3.2 Air Quality

This section addresses the air quality impacts of the Proposed Project on the Caltrain corridor and San Francisco Bay Area Air Basin (SFBAAB). Air pollutants of concern along the Caltrain corridor and in the SFBAAB are ozone (O_3)—including precursors of reactive organic gases (ROG) and oxides of nitrogen (NO_X)—carbon monoxide (CO), and inhalable particulate matter (PM2.5 and PM10). This section reports the type and quantity of emissions that would be generated by the construction and operation of the Proposed Project.

3.2.1 Existing Conditions

3.2.1.1 Regulatory Setting

This section summarizes federal, state, and local regulations that apply to air quality. The air quality management agencies of direct importance in the county are the U.S. Environmental Protection Agency (EPA), the California Air Resources Board (ARB), and Bay Area Air Quality Management District (BAAQMD). EPA has established federal air quality standards for which ARB and BAAQMD have primary implementation responsibility. ARB and BAAQMD are also responsible for ensuring that state air quality standards are met.

Federal

Clean Air Act and National Ambient Air Quality Standards

The federal Clean Air Act (CAA), promulgated in 1963 and amended several times thereafter, including the 1990 Clean Air Act amendments (CAAA), establishes the framework for modern air pollution control. The act directs EPA to establish national ambient air quality standards (NAAQS) for six criteria pollutants: O_3, CO, PM, which consists of PM that is 10 microns in diameter or less (PM10) and PM that is 2.5 microns in diameter or less (PM2.5), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and lead (Pb). The NAAQS are divided into primary and secondary standards; the former are set to protect human health within an adequate margin of safety, the latter to protect environmental values, such as plant and animal life. Table 3.2-1 summarizes the NAAQS.

The CAA requires states to submit a state implementation plan (SIP) for areas in nonattainment for federal standards. The SIP, which is reviewed and approved by EPA, must demonstrate how the federal standards would be achieved. Failing to submit a plan or secure approval can lead to denial of federal funding and permits. In cases where the SIP is submitted by the state but fails to demonstrate achievement of the standards, EPA is directed to prepare a federal implementation plan.

Locomotive Emissions Standards

In March 2008, the EPA adopted a three-part emissions standard program that will reduce emissions from diesel locomotives. The regulation tightens emission standards for existing, remanufactured locomotives; sets near term engine-out emission standards (Tier 3) for newly built locomotives; and sets longer-term standards (Tier 4) for future locomotives. It is expected that the regulation will reduce PM emissions by as much as 90 percent and NO_X emissions by as much as 80 percent when fully implemented.

Table 3.2-1. National and State Ambient Air Quality Standards

		California	National Standards[a]	
Criteria Pollutant	Average Time	Standards	Primary	Secondary
Ozone	1-hour	0.09 ppm	None	None
	8–hour	0.070 ppm	0.075 ppm	0.075 ppm
Particulate Matter (PM10)	24-hour	50 μg/m³	150 μg/m³	150 μg/m³
	Annual mean	20 μg/m³	None	None
Fine Particulate Matter (PM2.5)	24-hour	None	35 μg/m³	35 μg/m³
	Annual mean	12 μg/m³	12.0 μg/m³	15 μg/m³
Carbon Monoxide	8-hour	9.0 ppm	9 ppm	None
	1-hour	20 ppm	35 ppm	None
Nitrogen Dioxide	Annual mean	0.030 ppm	0.053 ppm	0.053 ppm
	1-hour	0.18 ppm	0.100 ppm	None
Sulfur Dioxide[b]	Annual mean	None	0.030 ppm	None
	24-hour	0.04 ppm	0.014 ppm	None
	3-hour	None	None	0.5 ppm
	1-hour	0.25 ppm	0.075 ppm	None
Lead	30-day average	1.5 μg/m³	None	None
	Calendar quarter	None	1.5 μg/m³	1.5 μg/m³
	3-month average	None	0.15 μg/m³	0.15 μg/m³
Sulfates	24-hour	25 μg/m³	None	None
Hydrogen Sulfide	1-hour	0.03 ppm	None	None
Vinyl Chloride	24-hour	0.01 ppm	None	None

Sources: California Air Resources Board 2013a.

[a] National standards are divided into primary and secondary standards. Primary standards are intended to protect public health, whereas secondary standards are intended to protect public welfare and the environment.

[b] The final 1-hour SO_2 rule was signed June 2, 2010. The annual and 24-hour SO_2 standards were revoked in that same rulemaking. However, these standards remain in effect until 1 year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

μg/m³ = micrograms per cubic meter
ppm = parts per million

State

California Clean Air Act and California Ambient Air Quality Standards

In 1988, the state legislature adopted the California Clean Air Act (CCAA), which established a statewide air pollution control program. CCAA requires all air districts in the state to endeavor to meet the California ambient air quality standards (CAAQS) by the earliest practical date. Unlike the federal CAA, the CCAA does not set precise attainment deadlines. Instead, the CCAA establishes increasingly stringent requirements for areas that will require more time to achieve the standards. CAAQS are generally more stringent than the NAAQS and incorporate additional standards for sulfates (SO_4), hydrogen sulfide (H_2S), vinyl chloride (C_2H_3Cl), and visibility-reducing particles. The CAAQS and NAAQS are listed together in Table 3.2-1.

ARB and local air districts bear responsibility for achieving California's air quality standards, which are to be achieved through district-level air quality management plans that would be incorporated into the SIP. In California, EPA has delegated authority to prepare SIPs to ARB, which, in turn, has delegated that authority to individual air districts. ARB traditionally has established state air quality standards, maintaining oversight authority in air quality planning, developing programs for reducing emissions from motor vehicles, developing air emission inventories, collecting air quality and meteorological data, and approving SIPs.

The CCAA substantially adds to the authority and responsibilities of air districts. The CCAA designates air districts as lead air quality planning agencies, requires air districts to prepare air quality plans, and grants air districts authority to implement transportation control measures. The CCAA also emphasizes the control of "indirect and area-wide sources" of air pollutant emissions. The CCAA gives local air pollution control districts explicit authority to regulate indirect sources of air pollution and to establish traffic control measures (TCMs).

Local

Bay Area Air Quality Management District/2010 Clean Air Plan

BAAQMD has local air quality jurisdiction over projects in SFBAAB. Responsibilities of BAAQMD include overseeing stationary-source emissions, approving permits, maintaining emissions inventories, maintaining air quality stations, overseeing agricultural burning permits, and reviewing air quality–related sections of environmental documents required by CEQA. The air quality district is also responsible for establishing and enforcing local air quality rules and regulations that address the requirements of federal and state air quality laws and for ensuring that NAAQS and CAAQS are met.

BAAQMD (2011a) has adopted advisory emission thresholds to assist CEQA lead agencies in determining the level of significance of a project's emissions, which are outlined in its *California Environmental Quality Act Air Quality Guidelines* (BAAQMD CEQA Guidelines).[1] BAAQMD has also adopted air quality plans to improve air quality, protect public health, and protect the climate. *The Bay Area 2001 Ozone Attainment Plan* was adopted to reduce ozone and achieve the NAAQS ozone standard; and the *2010 Clean Air Plan* was adopted to provide an integrated control strategy for ozone, PM, Toxic Air Contaminants (TACs), and greenhouse gas (GHG) emissions. BAAQMD also adopted a redesignation plan for CO in 1994. The redesignation plan includes strategies to ensure the continuing attainment of the NAAQS for CO in the SFBAAB.

The Proposed Project may be subject to the following district rules. This list of rules may not be all encompassing as additional BAAQMD rules may apply to the Proposed Project as specific components are identified.

- Regulation 2, Rule 2 (New Source Review). This regulation contains requirements for Best Available Control Technology and emission offsets.
- Regulation 2, Rule 5 (New Source Review of Toxic Air Contaminates). This regulation outlines guidance for evaluating TAC emissions and their potential health risks.

