25	0.73		1		6.5E-04	
	2040			1					0.0026	0.0026
	2041			1					0.0026	0.0026
	2042			1					0.0026	0.0026
	2043			1					0.0026	0.0026
	2044			1					0.0026	0.0026
	2045			1					0.0026	0.0026
	2046			1					0.0026	0.0026
	2047			1					0.0026	0.0026
	2048			1					0.0026	0.0026
	2049			1					0.0026	0.0026
	2050+			3.8					0.010	0.010

Table 22
Exposure Parameters
Rail Bridge & Rail Improvements Project
Stockton, California

Construction + Operation Scenario

Receptor Type	Year	Age Group	Daily Breathing Rate[1,2,3]	Exposure Duration[4]	Fraction of Time at Home[5]	Exposure Frequency[6]	Age Sensitivity Factor[7]	Averaging Time	ASF-Weighted Intake Factor, Inhalation	Cumulative Intake Factor, Inhalation
			[L/kg-day]	[years]	[unitless]	[days/year]		[days]	[m^3/kg-day]	[m^3/kg-day]
Worker	2023	16-70	230	1	--	250	1	25,550	0.0023	0.0023
	2024			1					0.0023	0.0023
	2025			1					0.0023	0.0023
	2026			1					0.0023	0.0023
	2027			1					0.0023	0.0023
	2028			1					0.0023	0.0023
	2029			1					0.0023	0.0023
	2030			1					0.0023	0.0023
	2031			1					0.0023	0.0023
	2032			1					0.0023	0.0023
	2033			1					0.0023	0.0023
	2034			1					0.0023	0.0023
	2035			1					0.0023	0.0023
	2036			1					0.0023	0.0023
	2037			1					0.0023	0.0023
	2038			1					0.0023	0.0023
	2039			1					0.0023	0.0023
	2040			1					0.0023	0.0023
	2041			1					0.0023	0.0023
	2042			1					0.0023	0.0023
	2043			1					0.0023	0.0023
	2044			1					0.0023	0.0023
	2045			1					0.0023	0.0023
	2046			1					0.0023	0.0023
	2047			1					0.0023	0.0023

Table 22
Exposure Parameters
Rail Bridge & Rail Improvements Project
Stockton, California

Construction + Operation Scenario

Receptor Type	Year	Age Group	Daily Breathing Rate[1,2,3]	Exposure Duration[4]	Fraction of Time at Home[5]	Exposure Frequency[6]	Age Sensitivity Factor[7]	Averaging Time	ASF-Weighted Intake Factor, Inhalation	Cumulative Intake Factor, Inhalation
			[L/kg-day]	[years]	[unitless]	[days/year]		[days]	[m^3/kg-day]	[m^3/kg-day]
Recreational	2023	0-<2	900	1	--	52	10	25,550	0.0183	0.018
	2024			1					0.018	0.018
	2025	2-<16	390	1			3		0.0024	0.0024
	2026			1					0.0024	0.0024
	2027			1					0.0024	0.0024
	2028			1					0.0024	0.0024
	2029			1					0.0024	0.0024
	2030			1					0.0024	0.0024
	2031			1					0.0024	0.0024
	2032			1					0.0024	0.0024
	2033			1					0.0024	0.0024
	2034			1					0.0024	0.0024
	2035			1					0.0024	0.0024
	2036			1					0.0024	0.0024
	2037			1					0.0024	0.0024
	2038			1					0.0024	0.0024
	2039	16-30	180	1			1		0.00037	0.0004
	2040			1					0.00037	0.00037
	2041			1					0.00037	0.00037
	2042			1					0.00037	0.00037
	2043			1					0.00037	0.00037
	2044			1					0.00037	0.00037
	2045			1					0.00037	0.00037
	2046			1					0.00037	0.00037
	2047			1					0.00037	0.00037
	2048			1					0.00037	0.00037
	2049			1					0.00037	0.00037
	2050+			3					0.0011	0.0011

Table 22
Exposure Parameters
Rail Bridge & Rail Improvements Project
Stockton, California

Operation Only Scenario

Receptor Type	Age Group	Daily Breathing Rate[1,2,3]	Exposure Duration[4]	Fraction of Time at Home[5]	Exposure Frequency[6]	Age Sensitivity Factor[7]	Averaging Time	ASF-Weighted Intake Factor, Inhalation	Cumulative Intake Factor, Inhalation
		[L/kg-day]	[years]	[unitless]	[days/year]		[days]	[m³/kg-day]	[m³/kg-day]
Residential	3rd Trimester	361	0.25	1	350	10	25,550	0.012	0.68
	0-<2	1,090	2	1	350	10	25,550	0.30	
	2-<16	572	14	1	350	3	25,550	0.33	
	16-30	261	14	0.73	350	1	25,550	0.037	
Worker	16-70	230	25	--	250	1	25,550	0.056	0.056
Recreational	0-<2	900	2	--	52	10	25,550	0.037	0.075
	2-<16	390	14	--	52	3	25,550	0.033	
	16-30	180	14	--	52	1	25,550	0.0051	

Notes:

