Appendix B

Air Quality and Greenhouse Gas Analysis Technical Data

Appendix B1: Construction Assumptions and Calculations

Criteria Pollutants and Greenhouse Gases

Mass criteria pollutant and greenhouse gas (GHG) emissions from heavy-duty equipment, on-road vehicle trips, and land disturbance were estimated using the California Emissions Estimator Model (CalEEMod) (version 2013.2.2) and the California Air Resources Board (ARB) EMFAC2011 model. Vehicle and equipment assumptions were provided by the JPB per the preliminary construction schedule (Cocke pers. comm. a). Horsepower and load factors were based on CalEEMod default data for equipment types similar to those expected for Proposed Project construction. Re-entrained road dust from construction vehicle operation in the project area was calculated using PM emission factors obtained from the United States Environmental Protection Agency (2011).

Toxic Air Contaminants

Exposure to construction-related diesel particulate matter (DPM) was assessed by predicting the health risks in terms of excess cancer, non-cancer hazard impacts, and elevated PM2.5 concentrations. A screening-level health risk assessment (HRA) was performed according to the following steps.

1. Evaluation of increased DPM cancer risk and the DPM non-cancer hazard impact based on the mass emissions of PM10 and PM2.5 exhaust estimated with CalEEMod.
2. Using EPA's AERSCREEN model, which is the screening-level model for AERMOD, prediction of PM10 and PM2.5 hourly concentrations at sensitive land uses based on the maximum daily exhaust emissions for each construction period.
3. Calculation of the project-level cancer risk, non-cancer hazard index (HI), and annual PM2.5 concentrations for each Proposed Project phase based on the AERSCREEN hourly concentrations and the construction durations using Bay Area Air Quality Management District (BAAQMD)-approved methodology.
4. Identification of background stationary sources within 1,000 feet of Caltrain corridor using Google Earth map files provided by BAAQMD. The Google Earth map files include estimated risk and hazard impacts at nearby receptors from these sources (BAAQMD 2011b).
5. Calculation of the cumulative health risks by adding the background health risk sources identified in step 4 to the project-level health risk and hazard impacts estimated in step 3.

Carbon Stock (Tree Removal)

The *Draft Tree Inventory and Canopy Assessment* (HortScience 2014, see Appendix F) identifies approximately 2,200 trees that would need to be removed as a result of Proposed Project construction. Removal of these trees would result in a one-time loss of stored carbon within the tree. Carbon stock values for the impacted trees were obtained from the U.S. Forest Service's (2011) Tree Carbon Calculator (CTCC) for each tree species. An average diameter breast height (DBH) of 16 inches was assumed for all trees, based on the tree inventory. Lost carbon stock was calculated by multiplying the TCC values by the number of removed trees.

Embodied Emissions in Concrete (For Information Purposes only)

GHG emissions for concrete manufacture and transport were estimated by determining the amount of concrete estimated for the project and then multiplying by a low to high range for life cycle emissions from Nisbet et al, 2002, Environmental Life Cycle Inventory of Portland Cement Concrete, prepared for the Portland Cement Association.

As noted in Section 3.7, Greenhouse Gas Emissions and Climate Change, It is not standard professional practice for CEQA greenhouse gas inventories to include indirect emissions due to building materials. The CAPCOA white paper on CEQA and Climate Change (http://www.capcoa.org/wp-content/uploads/2012/03/CAPCOA-White-Paper.pdf) notes that "In many cases, only direct and indirect emissions may be addressed, rather than life-cycle emissions. A project applicant has traditionally been expected to only address emissions that are closely related and within the capacity of the project to control and/or influence." The BAAQMD CEQA guidelines (http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CEQA/BAAQMD%20CEQA%20Guidelines_Final_May%202012.ashx?la=en) do not require inclusion of such life-cycle emissions in project GHG emissions estimates. Thus, the inclusion of such indirect emissions is for informational purposes only.

2015 Offroad Assumptions

2015 Equipment	# Day	Hrs/ Day	Days	HP	LF	g/hp-hr (CalEEMod)								
						ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O
Utilities														
Advance Utility Relocation														
Off-Highway Truck	1	3	270	400	0.38	0.38	4.53	2.04	0.17	0.16	0.00	515.84	0.15	0.01
Excavator	1	3	90	163	0.38	0.38	4.48	3.17	0.22	0.20	0.00	511.69	0.15	0.01
Tractor/Loader/Backhoe	1	3	90	98	0.37	0.57	5.42	3.83	0.42	0.39	0.00	517.37	0.15	0.01
Concrete Industrial Saws	1	2	90	81	0.42	0.68	4.79	3.65	0.37	0.37	0.01	568.30	0.06	0.01
Generator Sets	1	4	90	84	0.42	0.65	4.77	3.50	0.35	0.35	0.01	568.30	0.06	0.01
Bore/Drill Rigs	1	3	90	206	0.5	0.21	3.32	1.18	0.10	0.09	0.00	506.50	0.15	0.01
Traction Power Substation Installation														
Advance Site Preparation - Traction Power Sites														
Off-Highway Trucks	0	0	0	400	0.38	0.38	4.53	2.04	0.17	0.16	0.00	515.84	0.15	0.01
Chainsaws (gas)	0	0	0	1	0.5	132.54	2.93	355.82	0.91	0.91	0.04	884.65	8.24	0.03
Trimmers/Edgers/Brush Cutters (gas)	0	0	0	1	0.5	21.45	8.45	402.11	0.54	0.54	0.03	858.88	1.21	0.03
Chippers/Stump Grinders (gas)	0	0	0	18	0.78	13.99	8.05	566.73	6.98	6.98	0.02	858.88	0.78	0.03
Traction Power Equipment Foundation Construction														
Off-Highway Truck	0	0	0	400	0.38	0.38	4.53	2.04	0.17	0.16	0.00	515.84	0.15	0.01
Tractor/Loader/Backhoe	0	0	0	98	0.37	0.57	5.42	3.83	0.42	0.39	0.00	517.37	0.15	0.01
Rubber Tired Loaders	0	0	0	200	0.36	0.41	5.37	1.48	0.18	0.17	0.00	508.91	0.15	0.01
Pumps	0	0	0	84	0.42	0.68	4.84	3.55	0.36	0.36	0.01	568.30	0.06	0.01
Vibratory Plate	0	0	0	8	0.42	0.66	4.14	3.47	0.16	0.16	0.01	568.30	0.06	0.01
Concrete Mixers	0	0	0	9	0.42	0.66	4.17	3.47	0.17	0.17	0.01	568.30	0.06	0.01
Crane	0	0	0	226	0.29	0.64	7.62	2.65	0.35	0.32	0.00	512.45	0.15	0.01
Traction Power Equipment Installation														
Off-Highway Truck	0	0	0	400	0.38	0.38	4.53	2.04	0.17	0.16	0.00	515.84	0.15	0.01
Crane	0	0	0	226	0.29	0.64	7.62	2.65	0.35	0.32	0.00	512.45	0.15	0.01
Tractor/Loader/Backhoe	0	0	0	98	0.37	0.57	5.42	3.83	0.42	0.39	0.00	517.37	0.15	0.01
Traction Power Equipment Testing														
Generator Set	0	0	0	84	0.42	0.65	4.77	3.50	0.35	0.35	0.01	568.30	0.06	0.01
Overhead Contact System (OCS)														
OCS Pole Foundation Construction - Crew #1														
Off-Highway Truck	0	0	0	400	0.38	0.38	4.53	2.04	0.17	0.16	0.00	515.84	0.15	0.01
Bore/Drill Rigs	0	0	0	206	0.5	0.21	3.32	1.18	0.10	0.09	0.00	506.50	0.15	0.01
Rubber Tired Loaders	0	0	0	200	0.36	0.41	5.37	1.48	0.18	0.17	0.00	508.91	0.15	0.01
Generators	0	0	0	84	0.42	0.65	4.77	3.50	0.35	0.35	0.01	568.30	0.06	0.01
Pumps	0	0	0	84	0.42	0.68	4.84	3.55	0.36	0.36	0.01	568.30	0.06	0.01
Concrete Mixers	0	0	0	9	0.42	0.66	4.17	3.47	0.17	0.17	0.01	568.30	0.06	0.01
Crane	0	0	0	226	0.29	0.64	7.62	2.65	0.35	0.32	0.00	512.45	0.15	0.01
OCS Pole Foundation Construction - Crew #2														
Off-Highway Truck	0	0	0	400	0.38	0.38	4.53	2.04	0.17	0.16	0.00	515.84	0.15	0.01

Bore/Drill Rigs	0	0	0	206	0.5	0.21	3.32	1.18	0.10	0.09	0.00	506.50	0.15	0.01
Rubber Tired Loaders	0	0	0	200	0.36	0.41	5.37	1.48	0.18	0.17	0.00	508.91	0.15	0.01
Generators	0	0	0	84	0.42	0.65	4.77	3.50	0.35	0.35	0.01	568.30	0.06	0.01
Pumps	0	0	0	84	0.42	0.68	4.84	3.55	0.36	0.36	0.01	568.30	0.06	0.01
Concrete Mixers	0	0	0	9	0.42	0.66	4.17	3.47	0.17	0.17	0.01	568.30	0.06	0.01
Crane	0	0	0	226	0.29	0.64	7.62	2.65	0.35	0.32	0.00	512.45	0.15	0.01
OCS Pole & Cantilever Installation - Crew #1														
Off-Highway Truck	0	0	0	400	0.38	0.38	4.53	2.04	0.17	0.16	0.00	515.84	0.15	0.01
Crane	0	0	0	226	0.29	0.64	7.62	2.65	0.35	0.32	0.00	512.45	0.15	0.01
Generator	0	0	0	84	0.42	0.65	4.77	3.50	0.35	0.35	0.01	568.30	0.06	0.01
Backhoe	0	0	0	98	0.37	0.57	5.42	3.83	0.42	0.39	0.00	517.37	0.15	0.01
OCS Pole & Cantilever Installation - Crew #2														
Off-Highway Truck	0	0	0	400	0.38	0.38	4.53	2.04	0.17	0.16	0.00	515.84	0.15	0.01
Crane	0	0	0	226	0.29	0.64	7.62	2.65	0.35	0.32	0.00	512.45	0.15	0.01
Generator	0	0	0	84	0.42	0.65	4.77	3.50	0.35	0.35	0.01	568.30	0.06	0.01
Backhoe	0	0	0	98	0.37	0.57	5.42	3.83	0.42	0.39	0.00	517.37	0.15	0.01
OCS Wire Installation & Testing														
On-Track Wire Installation Equipment	0	0	0	172	0.42	0.56	6.23	3.38	0.33	0.30	0.00	509.31	0.15	0.01
Signal & Grade Crossings														
Signaling Equipment Installation at CPs & Houses														
Off-Highway Truck	0	0	0	400	0.38	0.38	4.53	2.04	0.17	0.16	0.00	515.84	0.15	0.01
Generators	0	0	0	84	0.42	0.65	4.77	3.50	0.35	0.35	0.01	568.30	0.06	0.01
Grade Crossing Modifications														
Off-Highway Truck	0	0	0	400	0.38	0.38	4.53	2.04	0.17	0.16	0.00	515.84	0.15	0.01
Backhoe	0	0	0	98	0.37	0.57	5.42	3.83	0.42	0.39	0.00	517.37	0.15	0.01
Generators	0	0	0	84	0.42	0.65	4.77	3.50	0.35	0.35	0.01	568.30	0.06	0.01
Communications														
Communication System Installation (incl. SCADA)														
Off-Highway Truck	0	0	0	400	0.38	0.38	4.53	2.04	0.17	0.16	0.00	515.84	0.15	0.01
Backhoe	0	0	0	98	0.37	0.57	5.42	3.83	0.42	0.39	0.00	517.37	0.15	0.01
Generators	0	0	0	84	0.42	0.65	4.77	3.50	0.35	0.35	0.01	568.30	0.06	0.01
Integration / Commissioning														
Integration Testing & Commissioning														
Generators	0	0	0	84	0.42	0.65	4.77	3.50	0.35	0.35	0.01	568.30	0.06	0.01

2015 Onroad Assumptions

2015	Vehicle Type	Trips/ Day	VMT/ day	VMT/ year	Days	grams per mile (EMFAC)									
						ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O	Other
Utilities															
Advance Utility Relocation															
	Employee Vehicle	15	186	50,220	270	0.04	0.15	1.45	0.00	0.00	0.00	344.50	-	-	17.22
	Flatbed	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
	Dump	1	50	13,500	270	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
Traction Power Substation Installation															
Advance Site Preparation - Traction Power Sites															
	Employee Vehicle	0	0	0	0	0.04	0.15	1.45	0.00	0.00	0.00	344.50	-	-	17.22
	Flatbed	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
	Dump	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
Traction Power Equipment Foundation Construction															
	Employee Vehicle	0	0	0	0	0.04	0.15	1.45	0.00	0.00	0.00	344.50	-	-	17.22
	Flatbed	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
	Dump	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
Traction Power Equipment Installation															
	Employee Vehicle	0	0	0	0	0.04	0.15	1.45	0.00	0.00	0.00	344.50	-	-	17.22
	Flatbed	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
	Dump	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
Traction Power Equipment Testing															
	Employee Vehicle	0	0	0	0	0.04	0.15	1.45	0.00	0.00	0.00	344.50	-	-	17.22
	Flatbed	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
	Dump	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
Overhead Contact System (OCS)															
OCS Pole Foundation Construction - Crew #1															
	Employee Vehicle	0	0	0	0	0.04	0.15	1.45	0.00	0.00	0.00	344.50	-	-	17.22
	Flatbed	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
	Dump	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
OCS Pole Foundation Construction - Crew #2															
	Employee Vehicle	0	0	0	0	0.04	0.15	1.45	0.00	0.00	0.00	344.50	-	-	17.22
	Flatbed	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
	Dump	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
OCS Pole & Cantilever Installation - Crew #1															
	Employee Vehicle	0	0	0	0	0.04	0.15	1.45	0.00	0.00	0.00	344.50	-	-	17.22
	Flatbed	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
	Dump	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
OCS Pole & Cantilever Installation - Crew #2															
	Employee Vehicle	0	0	0	0	0.04	0.15	1.45	0.00	0.00	0.00	344.50	-	-	17.22
	Flatbed	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
	Dump	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00

OCS Wire Installation & Testing															
	Employee Vehicle	0	0	0	0	0.04	0.15	1.45	0.00	0.00	0.00	344.50	-	-	17.22
	Flatbed	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
	Dump	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
Signal & Grade Crossings															
Signaling Equipment Installation at CPs & Houses															
	Employee Vehicle	0	0	0	0	0.04	0.15	1.45	0.00	0.00	0.00	344.50	-	-	17.22
	Flatbed	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
	Dump	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
Grade Crossing Modifications															
	Employee Vehicle	0	0	0	0	0.04	0.15	1.45	0.00	0.00	0.00	344.50	-	-	17.22
	Flatbed	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
	Dump	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
Communications															
Communication System Installation (incl. SCADA)															
	Employee Vehicle	0	0	0	0	0.04	0.15	1.45	0.00	0.00	0.00	344.50	-	-	17.22
	Flatbed	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
	Dump	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
Integration / Commissioning															
Integration Testing & Commissioning															
	Employee Vehicle	0	0	0	0	0.04	0.15	1.45	0.00	0.00	0.00	344.50	-	-	17.22
	Flatbed	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00
	Dump	0	0	0	0	0.28	9.02	1.31	0.11	0.10	0.00	1,784.42	0.10	0.05	0.00

2016 Offroad Assumptions

2016 Equipment	# Day	Hrs/ Day	Days	HP	LF	g/hp-hr (CalEEMod) ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O
Utilities														
Advance Utility Relocation														
Off-Highway Truck	1	3	90	400	0.4	0.35	4.05	1.89	0.15	0.14	0.00	509.86	0.15	0.01
Excavator	1	3	90	163	0.4	0.36	4.08	3.16	0.20	0.18	0.00	506.50	0.15	0.01
Tractor/Loader/Backhoe	1	3	90	98	0.4	0.54	5.14	3.81	0.40	0.36	0.00	511.35	0.15	0.01
Concrete Industrial Saws	1	2	90	81	0.4	0.62	4.43	3.62	0.33	0.33	0.01	568.30	0.06	0.01
Generator Sets	1	4	90	84	0.4	0.58	4.41	3.47	0.31	0.31	0.01	568.30	0.05	0.01
Bore/Drill Rigs	0	0	0	206	0.5	0.19	2.90	1.13	0.09	0.08	0.00	502.13	0.15	0.01
Traction Power Substation Installation														
Advance Site Preparation - Traction Power Sites														
Off-Highway Trucks	1	3	180	400	0.4	0.35	4.05	1.89	0.15	0.14	0.00	509.86	0.15	0.01
Chainsaws (gas)	1	2	90	1	0.5	129.47	2.92	350.34	0.84	0.84	0.04	884.65	8.05	0.03
Trimmers/Edgers/Brush Cutters (gas)	1	2	90	1	0.5	20.98	8.49	396.35	0.50	0.50	0.03	858.88	1.18	0.03
Chippers/Stump Grinders (gas)	1	2	90	18	0.8	13.82	8.10	563.50	7.02	7.02	0.02	858.88	0.77	0.03
Traction Power Equipment Foundation Construction														
Off-Highway Truck	1	3	180	400	0.4	0.35	4.05	1.89	0.15	0.14	0.00	509.86	0.15	0.01
Tractor/Loader/Backhoe	1	3	180	98	0.4	0.54	5.14	3.81	0.40	0.36	0.00	511.35	0.15	0.01
Rubber Tired Loaders	1	3	180	200	0.4	0.39	5.12	1.45	0.17	0.16	0.00	503.65	0.15	0.01
Pumps	0	0	0	84	0.4	0.61	4.48	3.52	0.33	0.33	0.01	568.30	0.06	0.01
Vibratory Plate	0	0	0	8	0.4	0.66	4.14	3.47	0.16	0.16	0.01	568.30	0.06	0.01
Concrete Mixers	0	0	0	9	0.4	0.66	4.15	3.47	0.17	0.17	0.01	568.30	0.06	0.01
Crane	0	0	0	226	0.3	0.62	7.38	2.58	0.33	0.31	0.00	507.16	0.15	0.01
Traction Power Equipment Installation														
Off-Highway Truck	0	0	0	400	0.4	0.35	4.05	1.89	0.15	0.14	0.00	509.86	0.15	0.01
Crane	0	0	0	226	0.3	0.62	7.38	2.58	0.33	0.31	0.00	507.16	0.15	0.01
Tractor/Loader/Backhoe	0	0	0	98	0.4	0.54	5.14	3.81	0.40	0.36	0.00	511.35	0.15	0.01
Traction Power Equipment Testing														
Generator Set	0	0	0	84	0.4	0.58	4.41	3.47	0.31	0.31	0.01	568.30	0.05	0.01
Overhead Contact System (OCS)														
OCS Pole Foundation Construction - Crew #1														
Off-Highway Truck	1	2	90	400	0.4	0.35	4.05	1.89	0.15	0.14	0.00	509.86	0.15	0.01
Bore/Drill Rigs	1	3	90	206	0.5	0.19	2.90	1.13	0.09	0.08	0.00	502.13	0.15	0.01
Rubber Tired Loaders	1	4	90	200	0.4	0.39	5.12	1.45	0.17	0.16	0.00	503.65	0.15	0.01
Generators	1	4	90	84	0.4	0.58	4.41	3.47	0.31	0.31	0.01	568.30	0.05	0.01
Pumps	0	0	0	84	0.4	0.61	4.48	3.52	0.33	0.33	0.01	568.30	0.06	0.01
Concrete Mixers	0	0	0	9	0.4	0.66	4.15	3.47	0.17	0.17	0.01	568.30	0.06	0.01
Crane	0	0	0	226	0.3	0.62	7.38	2.58	0.33	0.31	0.00	507.16	0.15	0.01
OCS Pole Foundation Construction - Crew #2														
Off-Highway Truck	1	2	90	400	0.4	0.35	4.05	1.89	0.15	0.14	0.00	509.86	0.15	0.01

Bore/Drill Rigs	1	3	90	206	0.5	0.19	2.90	1.13	0.09	0.08	0.00	502.13	0.15	0.01
Rubber Tired Loaders	1	4	90	200	0.4	0.39	5.12	1.45	0.17	0.16	0.00	503.65	0.15	0.01
Generators	1	4	90	84	0.4	0.58	4.41	3.47	0.31	0.31	0.01	568.30	0.05	0.01
Pumps	0	0	0	84	0.4	0.61	4.48	3.52	0.33	0.33	0.01	568.30	0.06	0.01
Concrete Mixers	0	0	0	9	0.4	0.66	4.15	3.47	0.17	0.17	0.01	568.30	0.06	0.01
Crane	0	0	0	226	0.3	0.62	7.38	2.58	0.33	0.31	0.00	507.16	0.15	0.01
OCS Pole & Cantilever Installation - Crew #1														
Off-Highway Truck	0	0	0	400	0.4	0.35	4.05	1.89	0.15	0.14	0.00	509.86	0.15	0.01
Crane	0	0	0	226	0.3	0.62	7.38	2.58	0.33	0.31	0.00	507.16	0.15	0.01
Generator	0	0	0	84	0.4	0.58	4.41	3.47	0.31	0.31	0.01	568.30	0.05	0.01
Backhoe	0	0	0	98	0.4	0.54	5.14	3.81	0.40	0.36	0.00	511.35	0.15	0.01
OCS Pole & Cantilever Installation - Crew #2														
Off-Highway Truck	0	0	0	400	0.4	0.35	4.05	1.89	0.15	0.14	0.00	509.86	0.15	0.01
Crane	0	0	0	226	0.3	0.62	7.38	2.58	0.33	0.31	0.00	507.16	0.15	0.01
Generator	0	0	0	84	0.4	0.58	4.41	3.47	0.31	0.31	0.01	568.30	0.05	0.01
Backhoe	0	0	0	98	0.4	0.54	5.14	3.81	0.40	0.36	0.00	511.35	0.15	0.01
OCS Wire Installation & Testing														
On-Track Wire Installation Equipment	0	0	0	172	0.4	0.52	5.82	3.36	0.31	0.28	0.00	503.96	0.15	0.01
Signal & Grade Crossings														
Signaling Equipment Installation at CPs & Houses														
Off-Highway Truck	1	0	90	400	0.4	0.35	4.05	1.89	0.15	0.14	0.00	509.86	0.15	0.01
Generators	1	0	90	84	0.4	0.58	4.41	3.47	0.31	0.31	0.01	568.30	0.05	0.01
Grade Crossing Modifications														
Off-Highway Truck	0	0	0	400	0.4	0.35	4.05	1.89	0.15	0.14	0.00	509.86	0.15	0.01
Backhoe	0	0	0	98	0.4	0.54	5.14	3.81	0.40	0.36	0.00	511.35	0.15	0.01
Generators	0	0	0	84	0.4	0.58	4.41	3.47	0.31	0.31	0.01	568.30	0.05	0.01
Communications														
Communication System Installation (incl. SCADA)														
Off-Highway Truck	0	0	0	400	0.4	0.35	4.05	1.89	0.15	0.14	0.00	509.86	0.15	0.01
Backhoe	0	0	0	98	0.4	0.54	5.14	3.81	0.40	0.36	0.00	511.35	0.15	0.01
Generators	0	0	0	84	0.4	0.58	4.41	3.47	0.31	0.31	0.01	568.30	0.05	0.01
Integration / Commissioning														
Integration Testing & Commissioning														
Generators	0	0	0	84	0.4	0.58	4.41	3.47	0.31	0.31	0.01	568.30	0.05	0.01

2016 Onroad Assumptions

2016	Vehicle Type	Trips/ Day	VMT/ day	VMT/ year	Days	grams per mile (EMFAC)									
						ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O	Other
Utilities															
Advance Utility Relocation															
	Employee Vehicle	15	186	16,740	90	0.04	0.13	1.29	0.00	0.00	0.00	344.71	-	-	17.24
	Flatbed	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
	Dump	1	50	4,500	90	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
Traction Power Substation Installation															
Advance Site Preparation - Traction Power Sites															
	Employee Vehicle	10	124	22,320	180	0.04	0.13	1.29	0.00	0.00	0.00	344.71	-	-	17.24
	Flatbed	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
	Dump	1	50	9,000	180	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
Traction Power Equipment Foundation Construction															
	Employee Vehicle	17.5	217	39,060	180	0.04	0.13	1.29	0.00	0.00	0.00	344.71	-	-	17.24
	Flatbed	2	100	18,000	180	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
	Dump	1	50	9,000	180	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
Traction Power Equipment Installation															
	Employee Vehicle	0	0	0	0	0.04	0.13	1.29	0.00	0.00	0.00	344.71	-	-	17.24
	Flatbed	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
	Dump	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
Traction Power Equipment Testing															
	Employee Vehicle	0	0	0	0	0.04	0.13	1.29	0.00	0.00	0.00	344.71	-	-	17.24
	Flatbed	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
	Dump	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
Overhead Contact System (OCS)															
OCS Pole Foundation Construction - Crew #1															
	Employee Vehicle	17.5	217	19,530	90	0.04	0.13	1.29	0.00	0.00	0.00	344.71	-	-	17.24
	Flatbed	1	50	4,500	90	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
	Dump	1	50	4,500	90	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
OCS Pole Foundation Construction - Crew #2															
	Employee Vehicle	17.5	217	19,530	90	0.04	0.13	1.29	0.00	0.00	0.00	344.71	-	-	17.24
	Flatbed	1	50	4,500	90	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
	Dump	1	50	4,500	90	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
OCS Pole & Cantilever Installation - Crew #1															
	Employee Vehicle	0	0	0	0	0.04	0.13	1.29	0.00	0.00	0.00	344.71	-	-	17.24
	Flatbed	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
	Dump	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
OCS Pole & Cantilever Installation - Crew #2															
	Employee Vehicle	0	0	0	0	0.04	0.13	1.29	0.00	0.00	0.00	344.71	-	-	17.24
	Flatbed	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
	Dump	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00