[1] The adoption of the 2011 CEQA guidelines was challenged in court by the Building Industry Association (BIA) who alleged that BAAQMD had to complete a CEQA evaluation of the CEQA thresholds contained in the guidelines prior to adoption. Alameda Superior Court ruled in favor of the BIA and BAAQMD withdrew its adoption of the 2011 guidelines per court orders. BAAQMD appealed the lower court ruling and it was overturned on appeal. BAAQMD has not yet readopted its guidelines, but there is no court order preventing them from doing so. For the purposes of this EIR, Caltrain has determined that there is substantial evidence in the record supporting the BAAQMD guidelines on their own including evidence supporting the thresholds in the 2011 guidelines, regardless of whether BAAQMD formally readopts the guidelines and/or formally recommends their use.

- Regulation 6, Rule 1 (Particulate Matter). This regulation restricts emissions of PM darker than No. 1 on the Ringlemann Chart to less than 3 minutes in any 1 hour.
- Regulation 7 (Odorous Substances): This regulation establishes general odor limitations on odorous substances and specific emission limitations on certain odorous compounds.
- Regulation 8, Rule 3 (Architectural Coatings): This regulation limits the quantity of VOCs in architectural coatings.
- Regulation 9, Rule 6 (Nitrogen oxides emission from natural gas-fired boilers and water heaters). This regulation limits emissions of NO_X generated by natural gas-fired boilers.
- Regulation 9, Rule 8 (Stationary Internal Combustion Engines). This regulation limits emissions of NO_X and CO from stationary internal combustion engines of more than 50 horsepower.

3.2.1.2 Environmental Setting

Air quality is affected by both the rate and location of pollutant emissions and by meteorological conditions that influence movement and dispersal of pollutants. Atmospheric conditions, such as wind speed, wind direction, and air temperature gradients, along with local topography, provide the link between air pollutant emissions and air quality. This section describes regional climate in the project area and provides monitoring data on existing air quality conditions. Receptors along the Caltrain corridor that may be sensitive to increasing levels of air pollution are also identified.

3.2.1.3 Climate and Meteorology

California is divided into 15 air basins based on geographic features that create distinctive regional climates. The Proposed Project is located within the SFBAAB, which contains all of Napa, Contra Costa, Alameda, Santa Clara, San Mateo, San Francisco, and Marin Counties, as well as portions of Sonoma and Solano Counties. Climate is primarily affected by marine air flow and the basin's proximity to the San Francisco Bay. Within the SFBAAB, Caltrain operates in the Peninsula Subregion and the Santa Clara Valley Subregion. The following sections discuss additional climate and meteorological information specific to these areas.

Peninsula Subregion

The Peninsula Subregion extends from northwest of San Jose to the Golden Gate Bridge. The Santa Cruz Mountains run up the center of the Peninsula, with elevations exceeding 2,000 feet at the southern end and decreasing to 500 feet in South San Francisco. Coastal towns experience a high incidence of cool, foggy weather in the summer. Cities in the southeastern Peninsula experience warmer temperatures and fewer foggy days because the marine layer is blocked by the ridgeline to the west. San Francisco lies at the northern end of the Peninsula. Because most of San Francisco's topography is below 200 feet, marine air is able to flow easily across most of the city, making its climate cool and windy.

The blocking effect of the Santa Cruz Mountains results in variations in summertime maximum temperatures in different parts of the Peninsula. For example, in coastal areas and San Francisco the mean maximum summer temperatures are in the mid-60s, while in Redwood City the mean maximum summer temperatures are in the low-80s. Mean minimum temperatures during the winter months are in the high-30s to low-40s in the eastern side of the Peninsula.

Air pollution potential is highest along the southeastern portion of the Peninsula. This is the area most protected from the high winds and fog of the marine layer. Pollutant transport from upwind sites is common. Also, air pollutant emissions are relatively high due to motor vehicle traffic as well as stationary sources. Pollutant emissions are also high, especially from motor vehicle congestion, at the northern end of the Peninsula in San Francisco, but there is more air movement to disperse pollution.

Santa Clara Valley Subregion

The Santa Clara Valley Subregion is bounded by the San Francisco Bay to the north and by mountains to the east, south, and west. Temperatures are warm on summer days and cool on summer nights, and winter temperatures are fairly mild. At the northern end of the valley, mean maximum temperatures are in the low-80s in the summer and the high-50s during the winter, and mean minimum temperatures range from the high-50s in the summer to the low-40s in the winter. Further inland, where the moderating effect of the bay is not as strong, temperature extremes are greater.

The air pollution potential of the Santa Clara Valley is high. High summer temperatures, stable air, and mountains surrounding the valley combine to promote O_3 formation. In addition to the many local sources of pollution, O_3 precursors from San Francisco, San Mateo, and Alameda Counties are carried by prevailing winds to the Santa Clara Valley. The valley tends to channel pollutants to the southeast. In addition, on summer days with low-level inversions, O_3 can be recirculated by southerly drainage flows in the late spring evening and early morning and by the prevailing northwesterlies in the afternoon. A similar recirculation pattern occurs in the winter, affecting levels of CO and particulate matter. This movement of the air up and down the valley increases the impact of pollutants.

Pollution sources are plentiful and complex in this subregion. The Santa Clara Valley has a high concentration of industry in the Silicon Valley at the northern end. Some of these industries are sources of air toxics as well as criteria air pollutants. In addition, Santa Clara Valley's large population and many worksite destinations generate the highest mobile source emissions of any subregion in the Bay Area.

3.2.1.4 Existing Air Quality Conditions

A number of ambient air quality monitoring stations are located in the Bay Area to monitor progress toward air quality standards attainment of the NAAQS and CAAQS (see Table 3.2-1). The BAAQMD maintains these stations. Three BAAQMD monitoring stations are on or near the Caltrain route, as noted below.

- San Francisco-Arkansas Street: Approximately 1 mile southwest of the tracks
- Redwood City station: Approximately 1 mile north of the tracks
- San Jose-Jackson Street station: Approximately 1 mile northeast of the tracks

Table 3.2-2 shows a 3-year summary (2010–2012) of data collected at these stations for monitored air pollutants and the total number of days that state and federal ambient air quality standards were exceeded.

1 **Table 3.2-2. Ambient Air Quality Monitoring Data for the Caltrain Corridor (2010–2012)**

	San Francisco-Arkansas Street			Redwood City			San Jose-Jackson Street		
Pollutant Standards	2010	2011	2012	2010	2011	2012	2010	2011	2012
Ozone (O_3)									
Maximum 1-hour concentration (ppm)	0.079	0.070	0.069	0.113	0.076	0.063	0.126	0.098	0.101
Maximum 8-hour concentration (ppm)	0.051	0.054	0.048	0.077	0.061	0.054	0.086	0.067	0.062
Number of days standard exceeded[a]									
CAAQS 1-hour (>0.09 ppm)	0	0	0	2	0	0	5	1	1
CAAQS 8-hour (>0.070 ppm)	0	0	0	1	0	0	3	0	0
NAAQS 8-hour (>0.075 ppm)	0	0	0	1	0	0	3	0	0
Carbon Monoxide (CO)									
Maximum 8-hour concentration (ppm)	1.37	1.20	1.19	1.72	1.67	1.81	2.19	2.18	1.86
Maximum 1-hour concentration (ppm)	1.8	1.8	2.0	3.3	3.8	4.0	2.7	2.4	2.5
Number of days standard exceeded[a]									
NAAQS 8-hour (≥9 ppm)	0	0	0	0	0	0	0	0	0
CAAQS 8-hour (≥9.0 ppm)	0	0	0	0	0	0	0	0	0
NAAQS 1-hour (≥35 ppm)	0	0	0	0	0	0	0	0	0
CAAQS 1-hour (≥20 ppm)	0	0	0	0	0	0	0	0	0
Nitrogen Dioxide (NO_2)									
State maximum 1-hour concentration (ppm)	92.9	93.3	124.0	58.7	56.3	60.4	64.0	61.0	67.2
State second-highest 1-hour concentration (ppm)	92	93	124	58	56	60	64	61	67
Annual average concentration (ppm)	13	14	12	12	12	11	14	14	13
Number of days standard exceeded									
CAAQS 1-hour (0.18 ppm)	0	0	0	0	0	0	0	0	0
Particulate Matter (PM10)[b]									
National[c] maximum 24-hour concentration (μg/m^3)	38.6	43.7	48.2	-	-	-	44.2	41.3	56.5
National[c] second-highest 24-hour concentration (μg/m^3)	36.6	35.6	46.6	-	-	-	37.4	40.1	46.1
State[d] maximum 24-hour concentration (μg/m^3)	39.7	45.6	50.6	-	-	-	46.8	44.3	59.6
State[d] second-highest 24-hour concentration (μg/m^3)	38.0	36.0	48.4	-	-	-	38.0	42.0	48.8
National annual average concentration (μg/m^3)	19.3	18.8	16.9	-	-	-	18.9	18.6	18.8
State annual average concentration (μg/m^3)[e]	-	19.5	17.5	-	-	-	19.5	19.2	18.8