1. Daily breathing rates for residents reflect default breathing rates from Cal/EPA 2015 as follows:
   95th percentile 24-hour daily breathing rate for age 3rd trimester and 0-<2 years
   80th percentile 24-hour daily breathing rate for age 2-<16 years
   80th percentile 24-hour daily breathing rate for age 16-30 years
2. Daily breathing rates for workers are based on the OEHHA Risk Assessment Guidelines 2015 as follows:
   95th percentile moderate intensity 8-hour daily breathing rate for age 16-70
3. Daily breathing rates for recreational receptors assume 95th Percentile Eight-Hour Breathing Rates for Moderate Intensity Activities, scaled to 6 hours per day.
4. Exposure duration represents the fraction of the year each age bin is exposed to Project emissions.
5. Fraction of time spent at home is conservatively assumed to be 1 (i.e., 24 hours/day) for all age bins except Age 16-30 Years. Fraction of time spent at home is assumed to be 0.73 for Ages 16-30 Years.
6. Exposure frequency was determined as follows:
   Residents: reflects default residential exposure frequency from Cal/EPA 2015.
   Workers: reflects default worker exposure frequency from Cal/EPA 2015.
   Recreational: reflects 52 days per year, assuming recreational receptors play a round of golf or go to the park once a week.
7. Age sensitivity factors account for an "anticipated special sensitivity to carcinogens" of infants and children as recommended in the OEHHA Technical Support Document (Cal/EPA 2009) and current OEHHA guidance (Cal/EPA 2015).

Abbreviations:

AT - averaging time
Cal/EPA - California Environmental Protection Agency
DBR - daily breathing rate
EF - exposure frequency
FAH - fraction of time at home
kg - kilogram
L - liter

Reference:

Cal/EPA. 2015. Air Toxics Hot Spots Program Risk Assessment Guidelines. Guidance Manual for Preparation of Health Risk Assessments. February.

Table 23
Toxicity
Rail Bridge & Rail Improvements Project
Stockton, California

Source	Chemical[1]	CAS Number	Cancer Potency Factor (mg/kg-day)$^{-1}$	Chronic Noncancer Reference Exposure Level ($\mu g/m^3$)
PM_{10}	Diesel PM	9-90-1	1.1	5.0

Notes:

1. Toxicity values are taken from ARB's Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values.

Abbreviations:

ARB - Air Resources Board
Cal/EPA - California Environmental Protection Agency
CAS - chemical abstract services
mg/kg-day - milligrams per kilogram per day
OEHHA - Office of Environmental Health Hazard Assessment
$\mu g/m^3$ - micrograms per cubic meter

Reference:

Cal/EPA. 2016. OEHHA/ARB Consolidated Table of Approved Risk Assessment Health Values. March. Available at: http://www.arb.ca.gov/toxics/healthval/contable.pdf.

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Table 24
Maximum Project Excess Lifetime Cancer Risk and Chronic HI
Rail Bridge & Rail Improvements Project
Stockton, California

Source Category	**Source**	**Excess Lifetime Cancer Risk**	**Chronic HI**
		in a million	**unitless ratio**
Construction Sources	Off-Road Equipment Exhaust	2.2	0.020
	On-Road Mobile Vehicles	0.0060	1.8E-07
	On-Site Truck Exhaust	0.16	2.1E-04
Operational Sources[1]	Class I Locomotives	0.0022	1.8E-06
	Class III Locomotives	6.3E-04	4.8E-07
	Total	**2.3**	**0.020**
Significance Threshold		**20**	**1.0**
Exceeds Threshold?		**No**	**No**
Location			
Year Occurred		--	2025
UTMx		648,000	646,120
UTMy		4,200,540	4,201,320
Receptor Type			
Classification		Residential	Worker

Notes:

1. Excess lifetime cancer risk and chronic HI from operational sources represent the incremental increase in activity (i.e., Future With Project - Future Without Project) expected as a result of the Project.
2. Excess lifetime cancer risks were estimated using the following equation:

   $Risk_{inh} = \Sigma C_i \times CF \times IF_{inh} \times CPF_i \times ASF$

   Where:

   $Risk_{inh}$ = Cancer Risk for the Inhalation Pathway (unitless)
   C_i = Annual Average Air Concentration for Chemical "i" ug/m^3
   CF = Conversion Factor (mg/ug)
   IF_{inh} = Intake Factor for Inhalation (m^3/kg-day)
   CPF_i = Cancer Potency Factor (mg/kg-day)$^{-1}$
   ASF = Age Sensitivity Factor (unitless)
3. Excess lifetime cancer risk was evaluated for two exposure scenarios, with the intent of identifying the most conservative scenario. Scenario 1 started exposure at the start of construction; Scenario 2 started exposure at the start of operation. Scenario 1 included overlapping construction and operational emissions, whereas Scenario 2 included operational emissions only. Ultimately, Scenario 1 yielded the highest risk results of the exposure scenarios, which are shown in the table above. The other scenario resulted in lower risks, which are not presented for that reason.
4. Chronic HI for each receptor was estimated using the following equation:

   $HI_{inh} = \Sigma C_i / cREL$

   Where:

   HI_{inh} = Chronic HI for the Inhalation Pathway (unitless)
   C_i = Annual Average Air Concentration for Chemical "i" (ug/m^3)
   cREL = Chronic Reference Exposure Level (ug/m^3)
5. Thresholds of significance are based on information from San Joaquin Valley Air Pollution Control District, Air Quality Thresholds of Significance - Toxic Air Contaminants.
6. This table shows the maximum exposed individual receptor, but three different receptor types were analyzed for this analysis: residential, worker, and recreational.
7. Potential Maximally Exposed Individual (MEI) locations were screened to remove any receptors located over roadways or open space. Further, only the subset of off-site receptors located on residential buildings or homes were considered residential receptors.

References:

San Joaquin Valley Air Pollution Control District, Air Quality Thresholds of Significance - Toxic Air Contaminants. Available at: http://www.valleyair.org/transportation/0714-GAMAQI-TACs-Thresholds-of-Significance.pdf.