OCS Wire Installation & Testing															
	Employee Vehicle	0	0	0	0	0.04	0.13	1.29	0.00	0.00	0.00	344.71	-	-	17.24
	Flatbed	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
	Dump	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
Signal & Grade Crossings															
Signaling Equipment Installation at CPs & Houses															
	Employee Vehicle	5	62	5,580	90	0.04	0.13	1.29	0.00	0.00	0.00	344.71	-	-	17.24
	Flatbed	1	50	4,500	90	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
	Dump	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
Grade Crossing Modifications															
	Employee Vehicle	0	0	0	0	0.04	0.13	1.29	0.00	0.00	0.00	344.71	-	-	17.24
	Flatbed	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
	Dump	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
Communications															
Communication System Installation (incl. SCADA)															
	Employee Vehicle	0	0	0	0	0.04	0.13	1.29	0.00	0.00	0.00	344.71	-	-	17.24
	Flatbed	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
	Dump	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
Integration / Commissioning															
Integration Testing & Commissioning															
	Employee Vehicle	0	0	0	0	0.04	0.13	1.29	0.00	0.00	0.00	344.71	-	-	17.24
	Flatbed	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00
	Dump	0	0	0	0	0.24	7.60	1.01	0.08	0.07	0.00	1,780.94	0.10	0.05	0.00

2017 Offroad Assumptions

2017 Equipment	# Day	Hrs/ Day	Days	HP	LF	g/hp-hr (CalEEMod)								
						ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O
Utilities														
Advance Utility Relocation														
Off-Highway Truck	0	0	0	400	0.38	0.33	3.67	1.75	0.14	0.13	0.00	501.44	0.15	0.01
Excavator	0	0	0	163	0.38	0.33	3.70	3.15	0.18	0.17	0.00	498.52	0.15	0.01
Tractor/Loader/Backhoe	0	0	0	98	0.37	0.50	4.81	3.78	0.36	0.33	0.00	502.80	0.15	0.01
Concrete Industrial Saws	0	0	0	81	0.42	0.56	4.09	3.60	0.29	0.29	0.01	568.30	0.05	0.01
Generator Sets	0	0	0	84	0.42	0.52	4.07	3.44	0.27	0.27	0.01	568.30	0.05	0.01
Bore/Drill Rigs	0	0	0	206	0.5	0.17	2.52	1.10	0.07	0.07	0.00	494.14	0.15	0.01
Traction Power Substation Installation														
Advance Site Preparation - Traction Power Sites														
Off-Highway Trucks	0	0	0	400	0.38	0.33	3.67	1.75	0.14	0.13	0.00	501.44	0.15	0.01
Chainsaws (gas)	0	0	0	1	0.5	127.28	2.91	346.19	0.79	0.79	0.04	884.65	7.91	0.03
Trimmers/Edgers/Brush Cutters (gas)	0	0	0	1	0.5	20.58	8.53	391.40	0.46	0.46	0.03	858.88	1.16	0.03
Chippers/Stump Grinders (gas)	0	0	0	18	0.78	13.67	8.14	560.46	7.05	7.05	0.02	858.88	0.76	0.03
Traction Power Equipment Foundation Construction														
Off-Highway Truck	1	3	360	400	0.38	0.33	3.67	1.75	0.14	0.13	0.00	501.44	0.15	0.01
Tractor/Loader/Backhoe	1	3	300	98	0.37	0.50	4.81	3.78	0.36	0.33	0.00	502.80	0.15	0.01
Rubber Tired Loaders	1	3	180	200	0.36	0.37	4.75	1.42	0.16	0.15	0.00	495.95	0.15	0.01
Pumps	1	4	120	84	0.42	0.55	4.13	3.50	0.29	0.29	0.01	568.30	0.05	0.01
Vibratory Plate	1	4	120	8	0.42	0.66	4.14	3.47	0.16	0.16	0.01	568.30	0.06	0.01
Concrete Mixers	1	7	120	9	0.42	0.66	4.15	3.47	0.17	0.17	0.01	568.30	0.06	0.01
Crane	1	4	120	226	0.29	0.56	6.66	2.38	0.30	0.27	0.00	499.37	0.15	0.01
Traction Power Equipment Installation														
Off-Highway Truck	0	0	0	400	0.38	0.33	3.67	1.75	0.14	0.13	0.00	501.44	0.15	0.01
Crane	0	0	0	226	0.29	0.56	6.66	2.38	0.30	0.27	0.00	499.37	0.15	0.01
Tractor/Loader/Backhoe	0	0	0	98	0.37	0.50	4.81	3.78	0.36	0.33	0.00	502.80	0.15	0.01
Traction Power Equipment Testing														
Generator Set	0	0	0	84	0.42	0.52	4.07	3.44	0.27	0.27	0.01	568.30	0.05	0.01
Overhead Contact System (OCS)														
OCS Pole Foundation Construction - Crew #1														
Off-Highway Truck	1	2	360	400	0.38	0.33	3.67	1.75	0.14	0.13	0.00	501.44	0.15	0.01
Bore/Drill Rigs	1	3	70	206	0.5	0.17	2.52	1.10	0.07	0.07	0.00	494.14	0.15	0.01
Rubber Tired Loaders	1	4	150	200	0.36	0.37	4.75	1.42	0.16	0.15	0.00	495.95	0.15	0.01
Generators	1	4	360	84	0.42	0.52	4.07	3.44	0.27	0.27	0.01	568.30	0.05	0.01
Pumps	1	4	100	84	0.42	0.55	4.13	3.50	0.29	0.29	0.01	568.30	0.05	0.01
Concrete Mixers	1	7	100	9	0.42	0.66	4.15	3.47	0.17	0.17	0.01	568.30	0.06	0.01
Crane	1	4	100	226	0.29	0.56	6.66	2.38	0.30	0.27	0.00	499.37	0.15	0.01

OCS Pole Foundation Construction - Crew #2														
Off-Highway Truck	1	2	360	400	0.38	0.33	3.67	1.75	0.14	0.13	0.00	501.44	0.15	0.01
Bore/Drill Rigs	1	3	160	206	0.5	0.17	2.52	1.10	0.07	0.07	0.00	494.14	0.15	0.01
Rubber Tired Loaders	1	4	285	200	0.36	0.37	4.75	1.42	0.16	0.15	0.00	495.95	0.15	0.01
Generators	1	4	360	84	0.42	0.52	4.07	3.44	0.27	0.27	0.01	568.30	0.05	0.01
Pumps	1	4	100	84	0.42	0.55	4.13	3.50	0.29	0.29	0.01	568.30	0.05	0.01
Concrete Mixers	1	7	100	9	0.42	0.66	4.15	3.47	0.17	0.17	0.01	568.30	0.06	0.01
Crane	1	7	100	226	0.29	0.56	6.66	2.38	0.30	0.27	0.00	499.37	0.15	0.01
OCS Pole & Cantilever Installation - Crew #1														
Off-Highway Truck	1	3	360	400	0.38	0.33	3.67	1.75	0.14	0.13	0.00	501.44	0.15	0.01
Crane	1	4	180	226	0.29	0.56	6.66	2.38	0.30	0.27	0.00	499.37	0.15	0.01
Generator	1	3	360	84	0.42	0.52	4.07	3.44	0.27	0.27	0.01	568.30	0.05	0.01
Backhoe	1	3	180	98	0.37	0.50	4.81	3.78	0.36	0.33	0.00	502.80	0.15	0.01
OCS Pole & Cantilever Installation - Crew #2														
Off-Highway Truck	1	3	270	400	0.38	0.33	3.67	1.75	0.14	0.13	0.00	501.44	0.15	0.01
Crane	1	4	210	226	0.29	0.56	6.66	2.38	0.30	0.27	0.00	499.37	0.15	0.01
Generator	1	2	270	84	0.42	0.52	4.07	3.44	0.27	0.27	0.01	568.30	0.05	0.01
Backhoe	1	2	210	98	0.37	0.50	4.81	3.78	0.36	0.33	0.00	502.80	0.15	0.01
OCS Wire Installation & Testing														
On-Track Wire Installation Equipment	1	7	210	172	0.42	0.50	5.49	3.34	0.29	0.27	0.00	495.93	0.15	0.01
Signal & Grade Crossings														
Signaling Equipment Installation at CPs & Houses														
Off-Highway Truck	1	3	150	400	0.38	0.33	3.67	1.75	0.14	0.13	0.00	501.44	0.15	0.01
Generators	1	4	150	84	0.42	0.52	4.07	3.44	0.27	0.27	0.01	568.30	0.05	0.01
Grade Crossing Modifications														
Off-Highway Truck	0	0	0	400	0.38	0.33	3.67	1.75	0.14	0.13	0.00	501.44	0.15	0.01
Backhoe	0	0	0	98	0.37	0.50	4.81	3.78	0.36	0.33	0.00	502.80	0.15	0.01
Generators	0	0	0	84	0.42	0.52	4.07	3.44	0.27	0.27	0.01	568.30	0.05	0.01
Communications														
Communication System Installation (incl. SCADA)														
Off-Highway Truck	0	0	0	400	0.38	0.33	3.67	1.75	0.14	0.13	0.00	501.44	0.15	0.01
Backhoe	0	0	0	98	0.37	0.50	4.81	3.78	0.36	0.33	0.00	502.80	0.15	0.01
Generators	0	0	0	84	0.42	0.52	4.07	3.44	0.27	0.27	0.01	568.30	0.05	0.01
Integration / Commissioning														
Integration Testing & Commissioning														
Generators	0	0	0	84	0.42	0.52	4.07	3.44	0.27	0.27	0.01	568.30	0.05	0.01

2017 Onroad Assumptions

2017	Vehicle Type	Trips/ Day	VMT/ day	VMT/ year	Days	grams per mile (EMFAC)									
						ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O	Other
Utilities															
Advance Utility Relocation															
	Employee Vehicle	0	0	0	0	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
Traction Power Substation Installation															
Advance Site Preparation - Traction Power Sites															
	Employee Vehicle	0	0	0	0	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
Traction Power Equipment Foundation Construction															
	Employee Vehicle	17.5	217	78,120	360	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	2	100	36,000	360	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	1	50	18,000	360	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
Traction Power Equipment Installation															
	Employee Vehicle	0	0	0	0	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
Traction Power Equipment Testing															
	Employee Vehicle	0	0	0	0	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
Overhead Contact System (OCS)															
OCS Pole Foundation Construction - Crew #1															
	Employee Vehicle	17.5	217	78,120	360	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	1	50	18,000	360	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	1	50	18,000	360	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
OCS Pole Foundation Construction - Crew #2															
	Employee Vehicle	17.5	217	78,120	360	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	1	50	18,000	360	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	1	50	18,000	360	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
OCS Pole & Cantilever Installation - Crew #1															
	Employee Vehicle	10	124	44,640	360	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	1	50	18,000	360	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
OCS Pole & Cantilever Installation - Crew #2															
	Employee Vehicle	10	124	33,480	270	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	1	50	13,500	270	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00

OCS Wire Installation & Testing															
	Employee Vehicle	2.5	31	6,510	210	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
Signal & Grade Crossings															
Signaling Equipment Installation at CPs & Houses															
	Employee Vehicle	5	62	9,300	150	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	1	50	7,500	150	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
Grade Crossing Modifications															
	Employee Vehicle	0	0	0	0	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
Communications															
Communication System Installation (incl. SCADA)															
	Employee Vehicle	0	0	0	0	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
Integration / Commissioning															
Integration Testing & Commissioning															
	Employee Vehicle	0	0	0	0	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
						2	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*

2018 Offroad Assumptions

2018 Equipment	# Day	Hrs/ Day	Days	HP	LF	g/hp-hr (CalEEMod)								
						ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O
Utilities														
Advance Utility Relocation														
Off-Highway Truck	0	0	0	400	0.38	0.29	3.09	1.56	0.11	0.10	0.00	493.51	0.15	0.01
Excavator	0	0	0	163	0.38	0.27	2.92	3.09	0.14	0.13	0.00	490.67	0.15	0.01
Tractor/Loader/Backhoe	0	0	0	98	0.37	0.42	4.15	3.69	0.29	0.27	0.00	494.12	0.15	0.01
Concrete Industrial Saws	0	0	0	81	0.42	0.50	3.75	3.57	0.26	0.26	0.01	568.30	0.04	0.01
Generator Sets	0	0	0	84	0.42	0.46	3.75	3.42	0.24	0.24	0.01	568.30	0.04	0.01
Bore/Drill Rigs	0	0	0	206	0.5	0.15	2.15	1.07	0.06	0.06	0.00	484.56	0.15	0.01
Traction Power Substation Installation														
Advance Site Preparation - Traction Power Sites														
Off-Highway Trucks	0	0	0	400	0.38	0.29	3.09	1.56	0.11	0.10	0.00	493.51	0.15	0.01
Chainsaws (gas)	0	0	0	1	0.5	125.38	2.89	342.56	0.74	0.74	0.04	884.65	7.79	0.03
Trimmers/Edgers/Brush Cutters (gas)	0	0	0	1	0.5	20.24	8.55	387.19	0.42	0.42	0.03	858.88	1.14	0.03
Chippers/Stump Grinders (gas)	0	0	0	18	0.78	13.52	8.18	557.81	7.08	7.08	0.02	858.88	0.75	0.03
Traction Power Equipment Foundation Construction														
Off-Highway Truck	0	0	0	400	0.38	0.29	3.09	1.56	0.11	0.10	0.00	493.51	0.15	0.01
Tractor/Loader/Backhoe	0	0	0	98	0.37	0.42	4.15	3.69	0.29	0.27	0.00	494.12	0.15	0.01
Rubber Tired Loaders	0	0	0	200	0.36	0.33	4.13	1.35	0.14	0.13	0.00	487.90	0.15	0.01
Pumps	0	0	0	84	0.42	0.49	3.81	3.47	0.25	0.25	0.01	568.30	0.04	0.01
Vibratory Plate	0	0	0	8	0.42	0.66	4.14	3.47	0.16	0.16	0.01	568.30	0.06	0.01
Concrete Mixers	0	0	0	9	0.42	0.66	4.14	3.47	0.16	0.16	0.01	568.30	0.06	0.01
Crane	0	0	0	226	0.29	0.48	5.77	2.13	0.25	0.23	0.00	491.41	0.15	0.01
Traction Power Equipment Installation														
Off-Highway Truck	1	3	360	400	0.38	0.29	3.09	1.56	0.11	0.10	0.00	493.51	0.15	0.01
Crane	2	3	240	226	0.29	0.48	5.77	2.13	0.25	0.23	0.00	491.41	0.15	0.01
Tractor/Loader/Backhoe	1	3	240	98	0.37	0.42	4.15	3.69	0.29	0.27	0.00	494.12	0.15	0.01
Traction Power Equipment Testing														
Generator Set	1	7	210	84	0.42	0.46	3.75	3.42	0.24	0.24	0.01	568.30	0.04	0.01
Overhead Contact System (OCS)														
OCS Pole Foundation Construction - Crew #1														
Off-Highway Truck	1	2	120	400	0.38	0.29	3.09	1.56	0.11	0.10	0.00	493.51	0.15	0.01
Bore/Drill Rigs	0	0	0	206	0.5	0.15	2.15	1.07	0.06	0.06	0.00	484.56	0.15	0.01
Rubber Tired Loaders	0	0	0	200	0.36	0.33	4.13	1.35	0.14	0.13	0.00	487.90	0.15	0.01
Generators	1	4	120	84	0.42	0.46	3.75	3.42	0.24	0.24	0.01	568.30	0.04	0.01
Pumps	1	4	60	84	0.42	0.49	3.81	3.47	0.25	0.25	0.01	568.30	0.04	0.01
Concrete Mixers	1	7	60	9	0.42	0.66	4.14	3.47	0.16	0.16	0.01	568.30	0.06	0.01
Crane	1	4	60	226	0.29	0.48	5.77	2.13	0.25	0.23	0.00	491.41	0.15	0.01
OCS Pole Foundation Construction - Crew #2														
Off-Highway Truck	1	2	300	400	0.38	0.29	3.09	1.56	0.11	0.10	0.00	493.51	0.15	0.01

Bore/Drill Rigs	0	0	0	206	0.5	0.15	2.15	1.07	0.06	0.06	0.00	484.56	0.15	0.01
Rubber Tired Loaders	0	0	0	200	0.36	0.33	4.13	1.35	0.14	0.13	0.00	487.90	0.15	0.01
Generators	1	4	300	84	0.42	0.46	3.75	3.42	0.24	0.24	0.01	568.30	0.04	0.01
Pumps	1	4	150	84	0.42	0.49	3.81	3.47	0.25	0.25	0.01	568.30	0.04	0.01
Concrete Mixers	1	7	150	9	0.42	0.66	4.14	3.47	0.16	0.16	0.01	568.30	0.06	0.01
Crane	1	7	150	226	0.29	0.48	5.77	2.13	0.25	0.23	0.00	491.41	0.15	0.01
OCS Pole & Cantilever Installation - Crew #1														
Off-Highway Truck	1	3	210	400	0.38	0.29	3.09	1.56	0.11	0.10	0.00	493.51	0.15	0.01
Crane	1	4	180	226	0.29	0.48	5.77	2.13	0.25	0.23	0.00	491.41	0.15	0.01
Generator	1	3	210	84	0.42	0.46	3.75	3.42	0.24	0.24	0.01	568.30	0.04	0.01
Backhoe	1	3	180	98	0.37	0.42	4.15	3.69	0.29	0.27	0.00	494.12	0.15	0.01
OCS Pole & Cantilever Installation - Crew #2														
Off-Highway Truck	1	3	360	400	0.38	0.29	3.09	1.56	0.11	0.10	0.00	493.51	0.15	0.01
Crane	1	4	270	226	0.29	0.48	5.77	2.13	0.25	0.23	0.00	491.41	0.15	0.01
Generator	1	2	360	84	0.42	0.46	3.75	3.42	0.24	0.24	0.01	568.30	0.04	0.01
Backhoe	1	2	270	98	0.37	0.42	4.15	3.69	0.29	0.27	0.00	494.12	0.15	0.01
OCS Wire Installation & Testing														
On-Track Wire Installation Equipment	1	7	360	172	0.42	0.44	4.75	3.26	0.25	0.23	0.00	487.99	0.15	0.01
Signal & Grade Crossings														
Signaling Equipment Installation at CPs & Houses														
Off-Highway Truck	0	0	0	400	0.38	0.29	3.09	1.56	0.11	0.10	0.00	493.51	0.15	0.01
Generators	0	0	0	84	0.42	0.46	3.75	3.42	0.24	0.24	0.01	568.30	0.04	0.01
Grade Crossing Modifications														
Off-Highway Truck	1	3	240	400	0.38	0.29	3.09	1.56	0.11	0.10	0.00	493.51	0.15	0.01
Backhoe	1	3	150	98	0.37	0.42	4.15	3.69	0.29	0.27	0.00	494.12	0.15	0.01
Generators	1	4	240	84	0.42	0.46	3.75	3.42	0.24	0.24	0.01	568.30	0.04	0.01
Communications														
Communication System Installation (incl. SCADA)														
Off-Highway Truck	1	3	360	400	0.38	0.29	3.09	1.56	0.11	0.10	0.00	493.51	0.15	0.01
Backhoe	1	3	180	98	0.37	0.42	4.15	3.69	0.29	0.27	0.00	494.12	0.15	0.01
Generators	1	4	360	84	0.42	0.46	3.75	3.42	0.24	0.24	0.01	568.30	0.04	0.01
Integration / Commissioning														
Integration Testing & Commissioning														
Generators	0	0	0	84	0.42	0.46	3.75	3.42	0.24	0.24	0.01	568.30	0.04	0.01

OCS Wire Installation & Testing															
	Employee Vehicle	2.5	31	6,510	210	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
Signal & Grade Crossings															
Signaling Equipment Installation at CPs & Houses															
	Employee Vehicle	5	62	9,300	150	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	1	50	7,500	150	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
Grade Crossing Modifications															
	Employee Vehicle	0	0	0	0	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
Communications															
Communication System Installation (incl. SCADA)															
	Employee Vehicle	0	0	0	0	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
Integration / Commissioning															
Integration Testing & Commissioning															
	Employee Vehicle	0	0	0	0	0.03	0.12	1.14	0.00	0.00	0.00	344.87	-	-	17.24
	Flatbed	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	6.73	0.94	0.07	0.06	0.00	1,777.07	0.10	0.05	0.00

2018 Onroad Assumptions

2018	Vehicle Type	Trips/ Day	VMT/ day	VMT/ year	Days	grams per mile (EMFAC)									
						ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O	Other
Utilities															
Advance Utility Relocation															
	Employee Vehicle	0	0	0	0	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
Traction Power Substation Installation															
Advance Site Preparation - Traction Power Sites															
	Employee Vehicle	0	0	0	0	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
Traction Power Equipment Foundation Construction															
	Employee Vehicle	0	0	0	0	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
Traction Power Equipment Installation															
	Employee Vehicle	10	124	44,640	360	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	1	50	18,000	360	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
Traction Power Equipment Testing															
	Employee Vehicle	2.5	31	6,510	210	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
Overhead Contact System (OCS)															
OCS Pole Foundation Construction - Crew #1															
	Employee Vehicle	17.5	217	26,040	120	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	1	50	6,000	120	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	1	50	6,000	120	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
OCS Pole Foundation Construction - Crew #2															
	Employee Vehicle	17.5	217	65,100	300	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	1	50	15,000	300	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	1	50	15,000	300	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
OCS Pole & Cantilever Installation - Crew #1															
	Employee Vehicle	10	124	26,040	210	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	1	50	10,500	210	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
OCS Pole & Cantilever Installation - Crew #2															
	Employee Vehicle	10	124	44,640	360	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25

	Flatbed	1	50	18,000	360	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
OCS Wire Installation & Testing															
	Employee Vehicle	2.5	31	11,160	360	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
Signal & Grade Crossings															
Signaling Equipment Installation at CPs & Houses															
	Employee Vehicle	0	0	0	0	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
Grade Crossing Modifications															
	Employee Vehicle	7.5	93	22,320	240	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	1	50	12,000	240	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
Communications															
Communication System Installation (incl. SCADA)															
	Employee Vehicle	7.5	93	33,480	360	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	1	50	18,000	360	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
Integration / Commissioning															
Integration Testing & Commissioning															
	Employee Vehicle	0	0	0	0	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00

2019 Offroad Assumptions

2019 Equipment	# Day	Hrs/ Day	Days	HP	LF	g/hp-hr (CalEEMod)								
						ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O
Utilities														
Advance Utility Relocation														
Off-Highway Truck	0	0	0	400	0.38	0.26	2.67	1.48	0.10	0.09	0.00	485.38	0.15	0.01
Excavator	0	0	0	163	0.38	0.25	2.53	3.08	0.12	0.11	0.00	482.68	0.15	0.01
Tractor/Loader/Backhoe	0	0	0	98	0.37	0.37	3.69	3.64	0.25	0.23	0.00	485.85	0.15	0.01
Concrete Industrial Saws	0	0	0	81	0.42	0.44	3.44	3.55	0.22	0.22	0.01	568.30	0.04	0.01
Generator Sets	0	0	0	84	0.42	0.41	3.45	3.40	0.21	0.21	0.01	568.30	0.04	0.01
Bore/Drill Rigs	0	0	0	206	0.5	0.14	1.89	1.06	0.05	0.05	0.00	475.79	0.15	0.01
Traction Power Substation Installation														
Advance Site Preparation - Traction Power Sites														
Off-Highway Trucks	0	0	0	400	0.38	0.26	2.67	1.48	0.10	0.09	0.00	485.38	0.15	0.01
Chainsaws (gas)	0	0	0	1	0.5	123.70	2.88	339.38	0.70	0.70	0.04	884.65	7.69	0.03
Trimmers/Edgers/Brush Cutters (gas)	0	0	0	1	0.5	19.98	8.57	384.06	0.39	0.39	0.03	858.88	1.12	0.03
Chippers/Stump Grinders (gas)	0	0	0	18	0.78	13.43	8.20	556.11	7.10	7.10	0.02	858.88	0.75	0.03
Traction Power Equipment Foundation Construction														
Off-Highway Truck	0	0	0	400	0.38	0.26	2.67	1.48	0.10	0.09	0.00	485.38	0.15	0.01
Tractor/Loader/Backhoe	0	0	0	98	0.37	0.37	3.69	3.64	0.25	0.23	0.00	485.85	0.15	0.01
Rubber Tired Loaders	0	0	0	200	0.36	0.31	3.74	1.30	0.13	0.12	0.00	480.10	0.15	0.01
Pumps	0	0	0	84	0.42	0.43	3.50	3.45	0.22	0.22	0.01	568.30	0.04	0.01
Vibratory Plate	0	0	0	8	0.42	0.66	4.14	3.47	0.16	0.16	0.01	568.30	0.06	0.01
Concrete Mixers	0	0	0	9	0.42	0.66	4.14	3.47	0.16	0.16	0.01	568.30	0.06	0.01
Crane	0	0	0	226	0.29	0.43	5.08	1.94	0.22	0.20	0.00	483.46	0.15	0.01
Traction Power Equipment Installation														
Off-Highway Truck	1	3	120	400	0.38	0.26	2.67	1.48	0.10	0.09	0.00	485.38	0.15	0.01
Crane	2	3	120	226	0.29	0.43	5.08	1.94	0.22	0.20	0.00	483.46	0.15	0.01
Tractor/Loader/Backhoe	1	3	120	98	0.37	0.37	3.69	3.64	0.25	0.23	0.00	485.85	0.15	0.01
Traction Power Equipment Testing														
Generator Set	1	7	180	84	0.42	0.41	3.45	3.40	0.21	0.21	0.01	568.30	0.04	0.01
Overhead Contact System (OCS)														
OCS Pole Foundation Construction - Crew #1														
Off-Highway Truck	0	0	0	400	0.38	0.26	2.67	1.48	0.10	0.09	0.00	485.38	0.15	0.01
Bore/Drill Rigs	0	0	0	206	0.5	0.14	1.89	1.06	0.05	0.05	0.00	475.79	0.15	0.01
Rubber Tired Loaders	0	0	0	200	0.36	0.31	3.74	1.30	0.13	0.12	0.00	480.10	0.15	0.01
Generators	0	0	0	84	0.42	0.41	3.45	3.40	0.21	0.21	0.01	568.30	0.04	0.01
Pumps	0	0	0	84	0.42	0.43	3.50	3.45	0.22	0.22	0.01	568.30	0.04	0.01
Concrete Mixers	0	0	0	9	0.42	0.66	4.14	3.47	0.16	0.16	0.01	568.30	0.06	0.01
Crane	0	0	0	226	0.29	0.43	5.08	1.94	0.22	0.20	0.00	483.46	0.15	0.01
OCS Pole Foundation Construction - Crew #2														
Off-Highway Truck	0	0	0	400	0.38	0.26	2.67	1.48	0.10	0.09	0.00	485.38	0.15	0.01