Pollutant Standards	San Francisco-Arkansas Street 2010	2011	2012	Redwood City 2010	2011	2012	San Jose-Jackson Street 2010	2011	2012
Number of days standard exceeded[a]									
NAAQS 24-hour (>150 µg/m³)[f]	0	0	0	-	-	-	0	0	0
CAAQS 24-hour (>50 µg/m³)[f]	0	0	6	-	-	-	0	0	3
Particulate Matter (PM2.5)									
National[c] maximum 24-hour concentration (µg/m³)	45.3	47.5	35.7	36.5	39.7	33.3	41.5	50.5	38.4
National[c] second-highest 24-hour concentration (µg/m³)	41.0	35.6	29.0	31.2	30.7	26.8	36.0	38.7	36.6
State[d] maximum 24-hour concentration (µg/m³)	-	-	-	32.7	24.0	34.3	41.5	50.5	38.4
State[d] second-highest 24-hour concentration (µg/m³)	-	-	-	16.7	20.5	19.2	36.0	38.7	36.6
National annual average concentration (µg/m³)	10.5	9.5	8.2	8.3	8.7	8.5	-	9.8	9.1
State annual average concentration (µg/m³)[e]	-	-	-	-	8.3	-	9.0	9.9	-
Number of days standard exceeded[a]									
NAAQS 24-hour (>35 µg/m³)	3	2	1	1	1	0	0	3	2
Sulfur Dioxide (SO_2)									
No data available									

Source: California Air Resources Board 2013b; U.S. Environmental Protection Agency 2013a.

[a] An exceedance is not necessarily a violation.

[b] National statistics are based on standard conditions data. In addition, national statistics are based on samplers using federal reference or equivalent methods.

[c] State statistics are based on local conditions data, except in the South Coast Air Basin, for which statistics are based on standard conditions data. In addition, State statistics are based on California approved samplers.

[d] Measurements usually are collected every 6 days.

[e] State criteria for ensuring that data are sufficiently complete for calculating valid annual averages are more stringent than the national criteria.

[f] Mathematical estimate of how many days' concentrations would have been measured as higher than the level of the standard had each day been monitored. Values have been rounded.

ppm = parts per million.
NAAQS = National Ambient Air Quality Standards.
CAAQS = California Ambient Air Quality Standards.
µg/m³ = micrograms per cubic meter.
mg/m³ = milligrams per cubic meter.
> = greater than.
NA = not applicable.

The data presented in Table 3.2-2 indicate that neither the federal nor state ambient air quality standards for CO or NO_2 were exceeded between 2010 and 2012 at the monitoring stations. Likewise, no violations of the state or federal ozone standards were recorded at the San Francisco-Arkansas Street monitoring station. However, the Redwood City station recorded violations of the ozone standards in 2010 and the San Jose-Jackson Street stations recorded violations in all three monitored years (2010–2012). These data indicate that ozone concentrations are slightly higher near portions of the Proposed Project that are located in the San Jose area. Annual violations of the federal PM2.5 standard were recorded at all stations, and the San Francisco-Arkansas Street and San Jose-Jackson Street both exceeded the state PM10 standard in 2012 (no data for the Redwood City station).

3.2.1.5 Attainment Status

Local monitoring data (Table 3.2-2) are used to designate areas as nonattainment, maintenance, attainment, or unclassified for the NAAQS and CAAQS. The four designations are further defined as:

- Nonattainment—assigned to areas where monitored pollutant concentrations consistently violate the standard in question.
- Maintenance—assigned to areas where monitored pollutant concentrations exceeded the standard in question in the past but are no longer in violation of that standard.
- Attainment—assigned to areas where pollutant concentrations meet the standard in question over a designated period of time.
- Unclassified—assigned to areas were data are insufficient to determine whether a pollutant is violating the standard in question.

Table 3.2-3 summarizes the attainment status of the portions of the project area within San Francisco, San Mateo, and Santa Clara Counties with regard to the NAAQS and CAAQS.

Table 3.2-3. Federal and State Attainment Status of San Francisco, San Mateo, and Santa Clara Counties

	San Francisco		San Mateo		Santa Clara	
Pollutant	Federal	State	Federal	State	Federal	State
Ozone (1 hr)	-	N (serious)	-	N (serious)	-	N (serious)
Ozone (8 hr)	N	N[a]	N	N	N	N
CO	M	A	M[a]	A	M[a]	A
PM10	A/U	N	A/U	N	A/U	N
PM2.5	N	N	N	N	N	N

Sources: U.S. Environmental Protection Agency 2013b; California Air Resources Board 2013c.

[a] Applies only to a portion of the county.

A/U = Attainment/Unclassified
CO = carbon monoxide
M = Maintenance
N = Nonattainment
PM10 = PM that is 10 microns in diameter or less
PM2.5 = PM that is 2.5 microns in diameter or less

3.2.1.6 Sensitive Receptors

The BAAQMD generally defines a sensitive receptor as a facility or land use that houses or attracts members of the population who are particularly sensitive to the effects of air pollutants, such as children, the elderly, and people with illnesses. Examples of sensitive receptors include residential areas, schools, and hospitals. The existing Caltrain corridor and the locations of the TPS outside the ROW are surrounded by a mix of industrial, commercial, residential, and recreational land uses. The closest sensitive receptors (residences) are located immediately adjacent to the Caltrain ROW, with various other receptor locations scattered along the project corridor.

3.2.2 Impact Analysis

3.2.2.1 Methods for Analysis

Air quality impacts associated with construction and operation of the Proposed Project were assessed and quantified using standard and accepted software tools, techniques, and emission factors. A summary of the methodology is provided below. A full list of assumptions can be found in Appendix B, *Air Quality and Greenhouse Gas Analysis Technical Data*.

Construction

Construction of the Proposed Project would generate emissions of ROG, NO_X, CO, PM10, and PM2.5 that would change ambient air quality temporarily in the study area. Emissions would originate from mobile and stationary construction equipment exhaust, employee vehicle exhaust, and haul truck vehicle exhaust. Approximately 2.7 acres would be graded to accommodate the TPSs and switching and paralleling stations.

Mass criteria pollutant 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 ARB's EMFAC2011 model. Vehicle and equipment assumptions were provided by the JPB (Cocke pers. comm. a) and are summarized in Appendix B. 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 EPA (2011).

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 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.

Operation

Proposed Project operation would generate emissions of ROG, NO_X, CO, PM10, and PM2.5 that could result in long-term changes to ambient air quality. The Proposed Project fleet during the first fully operational year (2020) would consist of nine diesel locomotives, 96 Electric Multiple Units (EMU), and 45 trailer cars. By 2040, assuming a fully electrified service between San Jose and San Francisco[2], a total of six diesel locomotives, 138 to 150 EMUs, and 31 trailer cars (for the San Jose to Gilroy service) would operate in the project corridor. Proposed Project operation would also affect regional traffic volumes and onroad fuel consumption through increased transit ridership. The operational emissions analysis considers criteria pollutants generated by these sources.

Caltrain operation presently consists of diesel locomotive-hauled, bi-level passenger train cars. Operation of these trains currently generates mobile source emissions, which would be effectively replaced with operational emissions associated with the Proposed Project. The difference, or *delta*, in operational emissions between the existing Caltrain service and the Proposed Project represents the net new impact of the Proposed Project analyzed in this document. The Proposed Project would not affect operational emissions from existing transit stations or maintenance activities. Further, the new traction power facilities (substations, paralleling stations, and a switching station) are not a source of emissions. Accordingly, these sources are not discussed further.