Bore/Drill Rigs	0	0	0	206	0.5	0.14	1.89	1.06	0.05	0.05	0.00	475.79	0.15	0.01
Rubber Tired Loaders	0	0	0	200	0.36	0.31	3.74	1.30	0.13	0.12	0.00	480.10	0.15	0.01
Generators	0	0	0	84	0.42	0.41	3.45	3.40	0.21	0.21	0.01	568.30	0.04	0.01
Pumps	0	0	0	84	0.42	0.43	3.50	3.45	0.22	0.22	0.01	568.30	0.04	0.01
Concrete Mixers	0	0	0	9	0.42	0.66	4.14	3.47	0.16	0.16	0.01	568.30	0.06	0.01
Crane	0	0	0	226	0.29	0.43	5.08	1.94	0.22	0.20	0.00	483.46	0.15	0.01
OCS Pole & Cantilever Installation - Crew #1														
Off-Highway Truck	0	0	0	400	0.38	0.26	2.67	1.48	0.10	0.09	0.00	485.38	0.15	0.01
Crane	0	0	0	226	0.29	0.43	5.08	1.94	0.22	0.20	0.00	483.46	0.15	0.01
Generator	0	0	0	84	0.42	0.41	3.45	3.40	0.21	0.21	0.01	568.30	0.04	0.01
Backhoe	0	0	0	98	0.37	0.37	3.69	3.64	0.25	0.23	0.00	485.85	0.15	0.01
OCS Pole & Cantilever Installation - Crew #2														
Off-Highway Truck	1	3	60	400	0.38	0.26	2.67	1.48	0.10	0.09	0.00	485.38	0.15	0.01
Crane	1	4	0	226	0.29	0.43	5.08	1.94	0.22	0.20	0.00	483.46	0.15	0.01
Generator	1	2	60	84	0.42	0.41	3.45	3.40	0.21	0.21	0.01	568.30	0.04	0.01
Backhoe	1	2	0	98	0.37	0.37	3.69	3.64	0.25	0.23	0.00	485.85	0.15	0.01
OCS Wire Installation & Testing						0.41	4.43	3.26	0.23	0.21	0.00	480.45	0.15	0.01
On-Track Wire Installation Equipment	1	7	150	172	0.42	0.41	4.43	3.26	0.23	0.21	0.00	480.45	0.15	0.01
Signal & Grade Crossings														
Signaling Equipment Installation at CPs & Houses														
Off-Highway Truck	0	0	0	400	0.38	0.26	2.67	1.48	0.10	0.09	0.00	485.38	0.15	0.01
Generators	0	0	0	84	0.42	0.41	3.45	3.40	0.21	0.21	0.01	568.30	0.04	0.01
Grade Crossing Modifications														
Off-Highway Truck	1	3	150	400	0.38	0.26	2.67	1.48	0.10	0.09	0.00	485.38	0.15	0.01
Backhoe	1	3	90	98	0.37	0.37	3.69	3.64	0.25	0.23	0.00	485.85	0.15	0.01
Generators	1	4	150	84	0.42	0.41	3.45	3.40	0.21	0.21	0.01	568.30	0.04	0.01
Communications														
Communication System Installation (incl. SCADA)														
Off-Highway Truck	1	3	150	400	0.38	0.26	2.67	1.48	0.10	0.09	0.00	485.38	0.15	0.01
Backhoe	0	0	0	98	0.37	0.37	3.69	3.64	0.25	0.23	0.00	485.85	0.15	0.01
Generators	1	4	150	84	0.42	0.41	3.45	3.40	0.21	0.21	0.01	568.30	0.04	0.01
Integration / Commissioning														
Integration Testing & Commissioning														
Generators	1	4	210	84	0.42	0.41	3.45	3.40	0.21	0.21	0.01	568.30	0.04	0.01

	Flatbed	1	50	18,000	360	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
OCS Wire Installation & Testing															
	Employee Vehicle	2.5	31	11,160	360	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
Signal & Grade Crossings															
Signaling Equipment Installation at CPs & Houses															
	Employee Vehicle	0	0	0	0	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
Grade Crossing Modifications															
	Employee Vehicle	7.5	93	22,320	240	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	1	50	12,000	240	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
Communications															
Communication System Installation (incl. SCADA)															
	Employee Vehicle	7.5	93	33,480	360	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	1	50	18,000	360	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
Integration / Commissioning															
Integration Testing & Commissioning															
	Employee Vehicle	0	0	0	0	0.02	0.11	1.01	0.00	0.00	0.00	345.03	-	-	17.25
	Flatbed	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00
	Dump	0	0	0	0	0.23	5.99	0.94	0.06	0.06	0.00	1,773.36	0.10	0.05	0.00

2019 Onroad Assumptions

2019	Vehicle Type	Trips/ Day	VMT/ day	VMT/ year	Days	grams per mile (EMFAC)									
						ROG	NOX	CO	PM10	PM2.5	SO2	CO2	CH4	N2O	Other
Utilities															
Advance Utility Relocation															
	Employee Vehicle	0	0	0	0	0.02	0.10	0.91	0.00	0.00	0.00	345.16	-	-	17.26
	Flatbed	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
Traction Power Substation Installation															
Advance Site Preparation - Traction Power Sites															
	Employee Vehicle	0	0	0	0	0.02	0.10	0.91	0.00	0.00	0.00	345.16	-	-	17.26
	Flatbed	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
Traction Power Equipment Foundation Construction															
	Employee Vehicle	0	0	0	0	0.02	0.10	0.91	0.00	0.00	0.00	345.16	-	-	17.26
	Flatbed	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
Traction Power Equipment Installation															
	Employee Vehicle	10	124	14,880	120	0.02	0.10	0.91	0.00	0.00	0.00	345.16	-	-	17.26
	Flatbed	1	50	6,000	120	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
Traction Power Equipment Testing															
	Employee Vehicle	2.5	31	5,580	180	0.02	0.10	0.91	0.00	0.00	0.00	345.16	-	-	17.26
	Flatbed	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
Overhead Contact System (OCS)															
OCS Pole Foundation Construction - Crew #1															
	Employee Vehicle	0	0	0	0	0.02	0.10	0.91	0.00	0.00	0.00	345.16	-	-	17.26
	Flatbed	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
OCS Pole Foundation Construction - Crew #2															
	Employee Vehicle	0	0	0	0	0.02	0.10	0.91	0.00	0.00	0.00	345.16	-	-	17.26
	Flatbed	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
OCS Pole & Cantilever Installation - Crew #1															
	Employee Vehicle	0	0	0	0	0.02	0.10	0.91	0.00	0.00	0.00	345.16	-	-	17.26
	Flatbed	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
OCS Pole & Cantilever Installation - Crew #2															
	Employee Vehicle	10	124	7,440	60	0.02	0.10	0.91	0.00	0.00	0.00	345.16	-	-	17.26

	Flatbed	1	50	3,000	60	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
OCS Wire Installation & Testing															
	Employee Vehicle	2.5	31	4,650	150	0.02	0.10	0.91	0.00	0.00	0.00	345.16	-	-	17.26
	Flatbed	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
Signal & Grade Crossings															
Signaling Equipment Installation at CPs & Houses															
	Employee Vehicle	0	0	0	0	0.02	0.10	0.91	0.00	0.00	0.00	345.16	-	-	17.26
	Flatbed	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
Grade Crossing Modifications															
	Employee Vehicle	7.5	93	13,950	150	0.02	0.10	0.91	0.00	0.00	0.00	345.16	-	-	17.26
	Flatbed	1	50	7,500	150	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
Communications															
Communication System Installation (incl. SCADA)															
	Employee Vehicle	7.5	93	13,950	150	0.02	0.10	0.91	0.00	0.00	0.00	345.16	-	-	17.26
	Flatbed	1	50	7,500	150	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
Integration / Commissioning															
Integration Testing & Commissioning															
	Employee Vehicle	2.5	31	6,510	210	0.02	0.10	0.91	0.00	0.00	0.00	345.16	-	-	17.26
	Flatbed	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00
	Dump	0	0	0	0	0.22	5.40	0.93	0.06	0.06	0.00	1,770.35	0.10	0.05	0.00

Re-Entrained Road Dust Calculations

Methodology

Calculation Methodology: USEPA AP-42, Paved Roads, Section 13.2.1, Revised January 2011:
http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0201.pdf
Avg Vehicle Weight, Silt Loading, and Precipitation Days (>0.254mm) for BAAQMD

Emission Factor Calculation

$$E_{ext} = [\, k\,(sL)^{0.91} \times (W)^{1.02} \,]\,(1 - P/4N)$$

Pollutant	Variables					Emission Factor
	k	sL	W	P	N	(lbs per VMT)
PM_{10}	0.0022	0.1	2.4	64	365	0.00063
$PM_{2.5}$	0.00054	0.1	2.4	64	365	0.00016

E = particulate emission factor (grams of particulate matter/VMT)
k = particle size multiplier (lb/VMT) *default from AP-42*
sL = roadway silt loading (g/m2) *Caleemod Default*
W = average weight of vehicles on the road (tons) *Caleemod Default*
P = number of wet days with > 0.254mm of precipitation *Caleemod Default for BAAQMD*
N = number of days in the averaging period *annual days*

	2015			2016		
Segment/Phase	**Daily VMT**	**Daily PM10**	**Daily PM2.5**	**Daily VMT**	**Daily PM10**	**Daily PM2.5**
Utilities	**236**	**0.15**	**0.04**	**236**	**0.15**	**0.04**
Advance Utility Relocation	236	0.15	0.04	236	0.15	0.04
Traction Power Substation Installation	**0**	**0.00**	**0.00**	**541**	**0.34**	**0.08**
Advance Site Preparation - Traction Power Sites	0	0.00	0.00	174	0.11	0.03
Traction Power Equipment Foundation Construction	0	0.00	0.00	367	0.23	0.06
Traction Power Equipment Installation	0	0.00	0.00	0	0.00	0.00
Traction Power Equipment Testing	0	0.00	0.00	0	0.00	0.00
Overhead Contact System (OCS)	**0**	**0.00**	**0.00**	**634**	**0.40**	**0.10**
OCS Pole Foundation Construction - Crew #1	0	0.00	0.00	317	0.20	0.05
OCS Pole Foundation Construction - Crew #2	0	0.00	0.00	317	0.20	0.05
OCS Pole & Cantilever Installation - Crew #1	0	0.00	0.00	0	0.00	0.00
OCS Pole & Cantilever Installation - Crew #2	0	0.00	0.00	0	0.00	0.00
OCS Wire Installation & Testing	0	0.00	0.00	0	0.00	0.00
Signal & Grade Crossings	**0**	**0.00**	**0.00**	**112**	**0.07**	**0.02**

Signaling Equipment Installation at CPs & Houses	0	0.00	0.00	112	0.07	0.02
Grade Crossing Modifications	0	0.00	0.00	0	0.00	0.00
Communications	**0**	**0.00**	**0.00**	**0**	**0.00**	**0.00**
Communication System Installation (incl. SCADA)	0	0.00	0.00	0	0.00	0.00
Integration / Commissioning	**0**	**0.00**	**0.00**	**0**	**0.00**	**0.00**
Integration Testing & Commissioning	0	0.00	0.00	0	0.00	0.00
		2017			**2018**	
Segment/Phase	**Daily VMT**	**Daily PM10**	**Daily PM2.5**	**Daily VMT**	**Daily PM10**	**Daily PM2.5**
Utilities	**0**	**0.00**	**0.00**	**0**	**0.00**	**0.00**
Advance Utility Relocation	0	0.00	0.00	0	0.00	0.00
Traction Power Substation Installation	**367**	**0.23**	**0.06**	**205**	**0.13**	**0.03**
Advance Site Preparation - Traction Power Sites	0	0.00	0.00	0	0.00	0.00
Traction Power Equipment Foundation Construction	367	0.23	0.06	0	0.00	0.00
Traction Power Equipment Installation	0	0.00	0.00	174	0.11	0.03
Traction Power Equipment Testing	0	0.00	0.00	31	0.02	0.00
Overhead Contact System (OCS)	**1,013**	**0.64**	**0.16**	**1,013**	**0.64**	**0.16**
OCS Pole Foundation Construction - Crew #1	317	0.20	0.05	317	0.20	0.05
OCS Pole Foundation Construction - Crew #2	317	0.20	0.05	317	0.20	0.05
OCS Pole & Cantilever Installation - Crew #1	174	0.11	0.03	174	0.11	0.03
OCS Pole & Cantilever Installation - Crew #2	174	0.11	0.03	174	0.11	0.03
OCS Wire Installation & Testing	31	0.02	0.00	31	0.02	0.00
Signal & Grade Crossings	**112**	**0.07**	**0.02**	**143**	**0.09**	**0.02**
Signaling Equipment Installation at CPs & Houses	112	0.07	0.02	0	0.00	0.00
Grade Crossing Modifications	0	0.00	0.00	143	0.09	0.02
Communications	**0**	**0.00**	**0.00**	**143**	**0.09**	**0.02**
Communication System Installation (incl. SCADA)	0	0.00	0.00	143	0.09	0.02
Integration / Commissioning	**0**	**0.00**	**0.00**	**0**	**0.00**	**0.00**
Integration Testing & Commissioning	0	0.00	0.00	0	0.00	0.00

	2019		
Segment/Phase	**Daily VMT**	**Daily PM10**	**Daily PM2.5**
Utilities	**0**	**0.00**	**0.00**
Advance Utility Relocation	0	0.00	0.00
Traction Power Substation Installation	**205**	**0.13**	**0.03**
Advance Site Preparation - Traction Power Sites	0	0.00	0.00
Traction Power Equipment Foundation Construction	0	0.00	0.00
Traction Power Equipment Installation	174	0.11	0.03
Traction Power Equipment Testing	31	0.02	0.00
Overhead Contact System (OCS)	**205**	**0.13**	**0.03**
OCS Pole Foundation Construction - Crew #1	0	0.00	0.00
OCS Pole Foundation Construction - Crew #2	0	0.00	0.00
OCS Pole & Cantilever Installation - Crew #1	0	0.00	0.00
OCS Pole & Cantilever Installation - Crew #2	174	0.11	0.03
OCS Wire Installation & Testing	31	0.02	0.00

Signal & Grade Crossings	**143**	**0.09**	**0.02**
Signaling Equipment Installation at CPs & Houses	0	0.00	0.00
Grade Crossing Modifications	143	0.09	0.02
Communications	**143**	**0.09**	**0.02**
Communication System Installation (incl. SCADA)	143	0.09	0.02
Integration / Commissioning	**31**	**0.02**	**0.00**
Integration Testing & Commissioning	31	0.02	0.00

Grading Calculations

Phase	SF	Acres	Acres/Day	PM10	PM2.5
Advance Site Preparation - Traction Power Sites	120,960	2.78	0.69	6.94	1.44

Average Daily Equipment Hours

The maximum daily hours were used to evaluate criteria pollutant emissions. Annual greenhouse gas emissions were evaluated using the following average daily assumptions.

Electrification Activities	Equipment	Ave Hr per day
Utilities		
Advance Utility Relocation	Off-Highway Truck	1.8
	Excavator	1.8
	Tractor/Loader/Backhoe	1.8
	Concrete Industrial Saws	1.2
	Generator Sets	2.4
	Bore/Drill Rigs	1.8
Traction Power Substation Installation		
Advance Site Preparation - Traction Power Sites	Off-Highway Truck	1.8
	Chainsaw	1.2
	Trimmer/Edger/Brush Cutter	1.2
	Chippers/Stump Grinders	1.2
Traction Power Equipment Foundation Construction	Off-Highway Truck	1.8
	Tractor/Loader/Backhoe	1.8
	Rubber Tired Loaders	1.8
	Pumps	2
	Vibratory Plate	2
	Concrete Mixers	4
	Crane	2
Traction Power Equipment Installation	Off-Highway Truck	1.8
	Crane	1.8
	Tractor/Loader/Backhoe	1.8
Traction Power Equipment Testing	Generator Set	4
Overhead Contact System (OCS)		
OCS Pole Foundation Construction - Crew #1	Off-Highway Truck	1.2
	Bore/Drill Rigs	1.8
	Rubber Tired Loaders	2.4
	Generators	2.4
	Pumps	2
	Concrete Mixers	4
	Crane	2
OCS Pole Foundation Construction - Crew #2	Off-Highway Truck	1.2
	Bore/Drill Rigs	1.8
	Rubber Tired Loaders	2.4
	Generators	2.4
	Pumps	2
	Concrete Mixers	4
	Crane	2
OCS Pole & Cantilever Installation - Crew #1	Off-Highway Truck	1.2
	Crane	2.4
	Generator	1.2
	Backhoe	1.2
OCS Pole & Cantilever Installation - Crew #2	Off-Highway Truck	1.2
	Crane	2.4
	Generator	1.2
	Backhoe	1.2
OCS Wire Installation & Testing	On-Track Wire Installation Equipment	4
Signal & Grade Crossings		

Signaling Equipment Installation at CPs & Houses	Off-Highway Truck	1.2
	Generators	2.4
Grade Crossing Modifications	Off-Highway Truck	1.2
	Backhoe	1.2
	Generators	2.4
Communications		
Communication System Installation (incl. SCADA)	Off-Highway Truck	1.2
	Backhoe	1.2
	Generators	2.4
Integration / Commissioning		
Integration Testing & Commissioning	Generators	2.4

Caltrain Electrification

Screen Level Health Risk Assessment - Construction

Construction Emissions and Emission Rates*

Construction Phase	PM10 Emissions (tons/year)	PM2.5 Emissions (tons/year)	Average hours/day	Average days/phase	PM10 Emission Rate (g/s)	PM2.5 Emission Rate (g/s)
Utilities (2015)	0.03	0.02	1.8	120	0.03037	0.028
Traction Power Substation Installation (2016)	0.04	0.04	2.0	66.0	0.07562	0.071
Overhead Contact System (OCS) (2017)	0.14	0.13	2.1	215.4	0.07975	0.075
Signal & Grade Crossings (2016)	0.01	0.01	1.7	36.0	0.02206	0.021
Communications (2018)	0.02	0.02	1.6	300.0	0.00972	0.009
Integration / Commissioning (2019)	0.00	0.00	2.4	210	0.00192	0.002

*DPM emissions are assumed to be equal to PM exhaust emission. Analysis conducted for highest DPM emissions.

Construction Health Risk (Table 3.2-8. Maximum Project-Level Health Risks during Construction)

		Concentrations (AERMOD)			Project-Level Risk		
Construction Phase	Max Receptor Distance (m)	Hourly PM10 Concentration (ug/m3)	Hourly PM2.5 Concentration (ug/m3)	Annual DPM Concentration (ug/m3)	Chronic Non-Cancer Hazard Index (HI)	DPM Cancer Risk (per Million)	Annual PM2.5 Concentration (ug/m3)
Utilities (2015)	50	0.19	0.18	0.0193	0.004	0.149	0.000
Traction Power Substation Installation (2016)	50	0.48	0.45	0.0481	0.010	0.372	0.001
Overhead Contact System (OCS) (2017)	50	0.51	0.48	0.0507	0.010	0.392	0.002
Signal & Grade Crossings (2016)	50	0.14	0.13	0.0141	0.003	0.109	0.000
Communications (2018)	50	0.06	0.06	0.0062	0.001	0.048	0.000
Integration / Commissioning (2019)	50	0.01	0.01	0.0012	0.000	0.009	0.000
BAAQMD Thresholds					**1**	**10**	**0.3**

Health Risk Calculation Factors

Hourly to Annual Concentration scaling factor	0.1	(per BAAQMD 2007 guidance)
Chronic Reference Exposure Level	5	(per OEHHA)
Daily Breath Rate - adult (L/kg-day)	302	
Daily Breath Rate - child (L/kg-day)	581	
Conversion Factor (mg/ug)	0.001	
Conversion Factor (m3/L)	0.001	
DPM Cancer Potency Factor ($[mg/kg\text{-}day]^{-1}$)	1.1	
Average Age Sensitivity Factor - residence	1.7	
Average Age Sensitivity Factor - office	1	
Average Age Sensitivity Factor - school	3	
Average Life Time (years)	70	
Average Life Time (days)	25550	

Exposure Frequency	Hours/day	Days/year	Years
Residence	24	350	70
School	8	200	6
Office	12	280	30

Carbon Stock Calculations

Common Name	Scientific Name	%	Trees Removed	Carbon Stock Removed (MT CO2)
Acacia	*Acacia sp.*	6%	134	201.50
Calif. Buckeye	*Aesculus californica*	0%	1	1.33
Eucalyptus	*Eucalyptus sp.*	8%	185	348.87
Fig	*Ficus sp.*	0%	2	1.74
Monterey Cypress	*Hesperocyparis macrocarpa*	1%	20	16.18
Myoporum	*Myoporum sp.*	0%	6	7.03
London plane	*Platanus x hispanica*	3%	73	94.53
Alder	*Alnus sp.*	0%	3	3.29
Brisbane box	*Lophostemon confertus*	2%	36	21.63
Mayten	*Maytenus boaria*	0%	1	0.73
Pine	*Pinus sp.*	4%	88	86.63
Pittosporum	*Pittosporum sp.*	0%	7	7.83
Willow	*Salix sp.*	0%	5	6.66
Pepper	*Schinus sp.*	2%	48	50.51
Bottlebrush	*Melaleuca citrina*	0%	2	0.63
Lombardy poplar	*Populus nigra*	1%	27	56.33
Canary Island Date Palm	*Phoenix canariensis*	0%	10	3.32
Oak	*Quercus sp.*	8%	188	410.66
Maple	*Acer sp.*	0%	6	9.90
Citrus	*Citrus sp.*	0%	1	1.04
Ash	*Fraxinus sp.*	1%	21	28.28
Black walnut	*Juglans nigra*	2%	37	55.60
Glossy privet	*Ligustrum lucidum*	1%	15	18.26
Purple leaf plum	*Prunus cerasifera*	0%	2	0.95
Coast redwood	*Sequoia sempervirens*	10%	227	179.10
Bailey acacia	*Acacia baileyana*	1%	17	25.82
Blackwood acacia	*Acacia melanoxylon*	1%	29	44.03
Blue gum	*Eucalyptus globulus*	0%	7	12.33
Coast live oak	*Quercus agrifolia*	8%	182	398.42
Monterey pine	*Pinus radiata*	0%	10	9.50
Mulberry	*Morus alba*	0%	0	0.24
Plum	*Prunus domestica*	0%	1	2.86
River red gum	*Eucalyptus camaldulensis*	0%	0	0.37
Valley oak	*Quercus lobata*	0%	11	23.44
Carrotwood	*Cupaniopsis anacardioides*	0%	1	0.72
Melaleuca	*Melaleuca sp.*	3%	73	41.46
Palm	*Phoenix sp. or Washingtonia*	1%	23	7.85
African sumac	*Rhus lancea*	0%	5	4.75
Zelkova	*Zelkova sp.*	0%	1	1.80
Canary Island palm	*Phoenix canariensis*	0%	4	1.24
Canary island pine	*Pinus canariensis*	0%	1	0.95
Pear	*Pyrus sp.*	2%	54	89.69
Evergreen pear	*Pyrus kawakamii*	1%	13	21.42
She-oak	*Casuarina sp.*	0%	5	10.80
Italian cypress	*Cupressus sempervirens*	2%	46	36.22
Dragon tree	*Dracaena draco*	0%	1	1.84
Locust	*Robinia sp.*	0%	5	10.09
Redwood	*Sequoia sempervirens*	0%	4	3.49
Elm	*Ulmus sp.*	0%	7	9.52
Crape myrtle	*Lagerstroemia indica*	2%	37	33.56
Camphor	*Cinnamomum camphora*	2%	35	40.20
Sweetgum	*Liquidambar stryaciflua*	3%	60	67.37
Tree of heaven	*Ailanthus altissima*	4%	96	120.16
Hackberry	*Celtis occidentalis*	0%	1	3.04

Hawthorn	*Crataegus sp.*	0%	3	8.04
Southern magnolia	*Magnolia grandiflora*	0%	3	4.37
Chinese pistache	*Pistacia chinensis*	0%	7	5.26
American elm	*Ulmus americana*	0%	3	6.18
California black walnut	*Juglans hindsii*	0%	1	1.55
Callery pear	*Pyrus calleryana*	0%	1	1.72
Compact blue gum	*Eucalyptus globulus*	0%	6	11.78
Italian buckthorn	*Rhamnus alaternus*	0%	2	2.61
Pittosporum sp.	*Pittosporum sp.*	0%	9	9.96
Podocarpus	*Podocarpus sp.*	1%	20	5.62
Arizona cypress	*Cupressus arizonica*	0%	1	1.34
California black	n/a	0%	0	0.00
English walnut	*Juglans regia*	0%	3	3.96
Italian stone pine	*Pinus pinea*	0%	1	0.91
Fremont	n/a	0%	0	0.00
cottonwood	*Populus fremontii*	0%	1	2.10
Portuguese laurel	*Prunus lusitanica*	0%	2	1.53
Holly Oak	*Quercus ilex*	0%	1	2.34
n/a	*Robinia x ambigua*	0%	0	0.00
Windmill palm	*Trachycarpus fortunei*	0%	1	0.37
California bay	*Umbellularia californica*	0%	3	4.02
Casuarina	*Casuarina sp.*	0%	1	1.57
Walnut	*Juglans sp.*	0%	5	8.08
Fremont cottonwood	*Populus fremontii*	0%	4	7.14
Chinese elm	*Ulmus parvifolia*	1%	15	21.14
Deodar cedar	*Cedrus deodara*	0%	9	6.34
Carob	*Ceratonia siliqua*	0%	7	7.28
Blue gum	*Eucalyptus globulus*	0%	7	12.33
Compacta	n/a	0%	2	2.73
Manna gum	n/a	0%	2	2.43
Juniper	n/a	0%	1	1.37
Glossy privet	n/a	0%	2	2.73
Austrian pine	n/a	0%	7	5.58
Monterey pine	n/a	0%	2	2.16
Victorian box	n/a	0%	2	2.32
Almond	n/a	0%	1	1.37
Coast Live Oak	n/a	3%	57	124.00
Holly Oak	n/a	0%	4	9.54
California pepper	n/a	0%	2	2.30
Jacaranda	*Jacaranda mimosifolia*	1%	24	9.95
Olive	*Olea europaea*	0%	3	1.98
Silk tree	*Albizia julibrissin*	0%	10	12.98
Strawberry tree	*Arbutus unedo*	0%	5	6.49
Loquat	*Eriobotrya sp.*	0%	5	6.49
Australian willow	*Geijera parviflora*	1%	16	23.18
Bottle brush	*Melaleuca citrina*	3%	73	28.24
Madrone	*Arbutus menziesii*	0%	2	2.51
Fruit	*Prunus sp.*	0%	3	6.91
Box elder	*Acer negundo*	0%	2	2.77
Pistache	*Pistacia sp.*	0%	2	1.23
Elderberry	*Sambucus sp.*	0%	2	2.05
Total			**2,220**	**3,035**

Construction Results (Critiera Pollutants and GHGs)

Table 1. Maximum Unmitigated Construction Emissions (pounds per day)

Year	ROG	NO_X	CO	PM10		PM2.5	
				Exhaust	Dust	Exhaust	Dust
2015	1	13	7	1	0	1	0
2016	3	39	45	1	7	1	2
2017	6	75	36	3	1	3	0
2018	5	60	33	3	1	2	0
2019	3	32	21	1	0	1	0
Threshold	54	54	-	82	BMPs	54	BMPs

Table 2. Construction GHG Emissions (metric tons CO_2e)

Construction Phase	2015	2016	2017	2018	2019	Phase Total
Utilities	105	42	0	0	0	146
Traction Power Substation Installatio	0	157	211	153	67	589
Overhead Contact System	0	105	601	434	38	1178
Signal and At-Grade Crossings	0	19	31	56	34	140
Communications	0	0	0	83	33	115
Integration / Commissioning	0	0	0	0	13	13
Construction Subtotal	**105**	**323**	**844**	**726**	**184**	**2,181**
Loss of carbon stock due to tree removal (one-time loss)						*3,035*
Construction Total	**105**	**323**	**844**	**726**	**184**	**5,216**

Appendix B2: Operational Assumptions and Calculations

Criteria Pollutants and Greenhouse Gases

Locomotive fuel consumption data for existing conditions, the Proposed Project and No Project scenarios were provided by JPB (Cocke pers. comm. b) and regional vehicle miles traveled (VMT) in the study area were provided by Santa Clara Valley Transportation Authority travel forecasting model (see Appendix I). LTK (2014a) provided BHP-Hour calculations for the Proposed Project remnant diesel fleet in 2020.

Criteria pollutants and GHGs generated by locomotive fuel consumption were estimated using emission factors obtained from the EPA and Climate Registry. Mass emissions from changes in regional VMT and onroad fuel consumption were quantified using the Caltrans' CT-EMFAC emissions model. GHG emissions associated with electricity generation and transmission were calculated based on expected energy demand and utility emission factors published by Pacific Gas and Electric Company (PG&E 2013), Delucchi (2006), USEPA Egrid (2014) and CalEEMod. Electricity consumption included transmission and distribution losses.

Pantograph Emission Calculations

LTK provided estimates of wear characteristics for the pantograph collector strips and copper content of the strips (LTK 2014b). ICF calculated potential emissions based on that input.

Induced Wind Particulate Entrainment

ICF estimated potential particulate entrainment along the Caltrain ROW due to induced wind from passing trains using a methodology used by the California High Speed Rail Authority for the EIR for the Merced-Fresno segment of the HSR system (CHSRA 2012) and modified it for the lower speeds and different conditions of the Proposed Project.

Operational DPM Emissions

ICF estimated potential health risks along the Caltrain ROW by using a prior Menlo Park EIR health risk assessment calculation of health risks along the Caltrain ROW for residential receptors 50 feet from the railroad (Menlo Park 2012). The prior study assumed no change in current Caltrain equipment. Thus health risks were scaled based on the PM10 emissions along the ROW of the Proposed Project (or alternative) compared to existing PM10 emissions along the ROW.

Carbon Sequestration (Tree Removal and Planting)

The *Draft Tree Inventory and Canopy Assessment* (HortScience 2014, see Appendix F) identifies approximately 2,200 trees that would need to be removed as a result of Proposed Project construction. Removal of these trees would result in an annual loss of CO_2 that would have been sequestered through photosynthesis. Carbon sequestration values for the impacted trees were obtained from the U.S. Forest Service's (2011) CTCC for each tree species. An average diameter breast height (DBH) of 16 inches was assumed for all trees, based on the tree inventory. Lost CO_2 sequestration was calculated by multiplying the TCC values by the number of removed trees.

Pursuant to Mitigation Measure BIO-5 in Section 3.3, *Biological Resources,* the 2,200 trees removed by the Proposed Project would, for the most part, be replaced either on-site or off-site. While replacement requirements vary, on an overall project basis, Mitigation Measure BIO-5 should result in somewhat more than 2,200 trees being planted but for this analysis it was assumed that 2,200

trees would be planted as a conservative assumption. Newly planted trees would sequester CO_2, but at a relatively slow rate until they mature. It was assumed that the trees would be planted in 2019. Annual CO_2 sequestration was estimated in 2020 and 2040, assuming the trees would be 1-year and 21-years old, respectively. The net effect on GHG emissions under 2020 and 2040 conditions represents the difference between the CO_2 sequestration rates for the removed and planted trees.

No Project Alternative Key Assumptions

The fleet assumptions for the No Project Alternative are described in Appendix L. It was assumed that the aging diesel locomotives would be replaced in 2020, resulting in a fleet of approximately 75% Tier 4 diesel locomotives in 2020. By 2040, all existing diesel locomotives are assumed to be replaced with Tier 4 diesel locomotives. The new locomotives are based on the T4DLs being procured by Caltrans being built by Siemens. LTK (2014a) provided BHP-Hour and fuel consumption calculations for the No Project Alternative.

Diesel Multiple Unit (DMU) Alternative Key Assumptions and ~~Calculations~~

Criteria pollutant and GHG emissions resulting from DMU operation were estimated using emission factors obtained from the EPA (2009). It was assumed that the DMU Alternative would result in the same increased ridership as the Proposed Project for 2020 but only 80~~75~~ percent of the increased ridership as the Proposed Project in 2040 (compared to No Project 2040 conditions) because the DMU Alternative would end at the San Francisco 4th and King Station, while the Proposed Project would terminate at the San Francisco Transbay Terminal Center downtown. Fuel consumption under DMU Alternative was estimated using a fuel consumption factor of 3.9 gallons per mile (Mass. EOT, ~~Jacobs~~ 2008). This value is consistent with published literature for similar 8-car DMUs. Emissions associated with the Gilroy shuttle and changes in regional VMT were assumed to remain consistent with what was analyzed for the Proposed Project in 2020 but VMT reductions for 2040 would be less than the Proposed Project as this alternative could not reach TTC.

Tier 4 Diesel Locomotive (T4DL) Alternative Key Assumptions

The fleet assumptions for the T4DL Alternative are described in Appendix L. It was assumed that the aging diesel locomotives would be replaced in 2020, resulting in a fleet of approximately 75% Tier 4 diesel locomotives in 2020 with additional new locomotives to support the same schedule as the Proposed Project. By 2040, all existing diesel locomotives are assumed to be replaced with Tier 4 diesel locomotives. The new locomotives are based on the T4DLs being procured by Caltrans being built by Siemens. LTK (2014a) provided BHP-Hour and fuel consumption estimated for the T4DL Alternative.

The T4DL Alternative is assumed to operate on the same schedule as the Proposed Project, except in the 2040 scenario, service does not include the TTC. Two scenarios were evaluated for the T4DL Alternative: 1) Single-head (SH) Scenario: use of one locomotive for all train consists; 2) Double-Head (DH) Scenario: use of two locomotives for peak hour/time-critical trains and single-head consists for all other services. Emissions associated with the Gilroy shuttle were assumed to remain consistent with what was analyzed for the Proposed Project. In 2020 VMT reductions for the T4DL-SH Scenario were assumed to be 75 percent of the Proposed Project due to slower performance, but were assumed to be the same as the Proposed Project for the T4DL-DH Scenario. In 2040 VMT reductions for the T4DL-SH Scenario were assumed to be 70 percent of the Proposed Project due to the combination of slower performance and not being able to reach the TTC, and were assumed to

be 80 percent of the Proposed Project for the T4DL-DH Scenario due to not being able to reach the TTC. The calculation of changes with the TTC on ridership is shown in Appendix L.

Freight Service Assumptions and Calculations

Nitrogen oxide (NO_X) and GHGs emissions generated by freight movement via locomotives were estimated using emission factors obtained from the EPA (2009) and Climate Registry (2013). It was assumed that 15,000 tons of freight is hauled on the Caltrain corridor between San Francisco and Santa Clara on average per day, carried by three locomotives. This equates to 48.1 million ton-miles per year, based on a trip length of 37 miles and a service period 260 days. Emissions generated by locomotive fuel consumption were quantified by multiplying the annual ton-mileage by emission factors from the EPA (2009) and Climate Registry (2013).

Emissions generated by haul trucks used to transport an equivalent amount of freight were quantified based on a literature review of transportation efficiencies. The EPA has noted that, on a ton-mile basis, trains are 2 to 4 times more fuel efficient and have one-half to one-third the NOx emissions compared with trucks (USEPA 2010). The EPA also concluded that, on a ton-mile basis, trains emit one-third the GHG emissions of trucks. NO_X and GHG emissions generated by haul trucks were estimated by multiplying the NOx rail emissions factors of two and three and multiplying the GHG rail emissions factor by three.

Energy Use Estimates

Energy use estimates were prepared for the Proposed Project and alternatives by estimating diesel fuel consumption, electricity consumption, and avoided passenger vehicle gasoline and then converting to BTUs. Fuel consumption by alternative was from the sources noted above. Electricity consumption for the Proposed Project was calculated by Caltrain. Electricity consumption for the alternative was based on the idling electricity for existing conditions and then scaling up by the increased number of trains per day as appropriate. Transmission and Distribution losses were included in the electricity estimates. Reduced passenger vehicle fuel use was estimated by converting VMT reductions to gallons of gasoline using average vehicle fleet mpg data. Factors from the EPA (2004) were used to convert fuels and electricity to BTUs.

Table B2-1a: Summary of Operational Daily Criteria Pollutant Emissions (Pounds) and GHG Emissions (MTC02e)

Condition	ROG	NOx	CO	PM10	PM2.5	GHG
Existing (2013)	251	5,979	642	159	155	46,738
Opening No Build (2020)	***46***	***1,048***	***735***	***24***	***23***	***58,287***
Opening Project (2020)						
Total Caltrain Emissions	37	812	218	26	25	23,025
Change in Regional VMT from Increased Ridership	*-159*	*-330*	*-1,296*	*-181*	*-53*	*-44,317*
Sequestration Loss						*260*
Total Project Emissions	**-122**	**482**	**-1,078**	**-155**	**-27**	**-21,032**
Tier 4 Alternative - SH (2020)						
Total Caltrain Emissions	56	1,291	877	29	29	68,255
Change in Regional VMT from Increased Ridership	*-159*	*-330*	*-1,296*	*-181*	*-53*	*-44,317*
Total Alternative Emissions	**-103**	**961**	**-419**	**-151**	**-24**	**23,938**
Total Alternative Emissions - if 100% VMT red	*-103*	*961*	*-419*	*-151*	*-24*	*23,938*
Tier 4 Alternative - DH (2020)						
Total Caltrain Emissions	66	1,530	1,183	33	32	95,426
Change in Regional VMT from Increased Ridership	*-159*	*-330*	*-1,296*	*-181*	*-53*	*-44,317*
Total Alternative Emissions	**-93**	**1,200**	**-113**	**-148**	**-21**	**51,109**
DMU Alternative (2020)						
Total Caltrain Emissions	65	1,500	1,144	33	32	72,020
Change in Regional VMT from Increased Ridership	*-159*	*-330*	*-1,296*	*-181*	*-53*	*-44,317*
Total Alternative Emissions	**-94**	**1,170**	**-152**	**-148**	**-21**	**27,703**
Cumulative No Build (2040)	***23***	***543***	***693***	***8***	***8***	***59,579***
Cumulative Project (2040)						
Total Caltrain Emissions	*7*	*159*	*142*	*7*	*7*	*16,611*
Change in Regional VMT from Increased Ridership	*-487*	*-1,009*	*-3,866*	*-483*	*-145*	*-146,241*
Sequestration Loss						*260*
Total Project Emissions	**-480**	**-850**	**-3,724**	**-477**	**-138**	**-129,370**
Tier 4 Alternative - SH (2040)						
Total Caltrain Emissions	*30*	*711*	*908*	*11*	*10*	*68,531*
Change in Regional VMT from Increased Ridership	*-390*	*-807*	*-3,093*	*-387*	*-116*	*-116,993*
Total Alternative Emissions	**-360**	**-96**	**-2,184**	**-376**	**-105**	**-48,462**
Total Alternative Emissions - if 100% VMT reduction	*-457*	*-298*	*-2,958*	*-473*	*-134*	*-77,710*
Tier 4 Alternative - DH (2040)						
Total Caltrain Emissions	*40*	*950*	*1,214*	*14*	*14*	*95,674*
Change in Regional VMT from Increased Ridership	*-390*	*-807*	*-3,093*	*-387*	*-116*	*-116,993*
Total Alternative Emissions	**-350**	**143**	**-1,878**	**-372**	**-102**	**-21,319**
Total Alternative Emissions - if 100% VMT reduction	*-447*	*-58*	*-2,652*	*-469*	*-131*	*-50,568*
DMU Alternative (2040)						
Total Caltrain Emissions	*43*	*1,029*	*1,315*	*16*	*15*	*74,802*
Change in Regional VMT from Increased Ridership	*-390*	*-807*	*-3,093*	*-387*	*-116*	*-116,993*
Total Alternative Emissions	**-346**	**222**	**-1,778**	**-371**	**-101**	**-42,191**
Total Alternative Emissions - if 100% VMT reduction	*-444*	*20*	*-2,551*	*-468*	*-130*	*-71,439*

Reductions

2020 PCEP vs. Existing (2013)	-373	-5,497	-1,720	-315	-182	-67,769
2020 PCEP vs. Existing (2013), percentage, Caltrain only	-85%	-86%	-66%	-84%	-84%	-51%
2020 PCEP vs. No Project 2020	-168	-566	-1,813	-179	-50	-79,319
2020 PCEP vs. Tier 4-SH 2020	-20	-479	-659	-4	-3	-44,970
2020 PCEP vs. Tier 4-DH 2020	-30	-718	-965	-7	-7	-72,141
2020 PCEP vs. DMU 2020	-29	-688	-927	-7	-7	-48,735
2040 PCEP with Full Electrification vs. Existing (2013)	-97%	-97%	-78%	-96%	-96%	-64%
2040 PCEP with Full Electrification vs. Existing (2013)	-731	-6,829	-4,366	-636	-292	-176,107
2040 PCEP with Full Electrification vs. No Project 2040	-503	-1,393	-4,417	-485	-146	-188,949
2040 PCEP with Full Electrification vs. Tier 4-SH 2040	-120	-754	-1,540	-101	-33	-80,908
2040 PCEP with Full Electrification vs. Tier 4-SH 2040 - 100% VMT	-23	-553	-766	-4	-4	-51,660
2040 PCEP with Full Electrification vs. Tier 4-DH 2040	-130	-993	-1,846	-104	-36	-108,050
2040 PCEP with Full Electrification vs. Tier 4-DH 2040 - 100% VMT	-33	-792	-1,072	-8	-7	-78,802
2040 PCEP with Full Electrification vs. DMU 2040	-133	-1,072	-1,946	-105	-37	-87,179
2040 PCEP with Full Electrification vs. DMU 2040 - 100% VMT	-36	-870	-1,173	-9	-8	-57,931
Note: Comparison of project to existing conditions does not include pollutant reductions due to VMT reduction.						

2020 DMU Alt vs. Existing (2013)	-345	-4,809	-793	-308	-176	-19,035
2020 DMMU Alt vs. Existing (2013)	-345	-4,809	-793	-308	-176	-19,035
2020 T4-SH Alt vs. Existing (2013)	-354	-5,018	-1,061	-311	-179	-22,799
2020 T4-SH Alt (100% VMT) vs. Existing (2013)	-354	-5,018	-1,061	-311	-179	-22,799
2020 T4-DH vs. Existing (2013)	-344	-4,779	-755	-307	-175	**4,371**
2020 DMU Alt vs. NP 2020	-140	**122**	-886	-172	-44	-30,584
2020 T4-SH Alt vs. NP2020	-148	-87	-1,154	-175	-47	-34,349
2020 T4-DH vs. NP2020	-138	**152**	-848	-171	-43	-7,178
2040 DMU Alt vs. NP2040	-369	-321	-2,470	-379	-109	-101,770
2040 DMU Alt (100% VMT) vs. NP2040	-467	-522	-3,244	-476	-138	-131,018
2040 T4-SH Alt vs. NP2040	-383	-639	-2,877	-384	-113	-108,041
2040 T4-SH Alt (100% VMT) vs. NP2040	-480	-840	-3,650	-481	-142	-137,289
2040 T4-DH vs. NP2040	-373	-399	-2,571	-381	-110	-80,898
2040 T4-DH (100% VMT) vs. NP2040	-470	-601	-3,344	-477	-139	-110,147

BAAQMD thresholds	54	54		82	54	1100

Table B2-1b: Summary of Operational GHG Emissions (MTCO2e)						
2020 GHG	Existing	No Project	DMU	T4DL-SH	T4DL-DH	Proposed Project
Caltrain Diesel Consumption	45,899	57,720	71,267	67,502	94,673	11,067
Caltrain Electricity Consumption	*839*	*567*	*753*	*753*	*753*	*11,958*
Total Caltrain System Emissions	*46,738*	*58,287*	*72,020*	*68,255*	*95,426*	*23,025*
Change in VMT	NA	NA	-44,317	-44,317	-44,317	-44,317
GHG Emissions due to Tree Sequestration Loss	NA	NA	NA	NA	NA	260
Total Emissions	***46,738***	***58,287***	***27,703***	***23,938***	***51,109***	***-21,032***
2040 GHG	Existing	No Project	DMU	T4DL-SH	T4DL-DH	Proposed Project
Caltrain Diesel Consumption	45,899	59,011	74,050	67,779	94,921	1,511
Caltrain Electricity Consumption	839	567	753	753	753	15,100
Total Caltrain System Emissions	*46,738*	*59,579*	*74,802*	*68,531*	*95,674*	*16,611*
Change in VMT	NA	NA	-116,993	-116,993	-116,993	-146,241
GHG Emissions due to Tree Sequestration Loss	NA	NA	NA	NA	NA	260
Total Emissions	**46,738**	**58,287**	**-42,191**	**-48,462**	**-21,319**	**-129,370**
Total with Same Ridership	*NA*	*NA*	*-71,439*	*-77,710*	*-50,568*	*NA*

2020 GHG compared to PCEP	203%	253%	313%	296%	414%	100%
2020 AQ - NOx compared to PCEP	1240%	217%	243%	199%	249%	100%

Table B2-2a: Summary of Daily Criteria Pollutant Emissions (Pounds)

Condition	ROG	NOx	CO	PM10	PM2.5
Existing (2013)					
Caltrain Diesel Consumption	251	5,973	637	159	154
Caltrain Electricity Consumption	0	6	5	0	0
Total Caltrain Emissions	**251**	**5,979**	**642**	**159**	**155**
Opening No Project (2020)					
Caltrain Diesel Consumption	45	1,043	731	23	23
Caltrain Electricity Consumption	0	4	4	0	0
Total Caltrain Emissions	**46**	**1,048**	**735**	**24**	**23**
Opening Project (2020)					
Caltrain Diesel Consumption	32	707	131	21	20
Caltrain Electricity Consumption	5	105	86	5	5
Total Caltrain Emissions	**37**	**812**	**218**	**26**	**25**
Change in Regional VMT from Increased Ridership	*-159*	*-330*	*-1,296*	*-181*	*-53*
Total Project Emissions	**-122**	**482**	**-1,078**	**-155**	**-27**
Cumulative No Project (2040)					
Caltrain Diesel Consumption	23	539	689	8	8
Caltrain Electricity Consumption	0	4	4	0	0
Total Caltrain Emissions	**23**	**543**	**693**	**8**	**8**
Cumulative Project (2040)					
Caltrain Diesel Consumption	1	26	33	0	0
Caltrain Electricity Consumption	6	133	109	6	6
Total Caltrain Emissions	**7**	**159**	**142**	**7**	**7**
Change in Regional VMT from Increased Ridership	*-487*	*-1,009*	*-3,866*	*-483*	*-145*
Total Project Emissions	**-480**	**-850**	**-3,724**	**-477**	**-138**
2020 Caltrain System vs. Existing (2013)	-214	-5,167	-424	-134	-130
2040 Caltrain System with Full Electrification vs. Existing (2013)	-244	-5,820	-500	-153	-148
2020 Project vs. 2020 No Project	-168	-566	-1,813	-179	-50
2040 Project with Full Electrification vs. 2040 No Project	-503	-1,393	-4,417	-485	-146

Table B2-2b: Summary of Annual GHG Emissions (Metric Tons)

Condition	CO2	Other	CO2e
Existing (2013)			
Caltrain Diesel Consumption	45,465	5	45,899
Caltrain Electricity Consumption	824	0	839
Total Caltrain Emissions	**46,289**	**5**	**46,738**
Opening No Build (2020)			
Caltrain Diesel Consumption	57,174	6	57,720
Caltrain Electricity Consumption	554	0	567
Total Caltrain Emissions	**57,728**	**6**	**58,287**
Opening Project (2020)			
Caltrain Diesel Consumption	10,963	1	11,067
Caltrain Electricity Consumption	11,683	1	11,958
Total Caltrain Emissions	**22,646**	**2**	**23,025**
Change in Regional VMT from Increased Ridership	*-42,207*	*-2,110*	*-44,317*
Loss in carbon sequestration from tree removal	*260*		*260*
Total Project Emissions	**-19,301**	**-2,108**	**-21,032**
Cumulative No Build (2040)			
Caltrain Diesel Consumption	58,453	6	59,011
Caltrain Electricity Consumption	554	0	567
Total Caltrain Emissions	**59,008**	**6**	**59,579**
Cumulative Project (2040)			
Caltrain Diesel Consumption	1497	0	1511
Caltrain Electricity Consumption	14,736	1	15,100
Total Caltrain Emissions	**16,233**	**1**	**16,611**
Change in Regional VMT from Increased Ridership	*-139,277*	*-6,964*	*-146,241*
Loss in carbon sequestration from tree removal	*260*		*260*
Total Project Emissions	**-122,784**	**-6,962**	**-129,370**
2020 Caltrain System vs. Existing (2013)	-23,643	-3	-23,713
2040 Caltrain System with Full Electrification vs. Existing (2013)	-30,056	-3	-30,126
2020 Project vs. 2020 No Project	-77,029	-2,114	-79,319
2040 Project with Full Electrification vs. 2020 No Project	-181,792	-6,969	-188,949

		2020	2040
Increase in carbon sequestration with tree replanting (1:1 min)		*3*	*216*

Table B2-2c: Comparisons of Criteria Pollutant Emissions

PCEP v. Existing (Caltrain System) 2020	ROG	NOx	CO	PM10	PM2.5
Along ROW	-87%	-88%	-79%	-87%	-87%
regional	-85%	-86%	-66%	-84%	-84%
PCEP vs. NP 2020 (Caltrain System)	ROG	NOx	CO	PM10	PM2.5
along ROW	-30%	-32%	-82%	-12%	-12%
PCEP (All) 2020	ROG	NOx	CO	PM10	PM2.5
V Existing	-234%	-178%	-334%	-281%	-202%
V NP	-368%	-54%	-247%	-758%	-220%
PCEP 2040 (Caltrain System)	ROG	NOx	CO	PM10	PM2.5
V Existing	-97%	-97%	-78%	-96%	-96%
V NP	-68%	-71%	-79%	-17%	-15%
PCEP 2040 (Caltrain System)	ROG	NOx	CO	PM10	PM2.5
Along ROW				-100%	-100%
V NP				-95%	-95%

Table B2-3: Summary of Criteria and GHG Emissions by Element

Summary of Daily Criteria Pollutant Emissions (Pounds)

Condition	ROG	NOx	CO	PM10	PM2.5
Existing (2013)	251	5,979	642	159	155
2020 No Project	46	1,048	735	24	23
PCEP 2020	-122	482	-1,078	-155	-27
2040 No Project	23	543	693	8	8
PCEP 2040	-480	-850	-3,724	-477	-138
Comparison to 2020 No Project	-168	-566	-1,813	-179	-50
Comparison to 2040 No Project	-503	-1,393	-4,417	-485	-146
	99	1454	254	63	62

Summary of Annual GHG Emissions (Metric Tons)

Condition	CO2	Other	CO2e
Existing (2013)	46,289	5	46,738
2020 No Project	57,728	6	58,287
PCEP 2020	-19,561	-2,108	-21,292
2040 No Project	59,008	6	59,579
PCEP 2040	-123,044	-6,962	-129,630
Comparison to 2020 No Project	-77,289	-2,114	-79,579
Comparison to 2040 No Project	-182,052	-6,969	-189,209

Table 1a. Daily Emissions from Diesel Fuel Consumption (lbs)

Condition	ROG	NOx	CO	PM10	PM2.5
Existing (2013)	251	5,973	637	159	154
2020 No Project	45	1,043	731	23	23
PCEP 2020	32	707	131	21	20
2040 No Project	23	539	689	8	8
PCEP 2040	1	26	33	0.4	0.4

Table 1b. Annual GHG Emissions from Diesel Fuel Consumption (MT)

Condition	CO2	CH4	N2O	SF6	CO2e
Existing (2013)	45,465	3.562	1.158	0	45,899
Opening No Build	57,174	4.480	1.456	0	57,720
Opening Project	10,963	0.859	0.279	0	11,067
Cumulative No Build	58,453	4.580	1.489	0	59,011
Cumulative Project	1,497	0.117	0.038	0	1,511

Table 2a. Daily Emissions from Electricity Consumption (lbs) - included as a worse case analysis

Condition	ROG	NOx	CO	PM10	PM2.5
Existing (2013)	0	6	5	0	0
2020 No Project	0	4	4	0	0
PCEP 2020	5	105	86	5	5
2040 No Project	0	4	4	0	0
PCEP 2040	6	133	109	6	6

Table 2b. Annual GHG Emissions from Electricity Consumption (MT)

Condition	CO2	CH4	N2O	SF6	CO2e
Existing (2013)	824	0.06	0.01	0.00	839
2020 No Project	554	0.04	0.01	0.00	567
PCEP 2020	11,683	0.81	0.17	0.01	11,958
2040 No Project	554	0.04	0.01	0.00	567
PCEP 2040	14,736	1.02	0.22	0.01	15,100

Table 3a. NET Daily Emissions from VMT (lbs)