Locomotive fuel consumption data for existing conditions, the Proposed Project and No Project scenarios were provided by the staff (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 (Naylor pers. comm.). Criteria pollutants generated by locomotive fuel consumption were estimated using emission factors obtained from the EPA (2009). Mass emissions from changes in regional VMT and onroad fuel consumption were quantified using the Caltrans' CT-EMFAC emissions model. Please refer to Appendix B for additional information on modeling assumptions and calculation methods.

While the Proposed Project would increase electricity consumption relative to existing conditions, the energy would be supplied by the California electrical grid. Power plants located throughout the state supply the grid with power, which would be distributed to the Caltrain corridor to meet Project demand. Because these power plants are located throughout the state, criteria pollutant emissions associated with the increased electricity required for Proposed Project operation would not likely all occur within the SFBAAB but rather occur on a distributed basis across the state (or even possibly out of state). However, as a worst-case analysis for regional air quality, emissions

[2] The Proposed Project only includes funding for electrification of approximately 75 percent of the fleet between San Jose and San Francisco. It is assumed for the sake of analysis that funding will be procured by 2040 for fully electrified service. In addition, fully electrified service is required in order to support future high-speed rail Blended Service, which is presently proposed to start sometime between 2026 and 2029 on the San Francisco Peninsula.

associated with the Proposed Project electricity consumption were included in operational analysis on the assumption that they would all occur within the SFBAAB.

The analysis of health risks of project operations typically considers receptor exposure to both DPM and CO hotspots. While NO_X and ROG influence overall atmospheric chemistry, they do not drive primary health risks associated with the types of activities that would occur under the Proposed Project. Accordingly, this analysis of health risks focuses on DPM and CO, which are the primary pollutants of concern with regard to operational mobile source emissions and local health risks.

Proposed Project implementation would reduce the number of diesel locomotives operating along the Caltrain corridor between San Francisco and San Jose, and would therefore reduce localized DPM concentrations. Accordingly, project-level operational DPM health risks were assessed qualitatively instead of comparing to BAAQMD's project-level HRA thresholds because there would be a beneficial project-level impact. Potential CO hotspots as a result of localized traffic increases around Caltrain stations associated with increased ridership were evaluated using traffic data from the traffic analysis and the CALINE4 dispersion model.

3.2.2.2 Thresholds of Significance

In accordance with Appendix G of the State CEQA Guidelines, the Proposed Project would be considered to have a significant impact if it would result in any of the conditions listed below.

- Conflict with or obstruct implementation of the applicable air quality plan.
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation.
- Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is a nonattainment area for an applicable federal or state ambient air quality standard.
- Expose sensitive receptors to substantial pollutant concentrations.
- Create objectionable odors affecting a substantial number of people.

According to the State CEQA Guidelines, the significance criteria established by the applicable air quality management or air pollution control district may be relied on to make significance determinations for potential impacts on environmental resources. As discussed above, BAAQMD is responsible for ensuring that state and federal ambient air quality standards are not violated within the SFBAAB. Analysis requirements for construction- and operational-related pollutant emissions are contained in the BAAQMD CEQA Guidelines (Bay Area Air Quality Management District 2011a). The BAAQMD CEQA Guidelines also contain thresholds of significance for ozone, CO, PM2.5, PM10, TACs, and odors; these thresholds are presented in Table 3.2-4.

In August 2013, the Court of Appeal reversed a Superior Court ruling that the BAAQMD needed to comply with CEQA prior to adopting the 2010 CEQA Guidelines and significance thresholds. The Superior Court had issued a writ of mandate ordering BAAQMD to set aside the thresholds and cease their dissemination until BAAQMD complied with CEQA. The Court of Appeal ruled that adoption of guidelines and thresholds is not considered a project subject to CEQA review and adoption of the significance thresholds was not arbitrary and capricious. As of February 2014, BAAQMD has yet to formally re-recommend its CEQA Guidelines and significance thresholds for use by local agencies.

Table 3.2-4. Bay Area Air Quality Management District Project-Level Criteria Pollutant Emissions Thresholds

Pollutant	Construction	Operations
ROG	54 lbs/day	54 lbs/day or 10 tons/year
NO_X	54 lbs/day	54 lbs/day or 10 tons/year
CO	–	Violation of CAAQS
PM10 (total)	–	-
PM10 (exhaust)	82 lbs/day	82 lbs/day or 15 tons/year
PM2.5 (exhaust)	54 lbs/day	54 lbs/day or 10 tons/year
PM10 /PM2.5 (fugitive dust)	Implementation of best management practices	-
TACs (Project-level)	Increased cancer risk of 10 in 1 million; increased non-cancer risk of greater than 1.0 (HI); PM2.5 increase of greater than 0.3 micrograms per cubic meter	Same as construction
TACs (cumulative)	Increased cancer risk of 100 in 1 million; increased non-cancer risk of greater than 10.0 HI; PM2.5 increase of greater than 0.8 microgram per cubic meter at receptors within 1,000 feet	Same as construction
Odors	–	Five complaints per year averaged over 3 years

Source: Bay Area Air Quality Management District 2011a.

CAAQS = California ambient air quality standards
CO = carbon monoxide
HI = hazard index
NO_X = oxides of nitrogen
PM10 = PM that is 10 microns in diameter or less
PM2.5 = PM that is 2.5 microns in diameter or less
ROG = reactive organic gases
TAC = toxic air contaminants

3.2.2.3 Impacts and Mitigation Measures

Changes resulting from Project Variant 1 (Electrification to just south of the Tamien Station) and Project Variant 2 (Defer electrification of storage tracks at the 4th and King Station) are described below each impact analysis.

Impact AQ-1	Conflict with or obstruct implementation of the applicable air quality plan
Level of Impact	Less than significant

Santa Clara County is currently designated a nonattainment area for the federal 8-hour ozone and PM2.5 standards, as well as a maintenance area for the federal CO standard (Table 3.3-3). The BAAQMD air quality attainment plans are the *2001 Ozone Attainment Plan* and the *1994 CO*

Redesignation Request and Maintenance Plan. BAAQMD also adopted the *2010 Clean Air Plan*, which provides an integrated strategy to control ozone, PM, TACs, and GHG emissions. The BAAQMD plans estimate future emissions in the SFBAAB and determine strategies necessary for emissions reductions through regulatory controls. Emissions projections are based on population, vehicle, and land use trends typically identified by the BAAQMD, Metropolitan Transportation Commission (MTC), and Association of Bay Area Governments (ABAG).

A project is deemed inconsistent with air quality plans if it would result in population and/or employment growth that exceeds estimates used to develop applicable air quality plans. Projects that propose development that is consistent with the growth anticipated by the relevant land use plans would be consistent with the current BAAQMD air quality plans. Likewise, projects that propose development that is less dense than anticipated within a general plan (or other governing land use document) would be consistent with the air quality plans because emissions would be less than estimated for the region. If a project proposes development that is greater than the anticipated growth projections, the project would be in conflict with BAAQMD air quality plans and might have a potentially significant impact on air quality because emissions would exceed those estimated for the region. This situation would warrant further analysis to determine if a proposed project and surrounding projects would exceed the growth projections used in the BAAQMD air quality plans for a specific subregional area.

As discussed in Section 3.10, *Land Use and Recreation*, the Proposed Project would not result in significant environmental impacts with respect to consistency with local general plans and policies. Likewise, as noted in Section 3.12, *Population and Housing*, the proposed improvements would not result in population of housing growth. The Proposed Project would increase service and ridership on the Caltrain system. However, this increased service would not materially increase the overall growth pressure in the communities served by Caltrain because Caltrain presently serves only developed areas and the Proposed Project would not provide new access to undeveloped areas. Accordingly, the Proposed Project would not induce growth and would be consistent with recent growth projections for the region.

Based on the above analysis, the Proposed Project would be consistent with recent growth projections for the region and would not conflict with the current BAAQMD air quality plans. While short-term emissions would be generated during construction, these would be mitigated below BAAQMD's significance thresholds (see Impact AQ-2a). Moreover, the Proposed Project would contribute to MTC's goals to improve long-term air quality. Long-term operation of the Proposed Project would also contribute to annual emissions reductions throughout the region. Accordingly, the Proposed Project would not conflict with or obstruct implementation of any applicable land use plan or policy. Therefore, the impact would be less than significant.