Condition	ROG	NOx	CO	PM10	PM2.5
Existing (2013)	0	0	0	0	0
2020 No Project	0	0	0	0	0
PCEP 2020	-159	-330	-1,296	-32	-16
2040 No Project	0	0	0	0	0
PCEP 2040	-487	-1,009	-3,866	-90	-48

Table 3b. NET Annual GHG Emissions from VMT (MT)

Condition	CO2	Other	CO2e
Existing (2013)	0	0	0
2020 No Project	0	0	0
PCEP 2020	-42,207	-2,110	-44,317
2040 No Project	0	0	0
PCEP 2040	-139,277	-6,964	-146,241

Table 4a. Daily Emissions from Road Dust (lbs)

Condition	ROG	NOx	CO	PM10	PM2.5
Existing (2013)	0	0	0	0	0
2020 No Project	0	0	0	0	0
PCEP 2020	0	0	0	-149	-37
2040 No Project	0	0	0	0	0
PCEP 2040	0	0	0	-393	-97

Table B2-4: Criteria Pollutant Analysis of Project and Alternatives using BHP-HR

		BHP-HR	ROG fac	ROG	NOx fac	NOx	CO fac	CO	PM10 fac	PM	PM 2.5 fac	PM2.5
Existing (2013)	F40 (Tier 0)	16,212	0.51	18.06	8.60	307.37	1.28	45.75	0.32	11.44	0.31	11.09
Existing (2013)	MP36 (Tier 1)	24,169	0.49	26.37	6.70	357.00	1.28	68.20	0.32	17.05	0.31	16.54
Existing (2013)	F40 Uncontrolled)	185,214	0.51	206.38	13.00	5308.25	1.28	522.66	0.32	130.66	0.31	126.74
Existing (2013)	Gilroy	6,176		0.70		16.54		21.17		2.72		0.24
Existing (2013)	SJ - SF			250.12	28.30	5956.08	3.84	615.44	0.96	156.43	0.93	154.14
No Project (2020)	F40 (Tier 0+)	14,563	0.32	10.14	7.20	231.16	1.28	41.10	0.20	6.42	0.19	6.23
No Project (2020)	MP36 (Tier 1+)	21,729	0.31	14.63	6.70	320.96	1.28	61.32	0.20	9.58	0.19	9.29
No Project (2020)	Tier 4	222,875	0.04	20.70	1.00	491.36	1.28	628.93	0.02	7.37	0.01	7.15
No Project (2020)	Gilroy-SJ-Tier 4	7,501	0.04	0.70	1.00	16.54	1.28	21.17	0.02	0.25	0.01	0.24
No Project (2020)	SJ- SF			44.77		1026.94		710.18		23.12		22.43
No Project (2040)	Tier 4	244,265	0.04	22.68	1.00	538.51	1.28	689.30	0.02	8.08	0.01	7.84
Project (2020)	F40 (Tier 0+)	18,275	0.32	12.73	7.20	290.08	1.28	51.57	0.20	8.06	0.19	7.82
Project (2020)	MP36 (Tier 1+)	28,231	0.31	19.01	6.70	417.00	1.28	79.67	0.20	12.45	0.19	12.07
Project (2020)	Gilroy -SJ-MP36	6,176	0.31	4.16	6.70	91.23	1.28	17.43	0.20	2.72	0.01	0.20
Project (2020)	SJ- SF			27.58		615.86		113.81		17.78		19.69
Tier 4 (2020)	F40 (Tier 0+) - SH-Mix	18,275	0.32	12.73	7.20	290.08	1.28	51.57	0.20	8.06	0.19	7.82
Tier 4 (2020)	MP36 (Tier 1+) - SH - Mix	28,231	0.31	19.01	6.70	417.00	1.28	79.67	0.20	12.45	0.19	12.07
Tier 4 (2020)	Tier 4- SH - Mix	262,949	0.04	24.42	1.00	579.70	1.28	742.02	0.02	8.70	0.01	8.43
Tier 4 (2020)	Gilroy-SJ - MP36	6,176	0.31	4.16	6.70	91.23	1.28	17.43	0.20	2.72	0.01	0.20
Tier 4 (2020)	SJ- SF			51.99		1,195.56		855.83		26.48		28.13
Tier 4 (2020)	F40 (tier 0+)-SH-DH_mix	18,275	0.32	12.73	7.20	290.08	1.28	51.57	0.20	8.06	0.19	7.82
Tier 4 (2020)	MP36 (Tier 1+)-SH-DH-Mix	28,231	0.31	19.01	6.70	417.00	1.28	79.67	0.20	12.45	0.19	12.07
Tier 4 (2020)	Tier 4-SH-DH-Mix	371,398	0.04	34.49	1.00	818.79	1.28	1048.05	0.02	12.28	0.01	11.91
Tier 4 (2020)	Gilroy - SJ - MP 36	6,176	0.31	4.16	6.70	91.23	1.28	17.43	0.20	2.72	0.01	0.20
Tier 4 (2020)	SJ- SF			62.06		1,434.65		1,161.86		30.06		31.61
Tier 4 (2040)	Tier 4-SH-Only	320,670	0.04	29.78	1.00	706.96	1.28	904.90	0.02	10.60	0.01	10.29
Tier 4 (2040)	Tier 4-SH/DH - SH	57,721	0.04	5.36	1.00	127.25	1.28	162.88	0.02	1.91	0.01	1.85
Tier 4 (2040)	Tier 4-SH/DH - DH	371,398	0.04	34.49	1.00	818.79	1.28	1048.05	0.02	12.28	0.01	11.91

Existing (2013)	Mix	225,594		251		5,973		637		159		154
No Project (2020)	Mix	259,167		45		1,043		731		23		23
No Project (2040)	Tier 4	244,265		23		539		689		8		8
Project (2020)	Mix	46,506		32		707		131		21		20
Tier 4 (2020)	SH - Mix	309,455		56		1,287		873		29		28
Tier 4 (2020)	SH-DH - Mix	417,904		66		1,526		1,179		33		32
Tier 4 (2040)	SH - All tier 4	320,670		30		707		905		11		10
Tier 4 (2040)	SH-DH - All Tier 4	429,119		40		946		1,211		14		14

Source for BHP-HR: LTK 2014a

NP 2020			
	F40	MP36	T4
Overall hours	143	143	143
percent	7.30%	9.40%	83.40%
Hours	10.439	13.442	119.262
BHP-Hr	**14,563**	**21,729**	**222,875**
BHP	1,395	1,617	1,869

NP 2040			
	T4	T4	T4
Overall hours	143	143	143
percent	7.30%	9.40%	83.40%
Hours	10.439	13.442	119.262
BHP-Hr	**19,508**	**1,882**	**222,875**
BHP	1,869	1,869	1,869

P 2020			
	F40	MP36	T4
Overall hours	157	157	157
percent	8.50%	12.40%	79.10%
Hours	13	19	124
BHP-Hr	**18,275**	**28,231**	**0**
BHP	1,448	1,669	0

EP 2013			
	F40 - 98	MP36-2003	F40 -old
Overall hours	143	143	143
percent	7.30%	9.40%	83.40%
Hours	10	13	119
BHP-Hr	**16,212**	**24,169**	**185,214**
BHP	1,553	1,798	1,553

T4-SH - 2020		
F40	MP36	T4
166	166	166
11.70%	8.10%	80.30%
19.422	13.446	133.298
18,275	**28,231**	**262,949**
941	2,100	1,973

T4-SH/DH 2020		
F40	MP36	T4
157	157	157
8.50%	12.40%	79.10%
13.345	19.468	124.187
18,275	**28,231**	**371,398**
1,369	1,450	2,991

T4 - SH - 2040		
T4		
166		
100.00%		
166		
320,670		
1,932		

T4-SH/DH -2040	
T4SH	T4DH
157	157
20.80%	79.20%
32.656	124.344
57,721	**371,398**
1,768	2,987

Table B2-5: Operational Criteria Pollutant Analysis for Alternatives					
	Pounds per Day				
Diesel Fuel Emissions	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**
Tier 4 - SH/Mix (2020)	56	1,287	873	29	28
Tier 4 - DH/SH Mix (2020)	66	1,526	1,179	33	32
DMU (2020)	65	1,496	1,141	32	31
Tier 4 - SH/All T4 (2040)	30	707	905	11	10
Tier 4 - DH/SH/All T4 (2040)	40	946	1,211	14	14
DMU (2040)	43	1,025	1,312	15	15
Electricity Emissions	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**
Electricity (133% X "no project")	0	4	4	0	0

VMT Emission Reductions	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**
2020 Proposed Project VMT Reductions	*-159*	*-330*	*-1,296*	*-181*	*-53*
2020 Change in VMT (T4SH - adjusted)	*-159*	*-330*	*-1,296*	*-181*	*-53*
2040 Proposed Project VMT Reductions	*-487*	*-1,009*	*-3,866*	*-483*	*-145*
2040 Change in VMT (T4SH - adjusted)	*-390*	*-807*	*-3,093*	*-387*	*-116*
2040 Change in VMT (T4DH, DMU -adjusted)	*-390*	*-807*	*-3,093*	*-387*	*-116*
Total Emissions - 2020	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**
Tier 4 SH/Mix - VMT adjust	-103	961	-419	-151	-24
Tier 4 SH/Mix - VMT 100%	-103	961	-419	-151	-24
Tier 4 DH/SH/Mix	-93	1,200	-113	-148	-21
DMU	-94	1,170	-152	-148	-21
Tier 4/SH/Mix vs. No Project	*-148*	*-87*	*-1,154*	*-175*	*-47*
Tier 4/SH/Mix - VMT 100% vs. No Project	*-148*	*-87*	*-1,154*	*-175*	*-47*
Tier 4/DH/SH/Mix vs. No Project	*-138*	*152*	*-848*	*-171*	*-43*
DMU vs. No Project	*-140*	*122*	*-886*	*-172*	*-44*
PCEP vs. No Project	*-168*	*-566*	*-1,813*	*-179*	*-50*
PCEP vs. Tier 4/SH/Mix	*-20*	*-479*	*-659*	*-4*	*-3*
PCEP vs. Tier 4/SH/Mix - VMT 100%	*-20*	*-479*	*-659*	*-4*	*-3*
PCEP vs. Tier 4/DH/SH/Mix	*-30*	*-718*	*-965*	*-7*	*-7*
PCEP vs. DMU	*-29*	*-688*	*-927*	*-7*	*-7*
BAAQMD threshold	**54**	**54**	**N/A**	**82**	**54**

Assume % of PCEP decreased VMT over No Project
100.00%
80.00%
80.00%

Total Emissions - 2040	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**
Tier 4/SH	-360	-96	-2,184	-376	-105
Tier 4/SH - 100% VMT	-457	-298	-2,958	-473	-134
Tier 4/SH-DH	-350	143	-1,878	-372	-102
Tier 4/SH-DH - 100% VMT	-447	-58	-2,652	-469	-131
DMU	-346	222	-1,778	-371	-101
DMU- 100%	-444	20	-2,551	-468	-130
Tier 4/SH vs. No Project	*-383*	*-639*	*-2,877*	*-384*	*-113*
Tier 4/SH-100% VMT vs. No Project	*-480*	*-840*	*-3,650*	*-481*	*-142*
Tier 4/DH vs. No Project	*-373*	*-399*	*-2,571*	*-381*	*-110*
Tier 4/DH-100% VMT vs. No Project	*-470*	*-601*	*-3,344*	*-477*	*-139*
DMU vs. No Project	*-369*	*-321*	*-2,470*	*-379*	*-109*
DMU-100% VMT vs. No Project	*-467*	*-522*	*-3,244*	*-476*	*-138*
Full Electrification v. No Project	*-503*	*-1,393*	*-4,417*	*-485*	*-146*
Full Electrification vs. Tier 4/SH	*-120*	*-754*	*-1,540*	*-101*	*-33*
Full Electrification vs. Tier 4/SH - 100% VMT	*-23*	*-553*	*-766*	*-4*	*-4*
Full Electrification vs. Tier 4/DH	*-130*	*-993*	*-1,846*	*-104*	*-36*
Full Electrification vs. Tier 4/DH - 100% VMT	*-33*	*-792*	*-1,072*	*-8*	*-7*
Full Electrification vs. DMU	*-133*	*-1,072*	*-1,946*	*-105*	*-37*
Full Electrification vs. DMU - 100% VMT	*-36*	*-870*	*-1,173*	*-9*	*-8*

Table B2-6: Greenhouse Gas Operation Emission Estimates for Alternatives (MT/year, unless otherwise noted))

Tier 4 - SH/Mix 2020	6,548,883	gallons/year	LTK 2014a
Tier 4 - DH/SH/Mix 2020	9,184,914	gallons/year	LTK 2014a
Tier 4 - SH 2040	6,575,679	gallons/day	LTK 2014a
Tier 4 - DH/SH 2040	9,208,950	gallons/day	LTK 2014a
DMU 2020	6,914,109	gallons/day	DMU Sheet
DMU 2040	7,184,064	gallons/day	DMU Sheet

Total Emissions - 2020	**CO2e**
Tier 4 - SH/Mix 2020	67,502
Tier 4 - DH/SH/Mix 2020	94,673
DMU 2020	71,267
Electricity (133% X "no project")	753
Change in VMT (T4SH) - Adj	*-44,317*
Change in VMT (T4SH) - 100% VMT	*-44,317*
Change in VMT (T4SH, DMU)	*-44,317*
Tier 4-SH/Mix	23,938
Tier 4-SH/Mix - 100% VMT	23,938
Tier 4-DH/Mix	51,109
DMU/Mix	27,703
Total Emissions - 2040	
Tier 4 - SH 2040	67,779
Tier 4 - DH/SH 2040	94,921
DMU/Mix	74,050
Electricity (133% X "no project")	753
Change in VMT (T4SH) - Adj	-116,993
Change in VMT (T4SH) - 100% VMT	-146,241
Change in VMT (T4DH, DMU)	-116,993
Change in VMT (T4DH, DMU) - 100% VMT	-146,241
Tier 4 - SH 2040	-48,462
Tier 4 - SH 2040 - 100% VMT	-77,710
Tier 4 - DH/SH 2040	-21,319
Tier 4 - DH/SH 2040 - 100% VMT	-50,568
DMU/Mix	-42,191
DMU/Mix - 100% VMT	-71,439
Conversion (gallons - MT C02e all in) from DMU GHG tab	10,307

% of PCEP VMT reduction over No Project	
100%	Does not take into account slower accel/decel.
100%	Does not take into account slower accel/decel.
100%	Although slower acceleration (DMU) and slower deceleration (TD4L) assumed 100% conservatively for comparison purposes only.

% of PCEP VMT reduction over No Project	
80%	Does not take into account slower accel/decel
100%	Sensitivity analysis.
80%	Effect of not reaching TTC; see Appendix K
100%	Sensitivity analysis

Table B2-7 DMU Air Quality Analysis

Assumptions

Single Level DMU Fuel Consumption (8 cars)	3.9	gallons/mile	Mass. EOT 2008
Double-Deck DMU Fuel Consumption (4 cars)	2.0	gallons/mile	Mass. EOT 2008 - rate is assumption for 4 X single-level as no double-deck factor was found
2020 PCEP EMU miles per day (SF-SJ weekday)	4,410	miles/day	project miles worksheet
2020 PCEP EMU miles per year (SF-SJ)	1,497,538	miles/year	project miles worksheet
2040 PCEP w/ FE EMU miles per day (SF-SJ weekday)	5,586	miles/day	project miles worksheet
2040 PCEP w/ FE EMU miles per year (SF-SJ)	1,804,474	miles/year	project miles worksheet
Non-Revenue Factor	1.00	-	Mass. EOT factor already includes dead-head time and idling

Fuel Consumption Rates	gallons/mile/car	Gallon/mile/8 car	Source
Denton	0.56	4.4	Caltrain Operations
Caltrain 2011	0.31	2.4	Caltrain 2011 Future Technology Assessment
LS Transit "Around the Bay" study 1998 low	0.42	3.4	http://sccrtc.org/wp-content/uploads/2010/09/Section3.pdf
LS Transit "Around the Bay" study 1998 high	0.28	2.2	http://sccrtc.org/wp-content/uploads/2010/09/Section3.pdf
Mass. EOT. 2008	0.49	3.9	http://www.eot.state.ma.us/downloads/DMU_Fairmount.pdf
Transystem 2010	0.50	4.0	http://kclightrail.com/wp-content/uploads/2010/05/rapid_rail_presentation.pdf
New Jersey Transit 2010	0.50	4.0	http://www.fta.dot.gov/documents/NJT_-_Diesel_Multiple_Unit.ppt
Colorado Railcar FAQ (2008)	0.50	4.0	http://web.archive.org/web/20081015235410/http://www.coloradorailcar.com/dmufaq.htm

HC Emissions	0.04	g/bhp-hr	EPA 2009, Table 1, Tier 4
NOx Emissions	1	g/bhp-hr	EPA 2009, Table 1, Tier 4
CO Emissions	1.28	g/bhp-hr	EPA 2009, Table 1, Tier 4
PM10 Emissions	0.015	g/bhp-hr	EPA 2009, Table 1, Tier 4
Bhp-Gal Conversion	20.8	bhp-hr/gal	EPA 2009, Table 3 (passenger train)
VOC/HC Conversion	1.053	-	EPA 2009, page 4
PM2.5/PM10 Conversion	0.97	-	EPA 2009, page 4

ROG Emission Factor	0.9	g/gal	Calculated
NOx Emission Factor	20.8	g/gal	Calculated
CO Emission Factor	26.6	g/gal	Calculated
PM10 Emission Factor	0.3	g/gal	Calculated
PM2.5 Emission Factor	0.3	g/gal	Calculated
CO2 Emission Factor	10,210	g/gal	Climate Registry 2013, Table 12.1
CH4 Emission Factor	0.8	g/gal	Climate Registry 2013, Table 13.7
N2O Emission Factor	0.3	g/gal	Climate Registry 2013, Table 13.7

lbs_gram	0.00220462		
MT_gram	0.000001		
Light_heavy DMU conversion	0.8	OFF	Fuel consumption rate is for "light DMU"

	Pounds per Day				
Condition	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**
2020 Diesel Mix (Project diesel from Project Analysis)	32	707	131	21	20
2040 Gilroy Shuttle (Project diesel from Project Analysis)	1	26	33	0	0

Daily Criteria Pollutant Analysis (pounds)

Type	**ROG**	**NOX**	**CO**	**PM10**	**PM2.5**	**Fuel (gal/d)**
2020 Single Level DMU	33.2	789	1010	11.8	11.5	17,199
2040 Single Level DMU	42.1	999	1279	15.0	14.5	21,785
2020 Diesel Locomotive	31.7	707	131	20.5	19.9	4,130
2040 Diesel Locomotive	1.1	26	33	0.4	0.4	564
Total Single-Level DMU Alternative for 2020	65.0	1496	1141	32.3	31.4	21,329
Total Single-Level DMU Alternative for 2040	43.2	1025	1312	15.4	14.9	22,349

2020 Double-Deck DMU	17.0	404	518	6.1	5.9	8,820
2020 Double-Deck DMU	21.6	512	656	7.7	7.5	11,172
2020 Diesel Locomotive	31.7	707	131	20.5	19.9	4,130
2040 Diesel Locomotive	1.1	26	33	0.4	0.4	564
2020 Total Double-Deck DMU	48.8	1112	649	26.6	25.8	21,329
2040 Total Double-Deck DMU	22.7	538	689	8.1	7.8	22,349

Summary Tables

% of PCEP VMT reduction compared to NP for 2040
80.00%

Condition	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**
2020 Proposed Project VMT Reductions	*-159*	*-330*	*-1,296*	*-181*	*-53*
2040 Proposed Project VMT Reductions	*-487*	*-1,009*	*-3,866*	*-483*	*-145*

Total Emissions - 2020	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**
Caltrain Diesel (DMU + Loco)	65	1,496	1,141	32	31
Electricity ("no project" X 133%)	0	4	4	0	0
Subtotal	65	1,500	1,144	33	32
Change in VMT (same as Proposed Project)	*-159*	*-330*	*-1,296*	*-181*	*-53*
DMU Emissions - 2020	-94	1,170	-152	-148	-21

Double-Deck DMU - 2020	-110	785	-643	-154	-27

Total Emissions - 2040	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**
Caltrain Diesel	43	1,025	1,312	15	15
Electricity ("no project" X 133%)	0	4	4	0	0
Subtotal	43	1,029	1,315	16	15
Change in VMT (less than PCEP w/o TTC)	*-390*	*-807*	*-3,093*	*-387*	*-116*
DMU Alt Emissions - 2040	-346	222	-1,778	-371	-101

Double-Deck DMU-2040	-367	-265	-2401	-378	-108

Double-Deck DMU compared to Project	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**
2020 Proposed Project	-122	482	-1,078	-155	-27
2020 Double-Deck DMU	-110	785	-643	-154	-27
Difference	*-12*	*-303*	*-435*	*-1*	*-1*
2040 Full Electrification	-480	-850	-3,724	-477	-138
2040 Double-Deck DMU	-367	-265	-2401	-378	-108
Difference	*-113*	*-586*	*-1324*	*-98*	*-30*

Table B2-8 DMU GHG Emissions Calculations

Assumptions			
Single Level DMU Fuel Consumption (8 car)	3.9	gallons/mile	Mass. EOT 2008
Double-Deck DMU Fuel Consumption (4 car)	2.0	gallons/mile	Mass. EOT 2008 - rate is assumption for 4 X single-level as no double-deck factor was found
2020 EMU trips per day (SF-SJ weekday)	4,410	miles/day	Project mile worksheet
2020 EMU trips per year (SF-SJ)	1,497,538	miles/year	Project mile worksheet
2040 EMU trips per day (SF-SJ weekday)	5,586	miles/day	Project mile worksheet
2040 EMU trips per year (SF-SJ)	1,804,474	miles/year	Project mile worksheet
Non-Revenue Factor	1.00	-	Mass. EOT factor already includes dead-head time and idling

Fuel Consumption Rates	**gallons/mile/car**	**Gallon/mile/8 car**	**Source**
DCTA Stadler DMUs	0.56	4.4	Caltrain Ops
Caltrain 2011	0.31	2.4	Caltrain 2011 Future Technology Assessment
LS Around the Bay Study 1998 low	0.42	3.4	http://sccrtc.org/wp-content/uploads/2010/09/Section3.pdf
LS Around the Bay Study 1998 high	0.28	2.2	http://sccrtc.org/wp-content/uploads/2010/09/Section3.pdf
Mass. EOT 2008	0.49	3.9	http://www.eot.state.ma.us/downloads/DMU_Fairmount.pdf
Transystem 2010	0.50	4.0	http://kclightrail.com/wp-content/uploads/2010/05/rapid_rail_presentation.pdf
NJT 2010	0.50	4.0	http://www.fta.dot.gov/documents/NJT_-_Diesel_Multiple_Unit.ppt
Colorado Railcar FAQ (2008)	0.50	4.0	http://web.archive.org/web/20081015235410/http://www.coloradorailcar.com/dmufaq.htm
Factors	**g/gal**	**GWP (IPCC)**	**Source**
CO2 Emission Factor	10,210	1	Climate Registry 2013, Table 12.1, IPCC
CH4 Emission Factor	0.80	25	Climate Registry 2013, Table 13.7
N2O Emission Factor	0.26	298	Climate Registry 2013, Table 13.7
Combined	10,307		Using GWPs from above
lbs_gram	0.00220462		
MT_gram	0.000001		

Fuel Consumption	**Single - Level DMU**	**Double-Deck DMU**	
Type	**Fuel (gal/y)**	**Fuel (gal/y)**	
2020 DMU	5,840,398	2,995,076	
2040 DMU	7,037,449	3,608,948	
2020 Diesel Locomotive	1,073,711	1,073,711	% of PCEP VMT reduction compared to NP for 2040
2040 Diesel Locomotive	146,615	146,615	80.00%
Total DMU Alternative - 2020	6,914,109	4,068,787	
Total DMU Alternative - 2040	7,184,064	3,755,563	
Diesel Fuel Emissions	**CO2e**	**CO2e**	
2020 DMU	60,200	30,872	
2020 Loco Emissions	11,067	37,199	
2040 DMU	72,538	11,067	
2040 Loco Emissions	1,511	1,511	
Electricity (133% x No Project)	753	753	
Change in VMT 2020 Project	*-44,317*	*-44,317*	
Change in VMT (Less than 2040 Project)	*-116,993*	*-116,993*	
DMU Emissions - 2020	**27,703**	**24,507**	
DMU Emissions - 2040	**-42,191**	**-103,662**	

Double-Deck DMU Comparison		
Proposed Project 2020		-21,032
Double-Deck DMU 2020		24,507
Difference		*-45,538*
Proposed Project 2040		-129,370
Double-Deck DMU 2040		-103,662
Difference		*-25,708*

Table B2-9a: Comparison of 2020 Daily PM10 Emissions using Conceptual Estimates for Other Particulate Sources (lb/day)						
	Existing	**2020 No Project**	**PCEP 2020**	**2020 DMU Alternative**	**2020 T4 Diesel Locomotive (DH)**	**Notes**
Diesel Engine Emissions	159	23	21	32	33	From criteria pollutant analysis
Wheel-Rail Particulates	NA	NA	NA	NA	NA	Negligible change from existing conditions for PCEP or alternatives per discussion above, so not meaningful for comparison.
Entrained Particulates (Conceptual Estimate)	NA	NA	NA	NA	NA	Area adjacent to ROW is graveled and contains limited soil available for resuspension.
Pantograph Particulate Emissions	0	0	0.5	0	0	
Subtotal Emissions Along ROW	*159*	*23*	*21*	*32*	*33*	
Tree Removal Benefit	NA	NA	NA	NA	NA	Speculative to estimate reductions over entire route given varying tree cover, density, and proximity to route. Tree cover is also absent in many commercial, industrial, and open areas and is low density in other areas.
Subtotal Net Emissions Along ROW	*159*	*23*	*21*	*32*	*33*	
Electricity Emissions	0	0	5	0	0	
Total Caltrain System	*159*	*24*	*26*	*33*	*33*	
Lowered VMT emissions	NA	0	-181	-181	-181	VMT reductions are relative to 2020 No Project.
TOTAL	**NA**	**24**	**-155**	**-148**	**-148**	

Table B2-9b: Comparison of Daily PM10 Caltrain Emissions using Conceptual Estimates for Other Particulate Sources (lb/day) For a Hypothetical Mile with Consistent Tree Buffer (Between San Jose and San Francisco)						
	Existing	**2020 No Project**	**PCEP 2020**	**2020 DMU Alternative**	**2020 T4 Diesel Locomotive (DH)**	**Notes**
Diesel Engine Emissions	3.07	0.45	0.35	0.63	0.59	Only includes emissions for diesel emissions from San Jose north divided by route miles.
Wheel-Rail Particulates	NA	NA	NA	NA	NA	Negligible change from existing conditions for PCEP or alternatives per discussion above, so not meaningful for comparison.
Entrained Particulates (Conceptual Estimate)	NA	NA	NA	NA	NA	Area adjacent to ROW is graveled and contains limited soil available for resuspension.
Pantograph Particulate Emissions	0.00	0.00	0.01	0.00	0.00	
Subtotal Emissions Along ROW	*3.07*	*0.45*	*0.36*	*0.63*	*0.59*	
Tree Removal Benefit - LOW (Conceptual Estimate)	-0.06	-0.01	0.00	-0.01	-0.01	Used lower range (2%) of Cahill (2008) estimate for 8.4 mph wind speed in laboratory study. No reduction for PCEP.
Tree Removal Benefit - HIGH (Conceptual Estimate)	-0.80	-0.12	0.00	-0.16	-0.15	Used higher range (26%) of Cahill (2008) estimate for 8.4 mph wind speed in laboratory study. No reduction for PCEP. Likely substantially overstates reduction effectiveness because this assumes complete filtering of train diesel emissions by trees next to ROW, when train diesel emissions are emitted vertically and disperse broadly, not horizontally and given periodic openings in most tree buffer areas.
Total Net Emissions per hypothetical mile (Low tree filtration scenario)	*3.01*	*0.44*	*0.36*	*0.62*	*0.58*	*Excludes VMT reductions of PCEP and alternatives which reduce local and regional particulate levels.*
Total Net Emissions per hypothetical mile (High tree filtration scenario)	*2.27*	*0.34*	*0.36*	*0.47*	*0.44*	*Excludes VMT reductions of PCEP and alternatives which reduce local and regional particulate levels.*
Note: Even if one used the hypothetical high tree filtration scenario and multiplied by the nominal 51-mile route from San Jose to San Francisco, the difference between the PCEP and the No Project would only be 1 lbs/day of PM10, which would be less than significant in comparison to the BAAQMD threshold of 54 lbs/day. Also, this estimate excluded VMT reduction benefits of the PCEP and the alternatives, which also influences local ambient air quality. If one multiplied the results by 51-miles for the high filtration scenario and then added in the VMT reduction, the Proposed Project would still have the lowest regional emissions compared to No Project conditions and all action alternatives.						

51 mile w/o VMT reduction	116	17	18	24	22	Calculation using analysis above for whole route
w/ VMT reduction	116	17	-162	-157	-158	Calculation using analysis above for whole route

Table B2-10: Induced Wind Particulate Calculations

			Results			Results		
Height above surface (half train) (cm)	188	CHSRA 2012	PM10	PM2.5	units	PM10	PM2.5	units
Embankment height (cm)	100	CHSRA 2012	0.68	0.10	g/linear meter	2989.38	448.41	lb/year
Surface roughness height (cm)	0.01	CHSRA 2012	0.21	0.03	g/foot	1.49	0.22	tons/year
Threshold friction velocity (m/s)	0.19	CHSRA 2012	1086.50	162.98	g/mile	0.00	0.00	tons/day
meters/feet	0.3048	Conversion	2.40	0.36	lb/mile	8.19	1.23	lbs/day (365)
MPH	79	Input	52.00	52.00	miles	**1.64**	**0.25**	lbs/day PCEP
meter/sect	35.32	Calc	124.56	18.68	g/event			
feet/sec	115.87	Calc	24.00	24.00	event			
PCEP percent of total in 2020	20.00%							

Train Speed

Distance from Train	Distance from Train	Wind Speed (U)	Wind speed	Friction Velocity	Erosion Pot	PM10	PM 2.5	PM10	PM 2.5
feet	Meters (d)	(m/s)	mph	m/s	g/m2	g/M2	g/m2	g/linear m	g/linear m
0.0	0.0	6.8	15.1	0.26	2.14	1.07	0.16	**0.00**	**0.00**
0.3	0.1	6.5	14.5	0.25	1.81	0.90	0.14	**0.09**	**0.01**
0.7	0.2	6.2	14.0	0.24	1.50	0.75	0.11	**0.07**	**0.01**
1.0	0.3	6.0	13.4	0.23	1.20	0.60	0.09	**0.06**	**0.01**
1.3	0.4	5.8	12.9	0.22	0.93	0.46	0.07	**0.05**	**0.01**
1.6	0.5	5.5	12.4	0.22	0.67	0.34	0.05	**0.03**	**0.01**
2.0	0.6	5.3	11.9	0.21	0.43	0.22	0.03	**0.02**	**0.00**
2.3	0.7	5.1	11.4	0.20	0.21	0.10	0.02	**0.01**	**0.00**
2.6	0.8	4.9	10.9	0.19	0.00	0.00	0.00	**0.00**	**0.00**
3.0	0.9	4.7	10.4	0.18	-0.20	-0.10	-0.01	-0.01	0.00
3.3	1.0	4.5	10.0	0.17	-0.38	-0.19	-0.03	-0.02	0.00
3.6	1.1	4.3	9.6	0.17	-0.55	-0.27	-0.04	-0.03	0.00
3.9	1.2	4.1	9.2	0.16	-0.71	-0.35	-0.05	-0.04	-0.01
4.3	1.3	3.9	8.8	0.15	-0.85	-0.43	-0.06	-0.04	-0.01
4.6	1.4	3.7	8.4	0.15	-0.99	-0.49	-0.07	-0.05	-0.01
4.9	1.5	3.6	8.0	0.14	-1.11	-0.56	-0.08	-0.06	-0.01
5.2	1.6	3.4	7.7	0.13	-1.23	-0.61	-0.09	-0.06	-0.01
5.6	1.7	3.3	7.3	0.13	-1.33	-0.67	-0.10	-0.07	-0.01
5.9	1.8	3.1	7.0	0.12	-1.43	-0.72	-0.11	-0.07	-0.01
6.2	1.9	3.0	6.7	0.12	-1.52	-0.76	-0.11	-0.08	-0.01
6.6	2.0	2.9	6.4	0.11	-1.60	-0.80	-0.12	-0.08	-0.01
6.9	2.1	2.7	6.1	0.11	-1.68	-0.84	-0.13	-0.08	-0.01
7.2	2.2	2.6	5.9	0.10	-1.75	-0.87	-0.13	-0.09	-0.01
7.5	2.3	2.5	5.6	0.10	-1.81	-0.90	-0.14	-0.09	-0.01
7.9	2.4	2.4	5.4	0.09	-1.87	-0.93	-0.14	-0.09	-0.01
8.2	2.5	2.3	5.2	0.09	-1.92	-0.96	-0.14	-0.10	-0.01
8.5	2.6	2.2	5.0	0.09	-1.96	-0.98	-0.15	-0.10	-0.01
8.9	2.7	2.1	4.8	0.08	-2.00	-1.00	-0.15	-0.10	-0.02
9.2	2.8	2.1	4.6	0.08	-2.04	-1.02	-0.15	-0.10	-0.02
9.5	2.9	2.0	4.5	0.08	-2.07	-1.04	-0.16	-0.10	-0.02
9.8	3.0	1.9	4.3	0.08	-2.10	-1.05	-0.16	-0.11	-0.02
10.1	3.1	1.9	4.2	0.07	-2.12	-1.06	-0.16	-0.07	-0.01

Table B2-10: Induced Wind Particulate Calculations

			Results			Results		
Height above surface (half train) (cm)	188	CHSRA 2012	PM10	PM2.5	units	PM10	PM2.5	units
Embankment height (cm)	100	CHSRA 2012	0.68	0.10	g/linear meter	2989.38	448.41	lb/year
Surface roughness height (cm)	0.01	CHSRA 2012	0.21	0.03	g/foot	1.49	0.22	tons/year
Threshold friction velocity (m/s)	0.19	CHSRA 2012	1086.50	162.98	g/mile	0.00	0.00	tons/day
meters/feet	0.3048	Conversion	2.40	0.36	lb/mile	8.19	1.23	lbs/day (365)
MPH	79	Input	52.00	52.00	miles	**1.64**	**0.25**	lbs/day PCEP
meter/sect	35.32	Calc	124.56	18.68	g/event			
feet/sec	115.87	Calc	24.00	24.00	event			
PCEP percent of total in 2020	20.00%							

Train Speed

Distance from Train	Distance from Train	Wind Speed (U)	Wind speed	Friction Velocity	Erosion Pot	PM10	PM 2.5	PM10	PM 2.5
feet	Meters (d)	(m/s)	mph	m/s	g/m2	g/M2	g/m2	g/linear m	g/linear m
0.0	0.0	6.8	15.1	0.26	2.14	1.07	0.16	**0.00**	**0.00**
0.3	0.1	6.5	14.5	0.25	1.81	0.90	0.14	**0.09**	**0.01**
0.7	0.2	6.2	14.0	0.24	1.50	0.75	0.11	**0.07**	**0.01**
1.0	0.3	6.0	13.4	0.23	1.20	0.60	0.09	**0.06**	**0.01**
1.3	0.4	5.8	12.9	0.22	0.93	0.46	0.07	**0.05**	**0.01**
1.6	0.5	5.5	12.4	0.22	0.67	0.34	0.05	**0.03**	**0.01**
2.0	0.6	5.3	11.9	0.21	0.43	0.22	0.03	**0.02**	**0.00**
2.3	0.7	5.1	11.4	0.20	0.21	0.10	0.02	**0.01**	**0.00**
2.6	0.8	4.9	10.9	0.19	0.00	0.00	0.00	**0.00**	**0.00**
3.0	0.9	4.7	10.4	0.18	-0.20	-0.10	-0.01	-0.01	0.00
3.3	1.0	4.5	10.0	0.17	-0.38	-0.19	-0.03	-0.02	0.00
3.6	1.1	4.3	9.6	0.17	-0.55	-0.27	-0.04	-0.03	0.00
3.9	1.2	4.1	9.2	0.16	-0.71	-0.35	-0.05	-0.04	-0.01
4.3	1.3	3.9	8.8	0.15	-0.85	-0.43	-0.06	-0.04	-0.01
4.6	1.4	3.7	8.4	0.15	-0.99	-0.49	-0.07	-0.05	-0.01
4.9	1.5	3.6	8.0	0.14	-1.11	-0.56	-0.08	-0.06	-0.01
5.2	1.6	3.4	7.7	0.13	-1.23	-0.61	-0.09	-0.06	-0.01
5.6	1.7	3.3	7.3	0.13	-1.33	-0.67	-0.10	-0.07	-0.01
5.9	1.8	3.1	7.0	0.12	-1.43	-0.72	-0.11	-0.07	-0.01
6.2	1.9	3.0	6.7	0.12	-1.52	-0.76	-0.11	-0.08	-0.01
6.6	2.0	2.9	6.4	0.11	-1.60	-0.80	-0.12	-0.08	-0.01
6.9	2.1	2.7	6.1	0.11	-1.68	-0.84	-0.13	-0.08	-0.01
7.2	2.2	2.6	5.9	0.10	-1.75	-0.87	-0.13	-0.09	-0.01
7.5	2.3	2.5	5.6	0.10	-1.81	-0.90	-0.14	-0.09	-0.01
7.9	2.4	2.4	5.4	0.09	-1.87	-0.93	-0.14	-0.09	-0.01
8.2	2.5	2.3	5.2	0.09	-1.92	-0.96	-0.14	-0.10	-0.01
8.5	2.6	2.2	5.0	0.09	-1.96	-0.98	-0.15	-0.10	-0.01
8.9	2.7	2.1	4.8	0.08	-2.00	-1.00	-0.15	-0.10	-0.02
9.2	2.8	2.1	4.6	0.08	-2.04	-1.02	-0.15	-0.10	-0.02
9.5	2.9	2.0	4.5	0.08	-2.07	-1.04	-0.16	-0.10	-0.02
9.8	3.0	1.9	4.3	0.08	-2.10	-1.05	-0.16	-0.11	-0.02
10.1	3.1	1.9	4.2	0.07	-2.12	-1.06	-0.16	-0.07	-0.01

Table B2-11: Pantograph Emissions Estimates

"Example Mile" Ambient Concentration Calculation (Note: Overstatement of Potential effect)				
PM10		Copper		
90	trains	90	trains	Notes
3	powered EMUs/train	3	pantos/train	
2	collectors/panto	2	collectors/panto	
9.4	g/1000 miles/collector	9.4	g/1000 miles/collector	LTK 2014b Memo on Pantographs
0.0564	g/mile/train	0.0564	g/mile/train	
100%	% PM10	12%	% Cu	
0.0564	g PM10/mile/train	0.006768	g Cu/mile/train	
90	Trains/day	90	Trains/day	
5.076	g/PM10/day/mile/90 trains	0.60912	g/Cu/day/mile/90 trains	
15	height	15	height	
75	width ROW	75	width ROW	
5280	feet/mile	5280	mile	
5940000	Cu Ft/mile	5940000	Cu Ft	
166320	M3/mile	166320	M3	
3.05195E-05	g/m3	3.66234E-06	g Cu/m3	
30.52	ug/m3 24 hour avg.	**3.66**	ug/m3 24 hour avg.	Assumes stay suspension at same location over 24 hours = not realistic and vast overestimate
8	Trains/day/peak hour	8	Trains/day/peak hour	
0.4512	g/peak hour mile	0.054144	g Cu/peak hour mile	
2.71284E-06	g/m3	3.25541E-07	g Cu/m3	
2.71	ug/m3 one hour	**0.33**	ug/m3 one hour	Assuming 100% stay in suspension for hour = vast overestimate as dispersion will occur.

100	OEHHA REL for copper (ug/m3)

Mass Daily Emissions Calculation

248.724	g PM10/day	29.84688	g Cu/day
5.076	g/PM10/mile/train	0.60912	g/Cu/mile/train

4410	Daily EMU miles 2020	4410	Daily EMU miles 2020
0.55	Daily emissions lb	**0.07**	Daily emissions lb

5586	Daily EMU miles 2040	5586	Daily EMU miles2040
0.69	Daily emissions lb	**0.08**	Daily emissions lb
453.59237	g/lb conversion	453.59237	g/lb conversion

Table B2-12: DPM Calculations Using Menlo Park Example

Menlo Park Downtown Specific Plan EIR	
	Cancer Risk (In a million)
Inside	38.6
Outside	58
	Non-Cancer Hazard Index (HI)
Risk levels	0.036
Notes: Study done for residential receptors approx. 50 feet from Caltrain ROW	
Ref: Menlo Park 2012. El Camino Real and Downtown Specific Plan, Final Environmental Impact Report. Available: http://www.menlopark.org/162/Environmental-Impact-Report	

Alternative	PM10 - 2013 Along ROW lb/day	PM10-2020 Along ROW lbs/day	PM10/Existing (percent)	Adjusted Indoor Cancer Risk (in a million)	Adjusted Indoor Non-Cancer Risk (HI)	Adjusted Indoor Cancer Risk if tree reduction is 2%	Adjusted Indoor Cancer Risk if tree reduction is 26%
Existing	159		100%	38.6	0.036	37.8	28.6
No Project		23	15%	5.7	0.005	5.6	4.2
PCEP		21	13%	5.0	0.005	NA	NA
DMU		32	20%	7.8	0.007	7.7	5.8
T4DL-SH		29	18%	7.1	0.007	6.9	5.2
T4DL-DH		33	21%	8.0	0.007	7.8	5.9

Table B2-13 Project Miles

2013

Segment/Service	Trips	Miles/trip	Miles	Notes
SF - SJ, weekday	86	49	4,214	Existing schedule
Gilroy - SF, weekday	6	77	462	Existing schedule
Total, weekday	**92**		**4,676**	
SF - SJ, weekend	68	49	3,332	Existing schedule
Annual (All Diesel)			**1,393,700**	52 weeks + 1 weekday

2020

Segment/Service	Trips	Miles/Trip	Miles	Notes
SF - SJ, weekday (Diesel)	18	49	882	Operations input
Gilroy - SF, weekday (Diesel)	6	77	462	Operations input
SF-SJ, weekday (EMU)	90	49	4,410	Remainder of 114 trips in Ridership analysis
Total, weekday	**114**		**5,754**	
Weekday Share - EMU			76.6%	
Weekday Share - Diesel			23.4%	
SF - SJ, weekend (EMU)	68	49	3,332	Existing schedule
Total Annual			**1,848,322**	**52 weeks + 1 weekday**
Annual Diesel	*24*		*350,784*	52 weeks + 1 weekday
Annual EMU	*90*		*1,497,538*	52 weeks + 1 weekday
Change in miles over NP			*133%*	

2040

Segment/Service	Trips	Miles/Trip	Miles	Notes
SF - SJ, weekday (EMU)	114	49	5,586	Ridership schedule
Gilroy - SJ, weekday (Diesel)	6	28	168	Operations input
Total, weekday	**120**		**5,754**	
SF - SJ, weekend (EMU)	68	49	3,332	Existing schedule
Total Annual			**1,848,322**	52 weeks + 1 weekday
Annual Diesel			*43,848*	52 weeks + 1 weekday
Annual EMU			*1,804,474*	52 weeks + 1 weekday
change in project miles			*133%*	

2020

Segment/Service	Trips	Miles/Trip	Miles	Notes
Annual miles (from above)			350,784	
Gallons/mile, including idling			3.13	2.848*1.1
Gallons (diesel)			**1,098,936**	

2040

Segment/Service	Trips	Miles/Trip	Miles	Notes
Annual miles (from above)			43,848	Existing schedule
Gallons/mile, including idling			3.13	From above
Gallons (diesel)			**137,367**	

Table B2-14: Fuel and Electricity Consumption

Condition	Description	Diesel Fuel Consumption (gal/yr)	Electricity (kWh/yr) including T&D	Diesel Fuel Consumption (gal/weekday)	Electricity (kWh/day)
Existing	All diesel	4,452,984	4,214,860	14,414	13,914
No Project	All diesel - Tier 4 + existing	5,599,784	4,214,860	18,611	13,914
Project (2020)	9 diesel locomotives 96 EMUs 45 trailer cars	1,073,711	88,817,309	4,130	341,605
Cumulative (2040)	6 diesel locomotives 138 to 150 EMUs 31 trailer cars	146,615	112,027,827	564	430,876
No Project (2040)	All Tier 4 (SH)	5,725,108	4,214,860	19,457	13,914

Existing Daily Miles (weekday)	4,601	LTK 2014a
Existing Annual Miles	1,393,700	Calc
Weekdays_year	260	
Non-Rev Factor	1.100	
GPM/revenue mile all in	3.133	Existing
GPM/revenue mile wo idle	*2.848*	Existing - LTK 2014a
Adjusted NP mix (2020) - all in	3.677	LTK 2014a
Project-Diesel GPM/rev mile - all in	3.133	Same as existing
Adjusted NP (2040, used T4 Alt SH) - all in	3.611	LTK 2014a

No Project Weekday Fuel Use	2020 NP	2040 NP	NR Multiplier
F40 (1998)+MP36 (2003)	3,157	0	1.1
F40 (tier 4)	15,454	19,093	1.15
Total	**18,611**	**19,093**	
Saturday Fuel Use			
Tier 4	**7,692**	**7,692**	
Sunday Fuel Use			
Tier 4	**6,809**	**6,809**	
Annual	**5,599,820**	**5,725,108**	
Annual Weekdays	260	260	
Annual Saturdays	52	52	
Annual Sunday	53	53	
Annual Days	365	365	

NOTE: Fuel consumption estimates are preliminary. Further project planning may take into account additional factors in estimating potential project fuel consumption. However, the methodology for estimating fuel consumption was consistent for the No Project Alternative, the Proposed Project, and the other analyzed alternatives and thus conclusions in this EIR related to energy consumption, air quality, GHG emissions are done on a reasonable basis based on available information at the time of preparation of the EIR.

Table B2-15: Re-entrained Paved Road Dust Emission Factor Calculation

=to adjust based on project area

Methodology

Calculation Methodology: USEPA AP-42, Paved Roads, Section 13.2.1, Revised January 2011:
http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0201.pdf
Avg Vehicle Weight, Silt Loading, and Precipitation Days greater than 0.254mm (0.01 in) for Santa Clara County (from Caleemod)

Emission Factor Calculation

Pollutant	Variables					Emission Factor
	k	sL	W	P	N	(lbs per VMT)
PM_{10}	0.0022	0.1	2.4	56	365	0.00064
$PM_{2.5}$	0.00054	0.1	2.4	56	365	0.00016

E = particulate emission factor (grams of particulate matter/VMT)
k = particle size multiplier (lb/VMT) *default from AP-42*
sL = roadway silt loading (g/m2) *Caleemod Default*
W = average weight of vehicles on the road (tons) *Caleemod Default*
P = number of wet days with at least 0.254mm of precipitation *Caleemod Default for Santa Clara County*
N = number of days in the averaging period *annual days (365)*

Condition	Daily VMT	PM10	PM2.5
Existing (2013)	178,662,869	113,576	27,878
Opening No Build	195,376,103	124,201	30,486
Opening Project	195,141,522	124,052	30,449
Cumulative No Build	226,522,817	144,001	35,346
Cumulative Project	225,903,910	143,607	35,249

Table B2-16: Re-entrained Paved Road Dust Emission Factor Calculation (Net) =to adjust based on project area

Methodology

Calculation Methodology: USEPA AP-42, Paved Roads, Section 13.2.1, Revised January 2011:
http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0201.pdf
Avg Vehicle Weight, Silt Loading, and Precipitation Days greater than 0.254mm (0.01 in) for Santa Clara County (from Caleemod)

Emission Factor Calculation

Pollutant	Variables					Emission Factor
	k	sL	W	P	N	(lbs per VMT)
PM_{10}	0.0022	0.1	2.4	56	365	0.00064
$PM_{2.5}$	0.00054	0.1	2.4	56	365	0.00016

E = particulate emission factor (grams of particulate matter/VMT)
k = particle size multiplier (lb/VMT) *default from AP-42*
sL = roadway silt loading (g/m2) *Caleemod Default*
W = average weight of vehicles on the road (tons) *Caleemod Default*
P = number of wet days with at least 0.254mm of precipitation *Caleemod Default for Santa Clara County*
N = number of days in the averaging period *annual days (365)*

Condition	Daily VMT	PM10	PM2.5
Existing (2013)	0	0	0
Opening No Build	0	0	0
Opening Project	-234,581	-149	-37
Cumulative No Build	0	0	0
Cumulative Project	-618,907	-393	-97

Table B2-17: Vehicle Miles Travelled Emissions Calculations

Speed,	2013			2020 No Project			2020 Project			2040 No Project			2040 Project		
MPH	Peak	Off-peak	Daily	Peak	Off-peak	Daily	Peak	Off-peak	Daily	Peak	Off-peak	Daily	Peak	Off-peak	Daily
5 mph	190,671	89,384	280,055	290,652	126,355	417,007	290,343	127,643	417,986	541,976	175,134	717,110	506,061	164,621	670,682
10 mph	382,852	124,294	507,146	453,203	162,454	615,657	447,943	159,998	607,941	1,033,383	262,459	1,295,842	1,020,153	266,605	1,286,758
15 mph	3,087,226	2,237,801	5,325,027	3,446,848	2,340,487	5,787,335	3,422,314	2,332,629	5,754,943	5,443,828	2,882,205	8,326,033	5,309,743	2,891,594	8,201,337
20 mph	6,586,370	3,924,875	10,511,245	7,334,128	4,305,013	11,639,141	7,370,379	4,314,999	11,685,378	9,744,821	5,153,194	14,898,015	9,710,101	5,137,248	14,847,349
25 mph	16,157,378	11,154,093	27,311,471	18,763,276	12,528,218	31,291,494	18,672,062	12,518,015	31,190,077	24,701,582	15,450,678	40,152,260	24,512,621	15,469,060	39,981,681
30 mph	10,434,768	5,728,636	16,163,404	12,332,864	6,527,407	18,860,271	12,242,763	6,553,220	18,795,983	15,993,111	8,447,271	24,440,382	15,882,250	8,411,206	24,293,456
35 mph	10,762,878	5,826,604	16,589,482	11,920,293	6,585,090	18,505,383	11,952,140	6,561,677	18,513,817	15,110,891	8,968,511	24,079,402	15,170,349	8,874,262	24,044,611
40 mph	6,422,393	2,493,128	8,915,521	7,601,472	2,814,788	10,416,260	7,268,562	2,805,834	10,074,396	9,683,585	4,885,291	14,568,876	9,601,331	4,967,060	14,568,391
45 mph	6,692,199	3,564,049	10,256,248	6,871,534	3,703,536	10,575,070	7,129,645	3,701,378	10,831,023	8,023,415	6,531,889	14,555,304	8,170,960	6,431,840	14,602,800
50 mph	5,910,380	1,654,108	7,564,488	7,504,758	2,679,200	10,183,958	7,523,590	2,638,960	10,162,550	6,453,363	4,568,746	11,022,109	6,390,532	4,602,229	10,992,761
55 mph	7,726,469	4,387,446	12,113,915	7,045,631	5,228,239	12,273,870	7,078,548	5,217,939	12,296,487	5,773,347	5,747,303	11,520,650	5,974,309	5,929,516	11,903,825
60 mph	8,784,362	15,728,021	24,512,383	8,473,759	16,383,044	24,856,803	8,417,395	16,470,611	24,888,006	7,417,026	16,895,276	24,312,302	7,041,663	16,729,488	23,771,151
65 mph	13,123,958	25,488,526	38,612,484	12,666,378	27,287,476	39,953,854	12,701,507	27,221,428	39,922,935	10,756,195	25,878,337	36,634,532	10,869,149	25,869,959	36,739,108
All	**96,261,904**	**82,400,965**	**178,662,869**	**104,704,796**	**90,671,307**	**195,376,103**	**104,517,191**	**90,624,331**	**195,141,522**	**120,676,523**	**105,846,294**	**226,522,817**	**120,159,222**	**105,744,688**	**225,903,910**

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Source: Appendix I (Naylor, 2014)