<u>Neither Project Variant 1 nor 2 would change the impact description above because they would not meaningfully change the project conditions relative to air quality plans. For construction, both variants would lower emissions. Project Variant 2 (Deferral of electrification of storage tracks at the San Francisco 4th and King Station) would have minimally higher operational emissions, but would not change the emission reductions of the project overall compared to No Project Conditions.</u>

Impact AQ-2a	Violate any air quality standard or contribute substantially to an existing or projected air quality violation during Proposed Project construction
Level of Impact	Significant
Mitigation Measures	AQ-2a: Implement BAAQMD basic and additional construction mitigation measures to reduce construction-related dust AQ-2b: Implement BAAQMD basic and additional construction mitigation measures to control construction-related ROG and NO_X emissions AQ-2c: Utilize clean diesel-powered equipment during construction to control construction-related ROG and NO_X emissions
Level of Impact after Mitigation	Less than significant

Proposed Project construction has the potential to create air quality impacts through the use of heavy-duty construction equipment, construction worker vehicle trips, and truck hauling trips. In addition, fugitive dust emissions would result from grading associated with the traction power substations and the switching and paralleling stations. Mass criteria pollutant emissions generated by these sources were quantified using CalEEMod (version 2013.2.2) and information provided by JPB staff.

Estimated construction emissions are summarized in Table 3.2-5. The duration of construction and the intensity of construction activity have a substantial effect on the amount of emissions occurring at any one time. Consequently, Table 3.2-5 only presents the maximum daily emissions that would occur during each construction year. These values represent the highest emissions levels associated with construction activities. Violations of the BAAQMD thresholds are shown in underline. Please refer to Appendix B, *Air Quality and Greenhouse Gas Analysis Technical Data*, for additional information on emissions modeling and quantification methods.

Table 3.2-5. Maximum Unmitigated Construction Emissions (pounds per day)

				PM10		PM2.5	
Year	ROG	NO_X	CO	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

Note: The construction analysis assumed completion by 2019 which would be more compressed than now expected in that construction is expected to be completed by 2020 or 2021. The analysis using 2019 would be more conservative than a more elongated schedule to 2020 and 2021 and thus may slightly overstate annual construction emissions.

BMPs = best management practices
CO = carbon monoxide
NO_X = oxides of nitrogen
PM10 = PM that is 10 microns in diameter or less
PM2.5 = PM that is 2.5 microns in diameter or less
ROG = reactive organic gases

As shown in Table 3.2-5, maximum daily NO_X emissions generated in 2017 and 2018 would exceed the BAAQMD's significance threshold. Emissions would result primarily from offroad equipment and haul truck trips.

Mitigation is required to reduce NO_X emissions. Mitigation is also required to reduce fugitive dust emissions pursuant to the BAAQMD's CEQA Guidelines, which consider dust impacts to be less than significant through the application of best management practices (BMPs). Mitigation Measures AQ-2a and AQ-2b outline the BAAQMD's basic and advanced construction mitigation measures for exhaust and fugitive dust emissions. Mitigation Measure AQ-2c will reduce NO_X emissions and requires offroad equipment to be rated Tier 3 (or higher).

Table 3.2-6 summarizes estimated construction emissions after the incorporation of Mitigation Measures AQ-2a through AQ-2c. As shown in the table, NO_X emissions would not exceed the BAAQMD's significance thresholds after implementation of onsite mitigation. Accordingly, with implementation of Mitigation Measures AQ-2a through AQ-2c, construction impacts would be reduced to less than significant.

Table 3.2-6. Maximum Mitigated Construction Emissions (pounds per day)

				PM10		PM2.5	
Year	ROG	NO_X	CO	Exhaust	Dust	Exhaust	Dust
2015	1	8	7	1	0	1	0
2016	2	26	45	1	5	1	1
2017	4	47	36	3	1	3	0
2018	3	37	33	2	1	2	0
2019	2	20	21	1	0	1	0
Threshold	54	54	-	82	BMPs	54	BMPs

<u>Note: As noted above, the analysis assumes construction completion in 2019, but construction is likely to be completed in 2020 or 2012 and thus the results above may overstate the annual level of construction emissions due to use of a more compressed construction schedule.</u>

CO = carbon monoxide
NO_X = oxides of nitrogen
ROG = reactive organic gases
PM10 = PM that is 10 microns in diameter or less
PM2.5 = PM that is 2.5 microns in diameter or less
BMPs = best management practices

With Project Variant 1 (Electrification to just south of the Tamien Station), the Caltrain corridor would only be electrified to just south of the Tamien Station. Therefore, there would be approximately 1.2 fewer miles of construction activities and, thus, fewer construction emissions. Under Project Variant 2, the electrification of the storage tracks at the 4th and King Station in San Francisco would be deferred. Therefore, there would similarly be fewer construction emissions. However, Mitigation Measures AQ-2a through AQ-2c would still apply and implementation of either or both Project Variants would not change this impact's level of significance.

Mitigation Measure AQ-2a: Implement BAAQMD basic and additional construction mitigation measures to reduce construction-related dust

JPB will require all construction contractors to implement the basic and additional construction mitigation measures recommended by BAAQMD to reduce fugitive dust emissions. Emission reduction measures will include, at a minimum, the following measures. Additional measures may be identified by BAAQMD or the contractor as appropriate.

- All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) will be watered two times per day.
- All haul trucks transporting soil, sand, or other loose material off site will be covered.
- All visible mud or dirt track-out onto adjacent public roads will be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited.
- All vehicle speeds on unpaved roads will be limited to 15 mph.
- All roadways, driveways, and sidewalks to be paved will be completed as soon as possible. Building pads will be laid as soon as possible after grading unless seeding or soil binders are used.
- A publicly visible sign will be posted with the telephone number and person to contact at the lead agency regarding dust complaints. This person will respond and take corrective action within 48 hours. BAAQMD's phone number will also be visible to ensure compliance with applicable regulations.
- All grading and demolition will be suspended when wind speeds exceed 20 mph.
- Wind breaks will be installed on the windward side(s) of actively disturbed areas of construction.
- Vegetative ground cover (e.g., fast-germinating native grass seed) will be planted in disturbed areas as soon as possible and watered appropriately until vegetation is established.
- The simultaneous occurrence of excavation, grading, and ground-disturbing construction activities on the same area at any one time will be limited. Activities shall be phased to reduce the amount of disturbed surfaces at any one time.
- Sandbags or other erosion control measures shall be installed to prevent silt runoff to public roadways from sites with a slope greater than one percent.

Mitigation Measure AQ-2b: Implement BAAQMD basic and additional construction mitigation measures to control construction-related ROG and NO_X emissions

JPB will implement the following BAAQMD-recommended basic and additional control measures to reduce ROG and NO_X emissions from construction equipment.

- All construction equipment will be maintained and properly tuned in accordance with manufacturer's specifications. All equipment will be checked by a certified mechanic and determined to be running in proper condition prior to operation.
- Minimize the idling time of diesel powered construction equipment to two minutes. Clear signage will be provided for construction workers at all access points.

- Require that all construction equipment, diesel trucks, and generators be equipped with Best Available Control Technology for emission reductions of NO_X and PM.
- Require all contractors use equipment that meets the ARB's most recent certification standard for off-road heavy duty diesel engines.

Mitigation Measure AQ-2c: Utilize clean diesel-powered equipment during construction to control construction-related ROG and NO_X emissions

JPB will ensure that all offroad diesel-powered equipment used during construction will be equipped with an EPA Tier 3 or cleaner engines, except for specialized construction equipment in which an EPA Tier 3 engine is not available. This mitigation measure assumes emission reductions compared with a fleet-wide average Tier 2 engine.