2013 Emissions (lbs/day and MT/year)

1	*2*	*3*	*4*	*5*	*6*	*7*												
	Peak						Off Peak						Total					
Speed	ROG	NOx	CO	PM10	PM2.5	CO2	ROG	NOx	CO	PM10	PM2.5	CO2	ROG	NOx	CO	PM10	PM2.5	CO2
5 mph	292	577	2,013	39	25	91,667	137	270	944	18	12	42,972	428	847	2,956	57	36	134,639
10 mph	444	900	3,368	67	40	138,257	144	292	1,093	22	13	44,886	588	1,192	4,461	89	53	183,143
15 mph	2,796	5,686	22,746	479	267	860,671	2,027	4,122	16,488	347	194	623,864	4,823	9,808	39,234	826	461	1,484,535
20 mph	4,926	9,993	41,837	928	484	1,463,942	2,936	5,955	24,931	553	288	872,376	7,862	15,947	66,767	1,480	772	2,336,318
25 mph	10,961	22,736	91,177	2,184	1,103	3,011,127	7,567	15,696	62,943	1,508	761	2,078,703	18,527	38,432	154,120	3,691	1,864	5,089,830
30 mph	6,600	13,820	53,307	1,370	676	1,690,456	3,623	7,587	29,265	752	371	928,052	10,223	21,407	82,572	2,123	1,047	2,618,508
35 mph	6,486	13,662	50,605	1,388	673	1,567,832	3,511	7,396	27,395	751	365	848,763	9,997	21,058	78,000	2,139	1,038	2,416,596
40 mph	3,751	7,937	28,285	821	395	870,931	1,456	3,081	10,980	319	153	338,089	5,207	11,018	39,265	1,140	549	1,209,020
45 mph	3,845	8,174	28,185	855	412	874,915	2,048	4,353	15,010	455	219	465,951	5,893	12,528	43,195	1,311	631	1,340,866
50 mph	3,389	7,263	24,322	761	369	769,742	948	2,033	6,807	213	103	215,424	4,337	9,295	31,129	974	472	985,165
55 mph	4,479	9,765	31,976	1,011	497	1,038,708	2,543	5,545	18,157	574	282	589,826	7,022	15,311	50,133	1,584	778	1,628,534
60 mph	5,237	11,505	37,827	1,176	589	1,254,270	9,376	20,599	67,727	2,105	1,055	2,245,717	14,613	32,103	105,554	3,281	1,644	3,499,987
65 mph	8,184	17,745	61,318	1,809	929	2,063,486	15,894	34,464	119,087	3,514	1,803	4,007,573	24,078	52,209	180,405	5,323	2,732	6,071,059
All	61,388	129,763	476,963	12,887	6,458	15,696,003	52,210	111,393	400,828	11,131	5,620	13,302,196	113,598	241,155	877,791	24,018	12,077	28,998,199

2020 No Project Emissions (lbs/day and MT/year)

	Peak						Off Peak						Total					
Speed	ROG	NOx	CO	PM10	PM2.5	CO2	ROG	NOx	CO	PM10	PM2.5	CO2	ROG	NOx	CO	PM10	PM2.5	CO2
5 mph	445	879	3,068	59	38	139,733	193	382	1,334	26	16	60,746	638	1,261	4,402	84	54	200,480
10 mph	526	1,065	3,987	79	48	163,663	188	382	1,429	28	17	58,666	714	1,447	5,416	108	65	222,329
15 mph	3,122	6,348	25,396	535	298	960,928	2,120	4,311	17,244	363	203	652,492	5,241	10,659	42,640	897	501	1,613,419
20 mph	5,486	11,127	46,586	1,033	539	1,630,145	3,220	6,531	27,345	606	316	956,869	8,706	17,659	73,932	1,639	855	2,587,014
25 mph	12,728	26,403	105,882	2,536	1,281	3,496,768	8,499	17,630	70,698	1,693	855	2,334,788	21,227	44,033	176,580	4,229	2,136	5,831,557
30 mph	7,801	16,334	63,003	1,620	799	1,997,952	4,129	8,645	33,346	857	423	1,057,455	11,929	24,979	96,349	2,477	1,221	3,055,406
35 mph	7,184	15,131	56,046	1,537	746	1,736,433	3,968	8,359	30,962	849	412	959,252	11,152	23,490	87,008	2,386	1,158	2,695,685
40 mph	4,439	9,394	33,478	972	468	1,030,824	1,644	3,479	12,397	360	173	381,709	6,083	12,873	45,874	1,331	641	1,412,532
45 mph	3,948	8,393	28,940	878	423	898,361	2,128	4,524	15,598	473	228	484,187	6,076	12,917	44,538	1,351	650	1,382,548
50 mph	4,303	9,222	30,883	967	468	977,386	1,536	3,292	11,025	345	167	348,927	5,839	12,514	41,908	1,312	636	1,326,313
55 mph	4,084	8,905	29,158	922	453	947,179	3,031	6,608	21,637	684	336	702,858	7,115	15,513	50,795	1,605	789	1,650,037
60 mph	5,052	11,098	36,489	1,134	568	1,209,921	9,767	21,456	70,548	2,193	1,099	2,339,244	14,818	32,554	107,037	3,327	1,667	3,549,164
65 mph	7,898	17,127	59,180	1,746	896	1,991,541	17,016	36,896	127,492	3,762	1,931	4,290,423	24,914	54,023	186,672	5,508	2,827	6,281,963
All	67,014	141,427	522,097	14,016	7,024	17,180,834	57,438	122,495	441,054	12,239	6,176	14,627,616	124,452	263,921	963,150	26,256	13,200	31,808,449

2020 Project Emissions (lbs/day and MT/year)

	Peak						Off Peak						Total					
Speed	ROG	NOx	CO	PM10	PM2.5	CO2	ROG	NOx	CO	PM10	PM2.5	CO2	ROG	NOx	CO	PM10	PM2.5	CO2
5 mph	444	878	3,065	59	38	139,585	195	386	1,347	26	17	61,365	639	1,264	4,412	85	54	200,950
10 mph	519	1,053	3,941	78	47	161,763	186	376	1,407	28	17	57,779	705	1,429	5,348	106	64	219,542
15 mph	3,099	6,303	25,215	531	296	954,088	2,113	4,296	17,186	362	202	650,301	5,212	10,599	42,401	892	498	1,604,389
20 mph	5,513	11,182	46,817	1,038	542	1,638,203	3,228	6,547	27,409	608	317	959,088	8,740	17,729	74,226	1,646	859	2,597,291
25 mph	12,666	26,275	105,368	2,524	1,275	3,479,770	8,492	17,615	70,640	1,692	855	2,332,887	21,158	43,890	176,008	4,216	2,129	5,812,656
30 mph	7,744	16,214	62,543	1,608	793	1,983,355	4,145	8,679	33,478	861	424	1,061,636	11,888	24,893	96,021	2,468	1,217	3,044,992
35 mph	7,203	15,171	56,196	1,541	748	1,741,072	3,954	8,329	30,852	846	411	955,842	11,157	23,500	87,048	2,387	1,158	2,696,914
40 mph	4,245	8,983	32,012	929	447	985,678	1,639	3,468	12,357	359	173	380,495	5,884	12,451	44,369	1,288	620	1,366,173
45 mph	4,096	8,709	30,027	911	438	932,105	2,127	4,521	15,589	473	228	483,905	6,223	13,230	45,616	1,384	666	1,416,010
50 mph	4,314	9,245	30,960	969	470	979,839	1,513	3,243	10,860	340	165	343,686	5,827	12,488	41,820	1,309	634	1,323,525
55 mph	4,103	8,947	29,294	926	455	951,604	3,025	6,595	21,594	682	335	701,474	7,128	15,542	50,888	1,608	790	1,653,078
60 mph	5,018	11,024	36,246	1,127	564	1,201,873	9,819	21,571	70,925	2,204	1,104	2,351,747	14,837	32,595	107,171	3,331	1,669	3,553,620
65 mph	7,920	17,174	59,344	1,751	899	1,997,064	16,975	36,807	127,184	3,753	1,926	4,280,038	24,895	53,981	186,527	5,504	2,825	6,277,102
All	66,885	141,158	521,027	13,991	7,011	17,145,999	57,408	122,433	440,827	12,233	6,173	14,620,243	124,293	263,591	961,854	26,224	13,184	31,766,243

2040 No Project Emissions (lbs/day and MT/year)

	Peak						Off Peak						Total					
Speed	ROG	NOx	CO	PM10	PM2.5	CO2	ROG	NOx	CO	PM10	PM2.5	CO2	ROG	NOx	CO	PM10	PM2.5	CO2
5 mph	829	1,639	5,721	110	71	260,559	268	530	1,849	35	23	84,197	1,097	2,169	7,570	145	93	344,757
10 mph	1,198	2,428	9,091	181	108	373,180	304	617	2,309	46	28	94,780	1,503	3,045	11,399	227	136	467,960
15 mph	4,930	10,026	40,109	844	471	1,517,655	2,610	5,308	21,235	447	250	803,514	7,540	15,335	61,344	1,291	721	2,321,169
20 mph	7,289	14,785	61,899	1,373	716	2,165,966	3,854	7,818	32,733	726	379	1,145,392	11,143	22,603	94,632	2,098	1,095	3,311,359
25 mph	16,757	34,760	139,393	3,339	1,686	4,603,445	10,481	21,742	87,189	2,088	1,055	2,879,425	27,238	56,502	226,582	5,427	2,741	7,482,870
30 mph	10,116	21,181	81,702	2,100	1,036	2,590,920	5,343	11,188	43,154	1,109	547	1,368,477	15,459	32,369	124,856	3,210	1,582	3,959,397
35 mph	9,106	19,181	71,048	1,949	945	2,201,209	5,405	11,384	42,168	1,156	561	1,306,446	14,511	30,565	113,216	3,105	1,507	3,507,655
40 mph	5,655	11,968	42,648	1,238	596	1,313,176	2,853	6,038	21,515	624	301	662,487	8,509	18,005	64,163	1,862	896	1,975,662
45 mph	4,610	9,800	33,792	1,025	493	1,048,954	3,753	7,979	27,510	835	402	853,957	8,363	17,779	61,301	1,860	895	1,902,910
50 mph	3,700	7,930	26,556	831	403	840,457	2,620	5,614	18,801	588	285	595,013	6,320	13,544	45,357	1,420	688	1,435,470
55 mph	3,347	7,297	23,893	755	371	776,140	3,331	7,264	23,785	752	369	772,639	6,678	14,561	47,678	1,507	740	1,548,778
60 mph	4,422	9,714	31,939	993	497	1,059,036	10,072	22,127	72,753	2,261	1,133	2,412,382	14,494	31,841	104,692	3,254	1,630	3,471,418
65 mph	6,707	14,544	50,255	1,483	761	1,691,202	16,137	34,991	120,908	3,568	1,831	4,068,863	22,844	49,535	171,163	5,050	2,592	5,760,065
All	78,666	165,253	618,044	16,220	8,155	20,441,898	67,032	142,599	515,909	14,236	7,162	17,047,572	145,698	307,852	1,133,953	30,456	15,317	37,489,470

2040 Project Emissions (lbs/day and MT/year)

	Peak						Off Peak						Total					
Speed	ROG	NOx	CO	PM10	PM2.5	CO2	ROG	NOx	CO	PM10	PM2.5	CO2	ROG	NOx	CO	PM10	PM2.5	CO2
5 mph	774	1,531	5,342	102	66	243,293	252	498	1,738	33	21	79,143	1,026	2,028	7,080	136	87	322,436
10 mph	1,183	2,397	8,974	179	107	368,402	309	627	2,345	47	28	96,278	1,492	3,024	11,319	225	135	464,680
15 mph	4,809	9,780	39,121	823	460	1,480,274	2,619	5,326	21,305	448	250	806,132	7,427	15,105	60,425	1,272	710	2,286,406
20 mph	7,263	14,732	61,679	1,368	714	2,158,249	3,843	7,794	32,632	724	378	1,141,848	11,105	22,526	94,310	2,091	1,091	3,300,097
25 mph	16,628	34,494	138,326	3,313	1,673	4,568,230	10,494	21,768	87,293	2,091	1,056	2,882,851	27,122	56,262	225,619	5,404	2,729	7,451,080
30 mph	10,046	21,034	81,136	2,086	1,028	2,572,960	5,320	11,140	42,969	1,105	545	1,362,634	15,366	32,174	124,105	3,190	1,573	3,935,595
35 mph	9,142	19,256	71,328	1,956	949	2,209,870	5,348	11,264	41,725	1,144	555	1,292,717	14,490	30,521	113,052	3,101	1,504	3,502,587
40 mph	5,607	11,866	42,285	1,227	591	1,302,021	2,901	6,139	21,875	635	306	673,575	8,508	18,005	64,161	1,862	896	1,975,596
45 mph	4,695	9,981	34,413	1,044	502	1,068,243	3,695	7,856	27,088	822	396	840,877	8,390	17,837	61,501	1,866	898	1,909,120
50 mph	3,664	7,853	26,298	823	399	832,274	2,639	5,655	18,939	593	287	599,374	6,303	13,508	45,236	1,416	686	1,431,648
55 mph	3,463	7,551	24,724	781	384	803,156	3,437	7,494	24,539	776	381	797,134	6,900	15,045	49,263	1,557	765	1,600,290
60 mph	4,198	9,222	30,322	942	472	1,005,440	9,973	21,910	72,039	2,239	1,122	2,388,710	14,171	31,132	102,362	3,181	1,594	3,394,150
65 mph	6,778	14,697	50,783	1,498	769	1,708,961	16,132	34,980	120,869	3,566	1,830	4,067,546	22,910	49,676	171,652	5,065	2,599	5,776,507
All	78,250	164,393	614,730	16,144	8,114	20,321,375	66,961	142,451	515,357	14,222	7,155	17,028,818	145,211	306,843	1,130,087	30,366	15,269	37,350,193

Table B2-18: Vehicle Miles Travelled Emissions Calculations (Net)

Speed,	2013			2020 Project Net			2020 Project			2040 Project Net			2040 Project		
MPH	Peak	Off-peak	Daily	Peak	Off-peak	Daily	Peak	Off-peak	Daily	Peak	Off-peak	Daily	Peak	Off-peak	Daily
5 mph				-309	1,288	979				-35,915	-10,513	-46,428			
10 mph				-5,260	-2,456	-7,716				-13,230	4,146	-9,084			
15 mph				-24,534	-7,858	-32,392				-134,085	9,389	-124,696			
20 mph				36,251	9,986	46,237				-34,720	-15,946	-50,666			
25 mph				-91,214	-10,203	-101,417				-188,961	18,382	-170,579			
30 mph				-90,101	25,813	-64,288				-110,861	-36,065	-146,926			
35 mph				31,847	-23,413	8,434				59,458	-94,249	-34,791			
40 mph				-332,910	-8,954	-341,864				-82,254	81,769	-485			
45 mph				258,111	-2,158	255,953				147,545	-100,049	47,496			
50 mph				18,832	-40,240	-21,408				-62,831	33,483	-29,348			
55 mph				32,917	-10,300	22,617				200,962	182,213	383,175			
60 mph				-56,364	87,567	31,203				-375,363	-165,788	-541,151			
65 mph				35,129	-66,048	-30,919				112,954	-8,378	104,576			
All				**-187,605**	**-46,976**	**-234,581**				**-517,301**	**-101,606**	**-618,907**			

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2020 Project NET Emissions (lbs/day and MT/year)

	Peak						Off Peak						Total					
Speed	ROG	NOx	CO	PM10	PM2.5	CO2	ROG	NOx	CO	PM10	PM2.5	CO2	ROG	NOx	CO	PM10	PM2.5	CO2
5 mph	0	-1	-3	0	0	-149	2	4	14	0	0	619	1	3	10	0	0	471
10 mph	-6	-12	-46	-1	-1	-1,900	-3	-6	-22	0	0	-887	-9	-18	-68	-1	-1	-2,786
15 mph	-22	-45	-181	-4	-2	-6,840	-7	-14	-58	-1	-1	-2,191	-29	-60	-239	-5	-3	-9,030
20 mph	27	55	230	5	3	8,057	7	15	63	1	1	2,220	35	70	294	7	3	10,277
25 mph	-62	-128	-515	-12	-6	-16,999	-7	-14	-58	-1	-1	-1,901	-69	-143	-572	-14	-7	-18,900
30 mph	-57	-119	-460	-12	-6	-14,597	16	34	132	3	2	4,182	-41	-85	-328	-8	-4	-10,415
35 mph	19	40	150	4	2	4,639	-14	-30	-110	-3	-1	-3,411	5	11	40	1	1	1,229
40 mph	-194	-411	-1,466	-43	-20	-45,145	-5	-11	-39	-1	-1	-1,214	-200	-422	-1,506	-44	-21	-46,360
45 mph	148	315	1,087	33	16	33,745	-1	-3	-9	0	0	-282	147	313	1,078	33	16	33,462
50 mph	11	23	77	2	1	2,453	-23	-49	-166	-5	-3	-5,241	-12	-26	-88	-3	-1	-2,788
55 mph	19	42	136	4	2	4,425	-6	-13	-43	-1	-1	-1,385	13	29	94	3	1	3,041
60 mph	-34	-74	-243	-8	-4	-8,048	52	115	377	12	6	12,503	19	41	134	4	2	4,455
65 mph	22	47	164	5	2	5,523	-41	-89	-309	-9	-5	-10,385	-19	-42	-144	-4	-2	-4,861
All	-129	-268	-1,069	-25	-13	-34,834	-30	-62	-227	-6	-3	-7,372	-159	-330	-1,296	-32	-16	-42,207

2040 Project NET Emissions (lbs/day and MT/year)

	Peak						Off Peak						Total					
Speed	ROG	NOx	CO	PM10	PM2.5	CO2	ROG	NOx	CO	PM10	PM2.5	CO2	ROG	NOx	CO	PM10	PM2.5	CO2
5 mph	-55	-109	-379	-7	-5	-17,266	-16	-32	-111	-2	-1	-5,054	-71	-140	-490	-9	-6	-22,321
10 mph	-15	-31	-116	-2	-1	-4,778	5	10	36	1	0	1,497	-11	-21	-80	-2	-1	-3,280
15 mph	-121	-247	-988	-21	-12	-37,381	9	17	69	1	1	2,618	-113	-230	-919	-19	-11	-34,763
20 mph	-26	-53	-221	-5	-3	-7,717	-12	-24	-101	-2	-1	-3,544	-38	-77	-322	-7	-4	-11,261
25 mph	-128	-266	-1,066	-26	-13	-35,215	12	26	104	2	1	3,426	-116	-240	-963	-23	-12	-31,790
30 mph	-70	-147	-566	-15	-7	-17,960	-23	-48	-184	-5	-2	-5,843	-93	-195	-751	-19	-10	-23,802
35 mph	36	75	280	8	4	8,661	-57	-120	-443	-12	-6	-13,729	-21	-44	-164	-4	-2	-5,068
40 mph	-48	-102	-362	-11	-5	-11,154	48	101	360	10	5	11,089	0	-1	-2	0	0	-66
45 mph	85	180	621	19	9	19,290	-57	-122	-421	-13	-6	-13,080	27	58	200	6	3	6,209
50 mph	-36	-77	-259	-8	-4	-8,183	19	41	138	4	2	4,361	-17	-36	-121	-4	-2	-3,822
55 mph	116	254	832	26	13	27,016	106	230	754	24	12	24,496	222	484	1,586	50	25	51,512
60 mph	-224	-492	-1,616	-50	-25	-53,596	-99	-217	-714	-22	-11	-23,672	-323	-709	-2,330	-72	-36	-77,268
65 mph	70	153	528	16	8	17,760	-5	-11	-39	-1	-1	-1,317	65	141	489	14	7	16,443
All	-416	-860	-3,313	-76	-41	-120,523	-71	-149	-553	-14	-7	-18,754	-487	-1,009	-3,866	-90	-48	-139,277

Table B2-19 CT-EMFAC Emissions Factors

2013 Aggregate Emission Factors (grams/mile)

Speed	ROG	NOx	CO	PM10	PM2.5	CO2
5 mph	0.693847	1.371847	4.787996	0.09186	0.059046	1385.4703
10 mph	0.526038	1.065962	3.990212	0.079385	0.047579	1040.7046
15 mph	0.410794	0.835429	3.341964	0.070341	0.039266	803.41357
20 mph	0.339276	0.68818	2.881222	0.063887	0.033335	640.54309
25 mph	0.3077	0.638289	2.559653	0.061307	0.030965	537.06732
30 mph	0.286898	0.600738	2.317218	0.059568	0.029369	466.8653
35 mph	0.273348	0.575761	2.13269	0.058491	0.028381	419.79926
40 mph	0.26491	0.560582	1.997672	0.057976	0.027907	390.80234
45 mph	0.260612	0.55405	1.910357	0.057961	0.027894	376.76236
50 mph	0.260072	0.557367	1.866584	0.058417	0.028312	375.31857
55 mph	0.262926	0.573295	1.877171	0.059328	0.029149	387.42069
60 mph	0.270407	0.594059	1.953233	0.060708	0.030416	411.48251
65 mph	0.28285	0.613321	2.11927	0.062533	0.032092	453.11374
70 mph	0.28285	0.613321	2.11927	0.062533	0.032092	453.11374
75 mph	0.28285	0.613321	2.11927	0.062533	0.032092	453.11374

Fleet Average Running Exhaust Emission Factors (grams/mile)

Speed	ROG	NOx	CO	PM10	PM2.5	CO2
5 mph	0.503521	1.371847	4.787996	0.043285	0.039769	1385.4703
10 mph	0.335712	1.065962	3.990212	0.03081	0.028302	1040.7046
15 mph	0.220468	0.835429	3.341964	0.021766	0.019989	803.41357
20 mph	0.14895	0.68818	2.881222	0.015312	0.014058	640.54309
25 mph	0.117374	0.638289	2.559653	0.012732	0.011688	537.06732
30 mph	0.096572	0.600738	2.317218	0.010993	0.010092	466.8653
35 mph	0.083022	0.575761	2.13269	0.009916	0.009104	419.79926
40 mph	0.074584	0.560582	1.997672	0.009401	0.00863	390.80234
45 mph	0.070286	0.55405	1.910357	0.009386	0.008617	376.76236
50 mph	0.069746	0.557367	1.866584	0.009842	0.009035	375.31857
55 mph	0.0726	0.573295	1.877171	0.010753	0.009872	387.42069
60 mph	0.080081	0.594059	1.953233	0.012133	0.011139	411.48251
65 mph	0.092524	0.613321	2.11927	0.013958	0.012815	453.11374
70 mph	0.092524	0.613321	2.11927	0.013958	0.012815	453.11374
75 mph	0.092524	0.613321	2.11927	0.013958	0.012815	453.11374

Fleet Average Running Loss Emission Factors (grams/mile)

ROG
0.190326

Fleet Average Tire Wear and Brake Wear Factors (grams/mile)

PM10	PM2.5
0.048575	0.019277

2020 Aggregate Emission Factors (grams/mile)

Speed	ROG	NOx	CO	PM10	PM2.5	CO2
5 mph	0.368021	0.67476	2.318406	0.065404	0.034745	1395.5653
10 mph	0.352118	0.54213	1.989351	0.0606	0.030296	1049.1879
15 mph	0.295396	0.434627	1.706132	0.057398	0.027331	810.57031
20 mph	0.261068	0.359502	1.497341	0.055328	0.025417	646.18622
25 mph	0.246624	0.328111	1.350755	0.054117	0.024297	542.50647
30 mph	0.237199	0.304203	1.235136	0.053374	0.023609	472.07803
35 mph	0.231066	0.287782	1.141587	0.052954	0.023221	424.79205
40 mph	0.227321	0.277316	1.069216	0.052778	0.023056	395.60629
45 mph	0.225548	0.272172	1.017963	0.052797	0.023074	381.42166
50 mph	0.22555	0.273037	0.984793	0.052988	0.023249	379.87817
55 mph	0.227321	0.281654	0.975588	0.053339	0.023571	391.93671
60 mph	0.231473	0.293479	0.99265	0.053858	0.02405	416.03946
65 mph	0.238535	0.302346	1.051185	0.054534	0.024672	457.79953
70 mph	0.238535	0.302346	1.051185	0.054534	0.024672	457.79953
75 mph	0.238535	0.302346	1.051185	0.054534	0.024672	457.79953

Fleet Average Running Exhaust Emission Factors (grams/mile)

Speed	ROG	NOx	CO	PM10	PM2.5	CO2
5 mph	0.243268	0.67476	2.318406	0.016665	0.015414	1395.5653
10 mph	0.161792	0.54213	1.989351	0.011861	0.010965	1049.1879
15 mph	0.10507	0.434627	1.706132	0.008659	0.008	810.57031
20 mph	0.070742	0.359502	1.497341	0.006589	0.006086	646.18622
25 mph	0.056298	0.328111	1.350755	0.005378	0.004966	542.50647
30 mph	0.046873	0.304203	1.235136	0.004635	0.004278	472.07803
35 mph	0.04074	0.287782	1.141587	0.004215	0.00389	424.79205
40 mph	0.036995	0.277316	1.069216	0.004039	0.003725	395.60629
45 mph	0.035222	0.272172	1.017963	0.004058	0.003743	381.42166
50 mph	0.035224	0.273037	0.984793	0.004249	0.003918	379.87817
55 mph	0.036995	0.281654	0.975588	0.0046	0.00424	391.93671
60 mph	0.041147	0.293479	0.99265	0.005119	0.004719	416.03946
65 mph	0.048209	0.302346	1.051185	0.005795	0.005341	457.79953
70 mph	0.048209	0.302346	1.051185	0.005795	0.005341	457.79953
75 mph	0.048209	0.302346	1.051185	0.005795	0.005341	457.79953

Fleet Average Running Loss Emission Factors (grams/mile)

ROG
0.124753

Fleet Average Tire Wear and Brake Wear Factors (grams/mile)

PM10	PM2.5
0.048739	0.019331

2040 Aggregate Emission Factors (grams/mile)

Speed	ROG	NOx	CO	PM10	PM2.5	CO2
5 mph	0.276503	0.391954	1.417747	0.065732	0.034869	1410.4419
10 mph	0.212049	0.316328	1.227355	0.060671	0.030176	1062.2459
15 mph	0.167132	0.254431	1.063504	0.057513	0.027251	821.65051
20 mph	0.140282	0.209199	0.940376	0.055516	0.0254	654.82605
25 mph	0.13128	0.189854	0.859774	0.054329	0.024301	551.02502
30 mph	0.12534	0.174686	0.793858	0.053622	0.023646	480.35223
35 mph	0.121483	0.163673	0.738971	0.053245	0.023296	432.7771
40 mph	0.11919	0.156027	0.695757	0.053113	0.023173	403.29907
45 mph	0.118241	0.151512	0.664864	0.053177	0.023231	388.84448
50 mph	0.118562	0.150439	0.644991	0.053413	0.023447	387.07068
55 mph	0.120341	0.153418	0.641162	0.053811	0.023814	398.93463
60 mph	0.124026	0.159196	0.656643	0.054379	0.024336	422.88123
65 mph	0.130164	0.163587	0.702385	0.055114	0.025015	464.49283
70 mph	0.130164	0.163587	0.702385	0.055114	0.025015	464.49283
75 mph	0.130164	0.163587	0.702385	0.055114	0.025015	464.49283