Impact AQ-2b	Violate any air quality standard or contribute substantially to an existing or projected air quality violation during Proposed Project operation
Level of Impact	Less than significant (beneficial)

Proposed Project operation has the potential to create air quality impacts primarily associated with transit operation and changes in regional traffic patterns. Transit operation would generate criteria pollutants through diesel fuel consumption to power the diesel locomotives. Changes in regional traffic would primarily affect emissions levels through changes in gasoline consumption associated with the diversion of private automobile trips to public transit. Emissions generated under the No Project scenario, including fuel consumption by the diesel locomotives and regional vehicles, represent the baseline, against which the Proposed Project is evaluated.

Criteria Pollutant Emissions relative to Diesel Combustion, Electricity Generation, and Changes in Vehicle Miles Travelled

Existing conditions (2013) and estimated operational emissions in 2020 and 2040 with and without the project are summarized in Table 3.2-7. The difference in operational emissions between the Proposed Project and the existing Caltrain service represents the net change over existing conditions. The difference between the Proposed Project and the No Project scenarios represents the impact of the Proposed Project.

As shown in Table 3.2-7, implementation of the Proposed Project would substantially reduce criteria pollutant emissions relative to the existing Caltrain service and relative to the No Project scenario in both 2020 and 2040. Reductions in Caltrain system criteria pollutant emissions compared with existing (2013) conditions would range from 66 to 86 ~~56 to 84~~ percent for the 2020 scenario, depending on the pollutant, and from 78 to 97 ~~77 to 96~~ percent for the 2040 scenario, depending on the pollutant (comparison with existing condition does not take into account VMT reduction emissions). The No Project Caltrain system emissions would also be less than existing conditions due to improvements in diesel engine technology (see Table 3.2-7).

Table 3.2-7. Estimated Operational Emissions (pounds per day)

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 System Emissions[a]	251	5,979	642	159	155
No Project (2020)					
Caltrain Diesel Consumption	45	1,043	731	23	23
Caltrain Electricity Consumption	0	4	4	0	0
Total Caltrain System Emissions[a]	46	1,048	735	24	23
Project (2020)					
Caltrain Diesel Consumption	32	707	131	21	20
Caltrain Electricity Consumption	5	105	86	5	5
Total Caltrain System Emissions[a]	37	812	218	26	25
Change in VMT emissions[b]	-159	-330	-1,296	-181	-53
Total Project Emissions	-122	482	-1,078	-155	-27
No Project (2040)					
Caltrain Diesel Consumption	23	539	689	8	8
Caltrain Electricity Consumption	0	4	4	0	0
Total Caltrain System Emissions[a]	23	543	693	8	8
Project with Full Electrification (2040)[c]					
Caltrain Diesel Consumption	1	26	33	0.4	0.4
Caltrain Electricity Consumption	6	133	109	6	6
Total Caltrain System Emissions[a]	7	159	142	7	7
Change in VMT Emissions[b]	-487	-1,009	-3,866	-483	-145
Total Project Emissions	-480	-850	-3,724	-477	-138
Comparisons					
2020 Caltrain System vs. Existing (2013)[d]	-373	-5,497	-1,720	-315	-182
2040 Caltrain System with Full Electrification vs. Existing (2013)[c,d]	-503	-1,393	-4,417	-485	-146
2020 Project vs. 2020 No Project[e]	-168	-566	-1,813	-179	-50
2040 Project with Full Electrification vs. 2040 No Project [c,e]	-503	-1,393	-4,417	-485	-146
BAAQMD Thresholds	**54**	**54**	**--**	**82**	**54**

[a] Includes diesel and electricity emissions; VMT-related reductions due to increased ridership are not included.
[b] Includes the net change in VMT from the No Project to the Proposed Project scenarios associated with increased ridership.
[c] The Proposed Project includes 75% electrified service from San Jose to San Francisco. Fully electrified service from San Jose to San Francisco is presumed by 2040 but is not presently fully funded.
[d] Comparison of Caltrain system emissions only. Changes in VMT emissions are not included.
[e] Includes changes in Caltrain system emissions and changes in VMT emissions.

CO = carbon monoxide
NO_X = oxides of nitrogen
ROG = reactive organic gases
PM10 = PM that is 10 microns in diameter or less
PM2.5 = PM that is 2.5 microns in diameter or less
VMT = vehicle miles traveled

Proposed Project emissions would be lower than under the No Project scenario in both 2020 and 2040. The difference in emissions would be a direct result of the Proposed Project, which would consume less diesel fuel than the No Project condition and would operate energy efficient EMUs. These features would enable the Proposed Project to increase transit service while reducing criteria pollutant emissions, relative to the No Project Caltrain system. In addition, due to the increase in service achieved by the Proposed Project, a greater number of riders would use Caltrain instead of driving. As discussed in Section 3.14, *Transportation and Traffic*, regional VMT in the peak and off-peak periods would be less under the 2020 Project scenario compared with the 2020 No Project scenario. Total daily VMT under the 2020 Project scenario is projected to decrease by approximately 235,000 miles compared with the 2020 No Project scenario. Removing vehicles from major highways and arterials ~~which~~ would reduce regional transportation emissions (as compared to the No Project scenario) (see Table 3.2-7).

~~This would~~ Overall, the project would result in substantially less emissions than under No Project Conditions, which would be an air quality benefit. Accordingly, this impact is considered less than significant. Additional discussion of particulates is provided after Table 3.2-7, but the overall conclusion for particulates is also that the project would have less than significant impacts and overall regional reduced particulate emissions compared to No Project conditions.

Particulate Matter Due to Wheel-Rail Interaction

Particulate matter may also be generated from friction between rail and locomotive wheels (wheel-rail interaction). This abrasion process can suspend metals such as iron, chromium, manganese, and copper, which can attach to the airborne particulates. This is an existing condition relative to the existing Caltrain and freight trains operating along the Caltrain corridor. The project would increase the number of trains/day by 22 trains/day compared to the 94 to 125 trains/day at present using the corridor between San Jose Diridon Station and San Francisco (including Caltrain, freight, ACE, Capitol Corridor, and Amtrak).

The amount of abrasion is influenced by the condition of the wheels and track as well as the weight on the train wheels. Because the EMUs are expected to be lighter and newer than today's diesel locomotives and carriages, they will result in lesser wear of the rails (Caltrain 2009 – EMU Report). Accordingly, while there will be approximately 20 percent more trains with the project, the new EMUs will result in less abrasion on a per train basis than existing diesel equipment. Thus, although the number of trains will increase, it may or may not result in an actual increase in particulate emissions due to wheel/rail contact.

While receptors adjacent to the Caltrain ROW may be exposed to particulates from existing and future operations, the contribution of wheel/rail wear particulates to the overall PM10 composition is expected to be minimal and well below established exposure guidelines. For example, Gehrig et al. (2007) measured PM10 and its elemental composition near two busy railway stations in Switzerland that serve over 700 trains per day, nearly exclusively electric locomotives (thus excluding diesel train emissions). Results of their study indicate that the difference in PM10 levels between urban background locations and locations 10 meters from the railway ranged from 1.4 to 2.0 $\mu g/m^3$.[3] Total PM10 levels ranged from 22.8 to 23.7 $\mu g/m^3$ at the three railway study sites indicating that railway contributions might be 6 to 8 percent of the total PM10 level. PM10

[3] The overall PM10 results are only slightly outside the uncertainty level reported for the study of 0.9 $\mu g/m^3$, thus there is some uncertainty in the overall results.

concentrations were also noted to decrease rapidly as function of distance. It is expected that elemental concentrations along the Caltrain ROW would be far lower than those reported by Gehrig et al. (2007), which are based on over 700 trains per day whereas the busiest part of the Caltrain Corridor has only 125 trains today (between Santa Clara and San Jose). It is important to note that this study did not specifically attribute the increases only due to wheel-rail abrasion, and thus the results may also reflect minor contributions of particulates due to induced wind as well as pantograph contact strip wear on electrical trains.

Other studies on wheel-rail interaction confirm that while slightly elevated concentrations of PM10 can be observed along railways, the concentrations are minimal and may be lower than levels generated from tier and brake wear along roadways (Kam 2013).

There are no studies of the exact particulate levels along the Caltrain ROW compared to urban background locations on the San Francisco Peninsula. Thus, a conceptual evaluation has been completed as follows. As noted above, the PCEP would increase train totals on the corridor by 22 trains. Using the Gehrig studies above, and crudely scaling down for the number of additional trains on the Caltrain Corridor (22/700), PM10 contributions due to increased trains might be rail wear today might be 0.04 to 0.06 $\mu g/m^3$. By comparison, the 24-hour California standard for PM10 is 50 $\mu g/m^3$ so this increase is only about 0.1% of the standard. While this is a somewhat crude estimate that is based on reasoning by proxy, it does demonstrate that the likely contributions of PM10 related to the increased number of trains and increased rail wear is very small.

Moreover, as noted above, the potential for increased rail abrasion and resultant particle suspension due to an increase in the number of trains may be somewhat or entirely offset due to the lighter weight and lesser friction of the EMU equipment compared to the diesel equipment it is replacing. Furthermore, the project will result in a substantial reduction in diesel engine PM10 emissions compared to existing and No Project conditions which will more than offset any minor increase in rail wear that might occur.

Particulate Emissions due to Entrained Dust

Another potential source of particulates from increased numbers of trains is due to the induced wind from passing trains. Trains create gusts of wind as they pass along the ROW that are short-lived and affect the area immediately adjacent to the tracks themselves. The California High-Speed Rail Authority (CHSRA 2012) studied induced winds for the Fresno-Merced segment EIR. In that study, CHSRA looked at FRA guidance and literature studies, EPA methodologies for modelling wind erosion, contacted researchers in the field, and performed calculations to identify potential induced wind and the effect on particulate matter concentrations along the high-speed rail segment. The study noted that an exact, analytical equation describing the induced wind from passing HSTs is unavailable because the technical means of obtaining it do not exist. Consequently, generally accepted scientific methods were used to extrapolate data from existing HST studies to approximate the induced winds expected from the California HST. The results showed that for trains running up to 220 mph, there would be minor resuspension of PM 10 and PM2.5 outside the track gravel between 3 to 10 feet from the train with no resuspension beyond 10 feet.

Using the same methodology as the CHSRA study, the potential for resuspension was estimated for the Caltrain service with the PCEP. The Caltrain service is only up to 79 mph and thus the induced winds are far lower than HST running at 220 mph. When running at 79 mph, the estimated induced winds within the first ten feet of the train range from 13 mph (1 foot from the train) to 4 mph (10 feet from the train). Using these estimated induced winds, assuming there is friable soil immediately adjacent to the rails (whereas in reality most of the ROW is graveled) and conservative assumptions about the threshold friction velocity of soils along the ROW (e.g., the wind speed necessary to suspend particulates), it is estimated that potential wind erosion due to induced wind would be limited to the first three feet from the train. Over the approximate 52 mile project area from San Jose to San Francisco, assuming the area within three feet were actually covered in friable soil (instead of gravel), annual fugitive dust emissions for the Caltrain service as a whole would be estimated as 1.49 tons of PM10 and 0.22 tons of PM 2.5. Averaging this on a daily basis, it would be 8.2 lbs./day of PM10 and 1.23 lbs./day of PM2.5. These are estimates for the Caltrain service as a whole. As noted above, this analysis assumes friable soils are along the entire 52-mile Caltrain corridor, whereas much of the ROW adjacent to the rails is covered in gravel (including the 3 feet from the track edge at virtually all locations), and thus is an unrealistic overestimate of the potential for particulate resuspension. This analysis also assumes that over a year, the soils in the right of way adjacent to the rails is disturbed twice monthly by maintenance, thus making soil available for resuspension.

In reality, there is very little residual soil on the gravel along the tracks that could be actually resuspended and the induced wind beyond the first three feet from the tracks falls to less than a conservative estimate of the threshold friction velocity. The existing 92 Caltrain trains per day is likely already resuspending the small amount of friable soil present within gravel along the tracks. As a result, the addition of 22 additional trains per day is not likely to result in any meaningful change in particulate resuspension along the tracks. The amount of increased fugitive dust from induced wind due to the PCEP is a trivial amount by comparison to the amount of reduced particulates from switching from diesel locomotives to EMUs.

Particulates from Pantograph Contact Strip Wear

As described in Chapter 2, the pantograph contact strips on the EMUs consist of a carbon-copper matrix. The wear characteristics of in-use pantograph contact strips of New Jersey Transit (NJT) are similar to those likely to be used for the PCEP and thus were used as the basis of evaluation for the EIR. New pantograph contact strips were weighed and compared to contact strips that had been changed out as part of regular inspection cycles. Based on the material loss over the inspection cycle period and the average miles travelled during the same period by an average vehicle, a wear characteristic pattern was calculated on a per mile basis. The average weight loss per contact strip was determined to be 10.4 grams per 1,000 miles. The impact per pantograph was identified as twice the individual strip due to the fact that there are two contact strips per pantograph on the NJT vehicles and thus the material loss per vehicle would be 20.8 grams per 1,000 miles (LTK 2014-PANTO).

In 2020, the PCEP would result in approximately 8 EMUs per peak hour (both directions) operating between San Jose and San Francisco In 2040, the PCEP would result in approximately 12 EMUs per peak hour (both directions) operating between San Jose and San Francisco. Peak hours would be the highest period of EMU activity. The project includes 6-car EMU consists. For the purposes of this analysis, it was assumed that half of the EMUs would be powered (meaning their pantograph would be active), which is a common operating scenario (actual operating scenario may vary). On a weekday daily basis, the PCEP would result in approximately 90 EMU trains per day in 2020 and 114 EMU trains per day in 2040 between San Jose and San Francisco. Using weekday daily miles, EMU daily particulate emissions from pantograph collector strip wear would be approximately 0.5 lb./day in 2020 and 0.7 lb/day in 2040.

As shown in the revised air quality analysis in the FEIR not including pantograph wear, in 2020 the PCEP would result in a net regional reduction of PM10 emissions of 179 lbs/day and a net regional reduction of PM2.5 of 50 lbs/day compared to No Project conditions. Focusing only on train emissions along the Caltrain ROW, in 2020, the PCEP would result in PM10 and PM2.5 emissions 136 to 132 lbs less than existing conditions (87 percent reduction). Compared to the 2020 No Project conditions, the project would have slightly (2 lbs./day) lower weekday train emissions along the Caltrain ROW, but this difference would only be changed by 0.5 lbs/day in 2020 when including the pantograph wear particulate emissions, and this calculation does not include the positive effect of lowering vehicle emissions along the San Francisco peninsula with the project. At any rate, the difference between the project and No Project train emissions overall is less than the BAAQMD thresholds even when including pantograph particulate emissions. A similar conclusion applies in the 2040 timeframe. As shown above, the particulate emissions along the ROW due to the pantograph wear are an extremely small source of emissions.

Tree Removal Effect on Particulates

The project would result in the removal of trees that are within 18 to 21 feet of the outer track edge.

While vegetative barriers have been shown to reduce PM10 and PM2.5 emissions under certain circumstances, their effectiveness is variable and heavily influenced by wind speed conditions (California Air Resources Board 2012; Cahill 2008). Average annual wind speeds along the project corridor range from 6.8 miles per hour (mph) to 10.3 mph (Western Regional Climate Center 2014). Induced winds from train movement, estimated as ranging from 4 to 10 mph in the first 10 feet adjacent to the train (see discussion above relative to entrained dust) can also contribute for vegetation very close to the tracks. Laboratory research conducted by Cahill (2008) demonstrates that at a wind speeds ranging of 8.4 mph with vegetation very close to and in the direct line of dispersion from the particulate source, PM removal effectiveness for three different tree types (redwood, deodar and live oak) ranged from 2 to 26 percent. Other studies document the complexity of vegetative barriers, with variable results depending on particular size, leaf density, tree species, season, and tree spacing (Steffens et al. 2012, Hagler et al. 2012). Some studies have even documented potential *increases* in downstream pollutant concentrations as a result of certain vegetative conditions (Fitzgerald and Bush 2013).