Fleet Average Running Exhaust Emission Factors (grams/mile)

Speed	ROG	NOx	CO	PM10	PM2.5	CO2
5 mph	0.184588	0.391954	1.417747	0.016656	0.015422	1410.4419
10 mph	0.120134	0.316328	1.227355	0.011595	0.010729	1062.2459
15 mph	0.075217	0.254431	1.063504	0.008437	0.007804	821.65051
20 mph	0.048367	0.209199	0.940376	0.00644	0.005953	654.82605
25 mph	0.039365	0.189854	0.859774	0.005253	0.004854	551.02502
30 mph	0.033425	0.174686	0.793858	0.004546	0.004199	480.35223
35 mph	0.029568	0.163673	0.738971	0.004169	0.003849	432.7771
40 mph	0.027275	0.156027	0.695757	0.004037	0.003726	403.29907
45 mph	0.026326	0.151512	0.664864	0.004101	0.003784	388.84448
50 mph	0.026647	0.150439	0.644991	0.004337	0.004	387.07068
55 mph	0.028426	0.153418	0.641162	0.004735	0.004367	398.93463
60 mph	0.032111	0.159196	0.656643	0.005303	0.004889	422.88123
65 mph	0.038249	0.163587	0.702385	0.006038	0.005568	464.49283
70 mph	0.038249	0.163587	0.702385	0.006038	0.005568	464.49283
75 mph	0.038249	0.163587	0.702385	0.006038	0.005568	464.49283

Fleet Average Running Loss Emission Factors (grams/mile)

ROG
0.091915

Fleet Average Tire Wear and Brake Wear Factors (grams/mile)

PM10	PM2.5
0.049076	0.019447

Table B2-20: Locomotive Emission Factors

Pollutant	Grams/Gallon			
	2013	2020 NP	2020 P	2040 P
HC	9.9	2.5	6.1	0.8
ROG	10.5	2.6	6.4	0.9
NOx	233.8	58.7	142.8	20.8
CO	26.6	26.6	26.6	26.6
PM10	6.7	1.5	4.2	0.31
PM2.5	6.5	1.5	4.0	0.3
CO2	10,210	10,210	10,210	10,210
CH4	0.8	0.8	0.8	0.8
N2O	0.26	0.26	0.26	0.26

Existing	Existing	Remnant 2020	Remnant 2020	Tier 4 2020 -69%	Tier 4 2020 - 69%	Tier 4 2020 - 76.5%	Tier 4 2020 - 76.5%
Blend 1 (g/bhp-hr)	Blend 1 (g/gal)	Blend 2 (g/bhp-hr)	Blend 2 (g/Gal)	Blend 3 (g/bhp-hr)	Blend 3 (g/gal)	Blend 4 (g/bhp-hr)	Blend4 (g/gal)
0.48	9.9	0.29	6.1	0.12	2.5	0.10	2.1
0.50	10.5	0.31	6.4	0.12	2.6	0.10	2.2
11.24	233.8	6.87	142.8	2.82	58.7	2.38	49.5
1.28	26.6	1.28	26.6	1.28	26.6	1.28	26.6
0.32	6.7	0.20	4.2	0.07	1.5	0.06	1.2
0.31	6.5	0.19	4.0	0.07	1.5	0.06	1.2
	10,210		10,210		10,210		10,210
	0.80		0.8		0.8		0.8
	0.26		0.26		0.26		0.26

USEPA Tier Emissions Factors (USEPA 2009)

	Uncontrolled	Uncontrolled	Tier 0	Tier 0	Tier 0+	Tier 0+	Tier 1	Tier 1	Tier 1+	Tier 1+	Tier 4	Tier 4	
	(g/bhp-hr)	(g/Gal)	(g/bhp-hr)	(g/Gal)	(g/bhp-hr)	(g/Gal)	(g/bhp-hr)	(g/Gal)	(g/bhp-hr)	(g/Gal)	(g/bhp-hr)	(g/gal)	Sources
HC	0.48	10.0	0.48	10.0	0.30	6.2	0.47	9.8	0.29	6.0	0.04	0.8	EPA 2009, Table 1
ROG	0.51	10.5	0.51	10.5	0.32	6.6	0.49	10.3	0.31	6.4	0.04	0.9	Calculated
NOx	13.00	270.4	8.60	178.9	7.20	149.8	6.70	139.4	6.70	139.4	1.00	20.8	EPA 2009,Table 1
CO	1.28	26.6	1.28	26.6	1.28	26.6	1.28	26.6	1.28	26.6	1.28	26.6	EPA 2009,Table 1
PM10	0.32	6.7	0.32	6.7	0.20	4.2	0.32	6.7	0.20	4.2	0.02	0.3	EPA 2009,Table 1
PM2.5	0.31	6.5	0.31	6.5	0.19	4.0	0.31	6.5	0.19	4.0	0.01	0.3	Calculated
CO2		10,210		10,210		10,210		10,210		10,210		10,210	Climate Registry 2013, Table 12.1
CH4		0.80		0.80		0.80		0.80		0.80		0.80	Climate Registry 2013, Table 13.7
N2O		0.26		0.26		0.26		0.26		0.26		0.26	Climate Registry 2013, Table 13.7

VOC/HC	1.053
PM2.5/PM10	0.97
grams/kg	1000
bhp-hr/gal	20.8
lbs_gram	0.00220462
MT_gram	0.000001

EPA 2009, page 4
EPA 2009, page 4
EPA 2009, Table 3

Existing Splits	Vehicle Type	2020 Splits (76.5%)
69.0%	1980s F40	
10.3%	1998 F40	7.8%
20.7%	2003 MP36	15.7%
	DMU/EMU	76.5%

Calc of 23.5% Split	
31.0%	Existing
132.1%	Adjustment
7.8%	New
15.7%	New

Table B2-21: Electricity Emission Factors

Existing Emission Factors

CO2	431	lbs/MWh	PG&E 2013
CH4	0.029	lb/MWh	CalEEMod (2010 State Data)
N2O	0.00617	lb/MWh	CalEEMod (2010 State Data)
SF6	0.000220462	lb/MWh	Source: ARB 2010; CEC 2012
NMHC	0.0111	g/kWh	Delucchi 2006 - Table 24 (SF Region, 2003 data)
NOx	0.2377	g/kWh	Delucchi 2006 - Table 24 (SF Region, 2003 data)
CO	0.195	g/kWh	Delucchi 2006 - Table 24 (SF Region, 2003 data)
PM10	0.0116	g/kWh	Delucchi 2006 - Table 24 (SF Region, 2003 data)
SOx	0.1736	g/kWh	Delucchi 2006 - Table 24 (SF Region, 2003 data)
NMHC	0.0097	g/kWh	Scaled Delucchi 2003 factors to 2010 (consistent with GHG factors)
NOx	0.2083	g/kWh	Scaled Delucchi 2003 factors to 2010 (consistent with GHG factors)
CO	0.171	g/kWh	Scaled Delucchi 2003 factors to 2010 (consistent with GHG factors)
PM10	0.0102	g/kWh	Scaled Delucchi 2003 factors to 2010 (consistent with GHG factors)
MWh_kWh	0.001		
MT_lbs	0.000453592		

T & D Losses	6.84%	
TD Factor	106.84%	2014 eGrid Version 1.0

RPS Adjusted (2020+)

CO2	290	lbs/MWh	PG&E 2013
CH4	0.0200	lb/MWh	Calculated based on 2010 statewide mix and change to 2020
N2O	0.0043	lb/MWh	Calculated based on 2010 statewide mix and change to 2020
NMHC	0.0065	g/kWh	Calculated based on 2003 PG&E mix and change to 2020
NOx	0.1398	g/kWh	Calculated based on 2003 PG&E mix and change to 2020
CO	0.1147	g/kWh	Calculated based on 2003 PG&E mix and change to 2020
PM10	0.0068	g/kWh	Calculated based on 2003 PG&E mix and change to 2020
SF6	0.0002	lb/MWh	No effect (transmission)

CA Statewide Energy Mix

2010 / 2020 BAU (no change)	Percentage	Lbs CH4/kWh	Emission Factor (lbs N2O/kWh)
hydro	10.5%	0.000000	0.000000
Nuclear	13.9%	0.000000	0.000000
renewable	13.9%	0.000000	0.000000
non-renewable	61.7%	0.000047	0.000010
total	100.0%	0.000029	0.000006
RPS Implementation	**Percentage**	**Lbs CH4/kWh**	**Emission Factor (lbs N2O/kWh)**
hydro	10.5%	0.000000	0.000000
Nuclear	13.9%	0.000000	0.000000
renewable	33.0%	0.000000	0.000000
non-renewable	42.6%	0.000047	0.000010
total	100.0%	0.000020	0.000004

PG&E (SF Region) (http://www.pgecorp.com/corp_responsibility/reports/2004/2004_PGE_CRR_Full.pdf)

2003 / 2020 BAU (no change)	Percentage	g NMHC/kWh	g NOx/kWh	g CO/kWh	g PM10/kWh
hydro	16.0%	0.000000	0.000000	0.000000	0.000000
Nuclear	21.0%	0.000000	0.000000	0.000000	0.000000
renewable	12.0%	0.000000	0.000000	0.000000	0.000000
non-renewable	51.0%	0.000022	0.000466	0.000382	0.000023
total	100.0%	0.000011	0.000238	0.000195	0.000012
RPS Implementation	**Percentage**	**g NMHC/kWh**	**g NOx/kWh**	**g CO/kWh**	**g PM10/kWh**
hydro	16.0%	0.000000	0.000000	0.000000	0.000000
Nuclear	21.0%	0.000000	0.000000	0.000000	0.000000
renewable	33.0%	0.000000	0.000000	0.000000	0.000000
non-renewable	30.0%	0.000022	0.000466	0.000382	0.000023
total	100.0%	0.000007	0.000140	0.000115	0.000007

PG&E (SF Region) (http://www.pgecorp.com/corp_responsibility/reports/2004/2004_PGE_CRR_Full.pdf)

2003 Mix	Percentage	g NMHC/kWh	g NOx/kWh	g CO/kWh	g PM10/kWh
hydro	16.0%	0.000000	0.000000	0.000000	0.000000
Nuclear	21.0%	0.000000	0.000000	0.000000	0.000000
renewable	12.0%	0.000000	0.000000	0.000000	0.000000
non-renewable	51.0%	0.000022	0.000466	0.000382	0.000023
total	100.0%	0.000011	0.000238	0.000195	0.000012

PG&E (SF Region) (http://www.pgecorp.com/corp_responsibility/reports/2010/index.html/report.jsp)

2010 Mix	Percentage	g NMHC/kWh	g NOx/kWh	g CO/kWh	g PM10/kWh
hydro	15.6%	0.000000	0.000000	0.000000	0.000000
Nuclear	23.8%	0.000000	0.000000	0.000000	0.000000
renewable	15.9%	0.000000	0.000000	0.000000	0.000000
non-renewable	44.7%	0.000022	0.000466	0.000382	0.000023
total	100.0%	0.000010	0.000208	0.000171	0.000010

Table B2-22: Freight via Truck vs. Freight by Rail Analysis

Parameters

tons/day	5,000
miles	37
Locomotive/day	1-3
locomotive miles/day	37
ton-miles/day	185,000
day/year	260
locomotive miles/year	9,620
ton-miles/year	48,100,000
lb/gram	0.002205
MT/gram	0.000001

	Grams/ton-Mile		
Pollutant	2020	2040	
NOx	0.25	0.07	Calculated from EPA 2009
CO2	25.53	25.53	Calculated from EPA 2009

Truck/Rail conversion (NOx low)	2	USEPA 2010
Truck/Rail conversion (NOx high; GHG)	3	USEPA 2010

Summary of Criteria Pollutant Emissions for Rail (pounds per day)

	1 train/day		3 trains/day	
Year	**NOx-High**	**Nox-Low**	**Nox-High**	**Nox-Low**
2020				
Truck	305.9	203.9	917.7	611.8
Rail	102.0	102.0	305.9	305.9
Difference (Truck minus Freight)	*203.9*	*102.0*	*611.8*	*305.9*
2040				
Truck	85.6	57.1	256.9	171.3
Freight	28.5	28.5	85.6	85.6
Difference (Truck minus Freight)	*57.1*	*28.5*	*171.3*	*85.6*

Summary of GHG Emissions (metric tons per year)

Year	**1 train per day**	**3 trains per day**
2020		
Truck	3,684	11,052
Freight	1,228	3,684
Difference (Truck minus Freight)	*2,456*	*7,368*
2040		
Truck	3,684	11,052
Freight	1,228	3,684
Difference (Truck minus Freight)	*2,456*	*7,368*

Table B2-23: Energy Use Estimates

Scenario	Year	Diesel (gals/year)	Electricity (kwh/year)	Caltrain Direct Energy Use (Million BTU/year)	Avoided VMT gallons/year	Net Direct Energy Use Million BTU (w/ VMT reduction)	Notes
Existing	2014	4,452,984	4,214,860	633,346	0	633,346	
No Project	2020	5,599,784	4,214,860	792,751	0	792,751	
PCEP	2020	1,073,711	88,817,309	452,290	-1,718,058	237,533	VMT reduction related to 2020 No Project
T4 Alt (DH)	2020	9,184,914	4,214,860	1,291,084	-1,718,058	1,076,327	VMT reduction related to 2020 No Project
DMU Alt	2020	6,914,109	4,214,860	975,442	-1,718,058	760,685	VMT reduction related to 2020 No Project
No Project	2040	5,725,108	4,214,860	810,171	0	810,171	
PCEP-FE	2040	146,615	112,027,827	402,618	-2,952,584	33,545	VMT reduction related to 2040 No Project
T4 Alt (DH)	2040	9,208,950	4,214,860	1,294,425	-2,657,325	962,259	VMT reduction related to 2040 No Project
T4 Alt (DH) - 100% VMT	2040	9,208,950	4,214,860	1,294,425	-2,952,584	925,352	VMT reduction related to 2040 No Project
DMU Alt	2040	7,184,064	4,214,860	1,012,966	-2,657,325	680,800	VMT reduction related to 2040 No Project
DMU Alt - 100% VMT	2040	7,184,064	4,214,860	1,012,966	-2,952,584	643,893	VMT reduction related to 2040 No Project

Conversion Factors	Amount	Unit	Source
Diesel	139,000	BTU/gallon	USEPA 2004
Electricity	3,412	BTU/kwh	USEPA 2004
VMT	125,000	BTU/Gallon	USEPA 2004
Fuel Economy 2020	35.5	Gal/mile	US 2016 new avg. (USEPA 2012)
Fuel Economy 2040	54.5	Gal/mile	US 2025 new avg. (USEPA 2012)

Table B2-24: Calculation of Indirect Cement GHG Emissions Associated with Concrete for the PCEP

PCEP Concrete Volumes			
PCEP	Total Volume (CY)	Total Volume (M3)	Notes
TPS	300	229	2 locations
PS	490	375	7 locations
SWS	160	122	1 location
Pole Foundations	18,000	13,762	3921 foundations at 4.5 CY/per
Other	2,060		Transformer foundations, retaining walls, duct banks, etc.
Subtotal	**21,010**	**14,488**	
Waste (10%)	*2,101*	*1,606*	
Contingency (5%)	*1,051*	*803*	
Total	**24,162**	**16,898**	

Source for Quantities: Caltrain Estimates

GHG Emissions for Concrete Manufacture and Transport		
Concrete Total Volume (CY)	24,162	From above
Emissions Factor (MT CO2e/CY Concrete)	0.10	Nisbett 2002
Emissions Factor (MT CO2e/CY Concrete)	0.37	Nisbett 2002
Emissions MTCO2e - low	2,499	Calculation
Emissions MTCO2e - high	8,902	Calculation
Other Construction Emissions	*5,216*	
Total - low	7,715	
Total - high	14,118	

Conversions

CY to M3	0.764554858

Factors	lbs CO2/CY concrete
Low Range (3,000 PSI)	228
High Range (Precast)	812
Source: Nisbet et al, 2002, Environmental Life Cycle Inventory of Portland Cement Concrete, prepared for the Portland Cement Association	

Carbon Sequestration Calculations

Common Name	Scientific Name	%	Number of Trees	2020 Sequestration (MT CO2)		2040 Sequestration (MT CO2)	
				Removed (Lost)	Removed (Gained)	Removed (Lost)	Removed (Gained)
Acacia	*Acacia sp.*	6%	134	18.36	0.08	18.36	6.83
Calif. Buckeye	*Aesculus californica*	0%	1	0.09	0.00	0.09	0.07
Eucalyptus	*Eucalyptus sp.*	8%	185	43.47	0.13	43.47	51.22
Fig	*Ficus sp.*	0%	2	0.10	0.00	0.10	0.10
Monterey Cypress	*Hesperocyparis macrocarpa*	1%	20	2.09	0.00	2.09	2.36
Myoporum	*Myoporum sp.*	0%	6	0.47	0.02	0.47	0.36
London plane	*Platanus x hispanica*	3%	73	7.16	0.01	7.16	4.76
Alder	*Alnus sp.*	0%	3	0.22	0.01	0.22	0.17
Brisbane box	*Lophostemon confertus*	2%	36	0.00	0.16	0.00	0.46
Mayten	*Maytenus boaria*	0%	1	0.05	0.00	0.05	0.04
Pine	*Pinus sp.*	4%	88	9.14	0.02	9.14	7.05
Pittosporum	*Pittosporum sp.*	0%	7	0.00	0.01	0.00	0.23
Willow	*Salix sp.*	0%	5	0.44	0.02	0.44	0.34
Pepper	*Schinus sp.*	2%	48	3.26	0.13	3.26	1.64
Bottlebrush	*Melaleuca citrina*	0%	2	0.00	0.00	0.00	0.01
Lombardy poplar	*Populus nigra*	1%	27	4.42	0.21	4.42	3.42
Canary Island Date Palm	*Phoenix canariensis*	0%	10	0.00	0.00	0.00	0.00
Oak	*Quercus sp.*	8%	188	33.25	0.36	33.25	24.61
Maple	*Acer sp.*	0%	6	0.51	0.01	0.51	0.13
Citrus	*Citrus sp.*	0%	1	0.07	0.00	0.07	0.05
Ash	*Fraxinus sp.*	1%	21	1.94	0.00	1.94	0.74
Black walnut	*Juglans nigra*	2%	37	3.52	0.00	3.52	2.36
Glossy privet	*Ligustrum lucidum*	1%	15	1.22	0.06	1.22	0.94
Purple leaf plum	*Prunus cerasifera*	0%	2	0.00	0.00	0.00	0.03
Coast redwood	*Sequoia sempervirens*	10%	227	23.14	0.04	23.14	26.10
Bailey acacia	*Acacia baileyana*	1%	17	2.35	0.01	2.35	0.87
Blackwood acacia	*Acacia melanoxylon*	1%	29	4.01	0.02	4.01	1.49
Blue gum	*Eucalyptus globulus*	0%	7	1.54	0.00	1.54	1.81
Coast live oak	*Quercus agrifolia*	8%	182	32.26	0.35	32.26	23.88
Monterey pine	*Pinus radiata*	0%	10	1.00	0.00	1.00	0.77
Mulberry	*Morus alba*	0%	0	0.02	0.00	0.02	0.01
Plum	*Prunus domestica*	0%	1	0.19	0.00	0.19	0.05
River red gum	*Eucalyptus camaldulensis*	0%	0	0.05	0.00	0.05	0.05
Valley oak	*Quercus lobata*	0%	11	1.90	0.02	1.90	1.40
Carrotwood	*Cupaniopsis anacardioides*	0%	1	0.00	0.00	0.00	0.02
Melaleuca	*Melaleuca sp.*	3%	73	3.40	0.03	3.40	2.53

Palm	*Phoenix sp. or Washingtonia*	1%	23	0.00	0.00	0.00	0.00
African sumac	*Rhus lancea*	0%	5	0.36	0.00	0.36	0.22
Zelkova	*Zelkova sp.*	0%	1	0.12	0.01	0.12	0.09
Canary Island palm	*Phoenix canariensis*	0%	4	0.00	0.00	0.00	0.00
Canary island pine	*Pinus canariensis*	0%	1	0.09	0.00	0.09	0.09
Pear	*Pyrus sp.*	2%	54	9.04	0.14	9.04	8.27
Evergreen pear	*Pyrus kawakamii*	1%	13	1.64	0.08	1.64	0.95
She-oak	*Casuarina sp.*	0%	5	0.87	0.01	0.87	0.65
Italian cypress	*Cupressus sempervirens*	2%	46	4.68	0.01	4.68	5.28
Dragon tree	*Dracaena draco*	0%	1	0.12	0.01	0.12	0.09
Locust	*Robinia sp.*	0%	5	0.80	0.01	0.80	0.50
Redwood	*Sequoia sempervirens*	0%	4	0.45	0.00	0.45	0.51
Elm	*Ulmus sp.*	0%	7	0.50	0.01	0.50	0.39
Crape myrtle	*Lagerstroemia indica*	2%	37	1.34	0.07	1.34	0.15
Camphor	*Cinnamomum camphora*	2%	35	2.12	0.09	2.12	0.41
Sweetgum	*Liquidambar stryaciflua*	3%	60	4.37	0.01	4.37	3.03
Tree of heaven	*Ailanthus altissima*	4%	96	8.02	0.36	8.02	6.18
Hackberry	*Celtis occidentalis*	0%	1	0.13	0.05	0.13	0.13
Hawthorn	*Crataegus sp.*	0%	3	0.24	0.00	0.24	0.15
Southern magnolia	*Magnolia grandiflora*	0%	3	0.29	0.01	0.29	0.23
Chinese pistache	*Pistacia chinensis*	0%	7	0.00	0.00	0.00	0.10
American elm	*Ulmus americana*	0%	3	0.41	0.06	0.41	0.29
California black walnut	*Juglans hindsii*	0%	1	0.10	0.00	0.10	0.07
Callery pear	*Pyrus calleryana*	0%	1	0.17	0.00	0.17	0.16
Compact blue gum	*Eucalyptus globulus*	0%	6	1.47	0.00	1.47	1.73
Italian buckthorn	*Rhamnus alaternus*	0%	2	0.17	0.01	0.17	0.13
Pittosporum sp.	*Pittosporum sp.*	0%	9	0.00	0.01	0.00	0.29
Podocarpus	*Podocarpus sp.*	1%	20	0.00	0.01	0.00	0.13
Arizona cypress	*Cupressus arizonica*	0%	1	0.09	0.00	0.09	0.07
California black	n/a	0%	0	0.00	0.00	0.00	0.00
English walnut	*Juglans regia*	0%	3	0.26	0.01	0.26	0.20
Italian stone pine	*Pinus pinea*	0%	1	0.11	0.00	0.11	0.11
Fremont	n/a	0%	0	0.00	0.00	0.00	0.00
cottonwood	*Populus fremontii*	0%	1	0.18	0.01	0.18	0.18
Portuguese laurel	*Prunus lusitanica*	0%	2	0.09	0.00	0.09	0.09
Holly Oak	*Quercus ilex*	0%	1	0.19	0.00	0.19	0.14
n/a	*Robinia x ambigua*	0%	0	0.00	0.00	0.00	0.00
Windmill palm	*Trachycarpus fortunei*	0%	1	0.00	0.00	0.00	0.00
California bay	*Umbellularia californica*	0%	3	0.27	0.01	0.27	0.21
Casuarina	*Casuarina sp.*	0%	1	0.08	0.00	0.08	0.03
Walnut	*Juglans sp.*	0%	5	0.51	0.00	0.51	0.34

Fremont cottonwood	*Populus fremontii*	0%	4	0.61	0.02	0.61	0.63
Chinese elm	*Ulmus parvifolia*	1%	15	1.11	0.01	1.11	0.88
Deodar cedar	*Cedrus deodara*	0%	9	0.73	0.00	0.73	0.70
Carob	*Ceratonia siliqua*	0%	7	0.52	0.00	0.52	0.28
Blue gum	*Eucalyptus globulus*	0%	7	1.54	0.00	1.54	1.81
Compacta	n/a	0%	2	0.18	0.01	0.18	0.14
Manna gum	n/a	0%	2	0.16	0.00	0.16	0.11
Juniper	n/a	0%	1	0.09	0.00	0.09	0.07
Glossy privet	n/a	0%	2	0.18	0.01	0.18	0.14
Austrian pine	n/a	0%	7	0.43	0.01	0.43	0.27
Monterey pine	n/a	0%	2	0.23	0.00	0.23	0.18
Victorian box	n/a	0%	2	0.00	0.00	0.00	0.07
Almond	n/a	0%	1	0.09	0.00	0.09	0.07
Coast Live Oak	n/a	3%	57	10.04	0.11	10.04	7.43
Holly Oak	n/a	0%	4	0.77	0.01	0.77	0.57
California pepper	n/a	0%	2	0.15	0.01	0.15	0.07
Jacaranda	*Jacaranda mimosifolia*	1%	24	0.00	0.04	0.00	0.20
Olive	*Olea europaea*	0%	3	0.08	0.00	0.08	0.07
Silk tree	*Albizia julibrissin*	0%	10	0.87	0.04	0.87	0.67
Strawberry tree	*Arbutus unedo*	0%	5	0.43	0.02	0.43	0.33
Loquat	*Eriobotrya sp.*	0%	5	0.43	0.02	0.43	0.33
Australian willow	*Geijera parviflora*	1%	16	1.68	0.00	1.68	1.56
Bottle brush	*Melaleuca citrina*	3%	73	0.00	0.01	0.00	0.43
Madrone	*Arbutus menziesii*	0%	2	0.17	0.01	0.17	0.13
Fruit	*Prunus sp.*	0%	3	0.46	0.00	0.46	0.12
Box elder	*Acer negundo*	0%	2	0.24	0.08	0.24	0.26
Pistache	*Pistacia sp.*	0%	2	0.00	0.00	0.00	0.02
Elderberry	*Sambucus sp.*	0%	2	0.14	0.01	0.14	0.11
Total			**2,220**	**260**	**3**	**260**	**216**

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