While there is some evidence that removal of existing trees could reduce filtration benefits, the research is variable, highly-location dependent, and limited with respect to real-world quantification. In addition, the specifics of the Caltrain diesel emissions need to be taken into account. The train's diesel engine exhaust exits the engine and is dispersed vertically at the top of the train meaning that it is not emitted directly toward adjacent trees, but rather is dispersed into the air column and then transported downwind. PM10 an remain suspended in the air for minutes to hours and travel from a hundred yards to as much as 30 miles (BAAQMD, no date). PM2.5 can remain suspended in the air for days or weeks, and can travel hundreds of miles before settling out of the air column (BAAQMD, no date). As a result, the PM10 emitted by diesel trains vertically from the train are not necessarily being filtered by the trees immediately adjacent to the right of way that may be most affected by project tree removal.

Even if one were to make the unrealistic assumption that the existing vegetation achieved the 26 percent filtration rate from the Cahill study (2008), electrification of the Caltrain system by 2020 would still result in over 80 percent reduction in PM10 emissions along the ROW, relative to the existing conditions. Similarly, comparisons to the No Project conditions would not be substantially changed even if you used the 26 percent assumption.

Given the pattern of train emission dispersion and the annual average wind speeds in the project area, and current literature that documents the variability in the effectiveness of vegetative barriers, the above example likely substantially overstates existing benefits achieved by trees within the Caltrain ROW. Moreover, as EMUs replace the remaining diesel locomotives over time, Caltrain will be able to completely eliminate diesel emissions from the Caltrain ROW, improving further the net PM10 reductions compared to existing conditions and No Project conditions.

Combined Effects of Project on Particulate Matter Emissions

As described above, the project will affect particulate matter in emissions in a number of ways. The dominant effect of the project is to lower diesel engine particulate emissions by replacing diesel locomotives with EMUs. While EMUs eliminate diesel engine emissions, there will be minor particulate emissions due to pantograph contact strip wear. With increased numbers of trains (independent of whether they are EMUs or diesel trains in the alternatives considered), there is a potential for increased rail wear, although with lighter EMUs this will likely be offset. With increased numbers of trains there is also the potential to increased particulates from induced winds from passing trains. With tree removal, there is a potential for a minor reduction in the filtering action of particulates adjacent to the ROW.

Above, a number of conceptual examples were derived to give an idea of the magnitude of the changes in particulate emissions other than the diesel engine emissions. Using those conceptual examples (while noting the limitations described above for each of the estimates), Table 3.2-8 gives an idea of the potential rough net effect of the project on particulate emissions compared to existing conditions.

Table 3.2-8. Comparison of 2020 Daily PM10 Emissions using Conceptual Estimates for Other Particulate Sources (lb/day)

	Existing	2020 No Project	PCEP 2020	Notes
Diesel Engine Emissions	159	23	21	From Table 3.2-7
Wheel-Rail Particulates	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	Area adjacent to ROW is graveled and contains limited soil available for resuspension.
Pantograph Particulate Emissions	0	0	0.5	From calculations above.
Subtotal Emissions Along ROW	*159*	*23*	*21*	
Tree Removal Benefit	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*	
Electricity Emissions	0	0	5	Non-PCEP conditions include a small amount of emissions for idle power when plugged in at terminal.
Total Caltrain System	*159*	*24*	*26*	
Lowered VMT emissions	NA	0	-181	VMT reductions are relative to 2020 No Project.
TOTAL	**NA**	**24**	**-155**	

As shown by the analysis in Table 3.2-9, even using highly conservative assumptions, the Proposed Project would not result in a significant impact related to particulate emissions when taking into account diesel emissions, electricity generation, lowered VMT-related emissions, wheel-rail contact, entrained particulates, pantograph particulates, and potential effects due to tree removal. The analysis in Table 3.2-9 is for illustrative purposes as the methods and assumptions used for the analysis of emissions other than diesel emissions, electricity generation and VMT-related emissions involves a high level of uncertainty and thus does not have a sufficient level of scientific certainty in the result. Thus, the results presented in Table 3.2-7 represent the best estimate of particulate emissions for the Proposed Project.

Table 3.2-9. Comparison of Daily PM10 Caltrain Emissions using Conceptual Estimates for Other Particulate Sources For a Hypothetical Mile with Consistent Tree Buffer (Between San Jose and San Francisco) (lb/day)

	Existing	2020 No Project	PCEP 2020	Notes
Diesel Engine Emissions	3.07	0.45	0.35	Only includes emissions for diesel emissions north of San Jose divided by route miles.
Wheel-Rail Particulates	NA	NA	NA	Negligible change from existing conditions for PCEP or alternatives per discussion above, so not meaningful for comparison.
Entrained Particulates	NA	NA	NA	Area adjacent to ROW is graveled and contains limited soil available for resuspension.
Pantograph Particulates	0.00	0.00	0.01	
Subtotal Emissions Along ROW	*3.07*	*0.45*	*0.36*	
Tree Removal Benefit - LOW (Conceptual Estimate)	-0.06	-0.01	0.00	Used lower range (2%) of Cahill estimate for 8.4 mph wind speed in laboratory study. No reduction assumed for PCEP although replanting mitigation may provide some benefit in certain locations.
Tree Removal Benefit - HIGH (Conceptual Estimate)	-0.80	-0.12	0.00	Used higher range (26%) of Cahill estimate for 8.4 mph wind speed in laboratory study. No reduction for PCEP. Likely substantially overstates reduction because 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*	*Excludes VMT reductions of PCEP and alternatives*
Total Net Emissions per hypothetical mile (High tree filtration scenario)	*2.27*	*0.34*	*0.36*	*Excludes VMT reductions of PCEP and alternatives*

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 (excluding VMT reduction) would only be 1 lb./day of PM10, which would be less than significant in comparison to the BAAQMD threshold of 54 lbs/day. Multiplying by 51-miles and including VMT reduction, the PCEP would have lower PM10 emissions than existing and No Project conditions.

Project Variant Impact Analysis

With Project Variant 1 (Electrification to just south of the Tamien Station), the Caltrain corridor would only be electrified to just south of Tamien Station. Under the Proposed Project, EMUs would only operate to just south of Tamien Station. Therefore, there would be no changes to operational emissions.

Under Project Variant 2, the electrification of the storage tracks at the 4th and King Station in San Francisco would be deferred. Normal commuter train operations would be the same as the Proposed Project. If maintenance or repair of EMUs would require the EMUs to be on the storage tracks, then a diesel yard hauler would be required to push or pull the EMUs onto the storage tracks and to push or pull the EMUs back onto the electrified tracks after service or repair. Under No Project conditions, such train movements would be using either diesel locomotives or diesel yard haulers and thus this variant would not represent in any increase compared to No Project conditions. While emissions would be slightly higher than the Proposed Project, this activity would be limited in extent and duration and would not meaningfully change the emissions of the Proposed Project.

Impact AQ-3a	Cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment under an applicable federal or state ambient air quality standard during Proposed Project construction
Level of Impact	Significant
Mitigation Measures	AQ-2a: Implement BAAQMD basic and additional construction mitigation measures to reduce construction-related dust AQ-2b: Implement BAAQMD basic and additional construction mitigation measures to control construction-related ROG and NO_X emissions AQ-2c: Utilize clean diesel-powered equipment during construction to control construction-related ROG and NO_X emissions
Level of Impact after Mitigation	Less than significant

BAAQMD has identified project-level thresholds to evaluate criteria pollutant impacts (see Table 3.2-4). In developing these thresholds, BAAQMD considered levels at which project emissions would be cumulatively considerable. The BAAQMD CEQA Guidelines state,

> In developing thresholds of significance for air pollutants, BAAQMD considered the emission levels for which a project's individual emissions would be cumulatively considerable. If a project exceeds the identified significance thresholds, its emissions would be cumulatively considerable, resulting in significant adverse air quality impacts to the region's existing air quality conditions. Therefore, additional analysis to assess cumulative impacts is unnecessary.

The criteria pollutant thresholds presented in Table 3.2-4 therefore represent the maximum emissions the Proposed Project may generate before contributing to a cumulative impact on regional air quality. Consequently, exceedances of the project-level thresholds would be cumulatively considerable.

As discussed in Impact AQ-2a, construction emissions associated with the Proposed Project would exceed BAAQMD's threshold of significance. Mitigation Measures AQ-2a through AQ-2c would be required to reduce construction-related emissions to a less-than-significant level.

As discussed above, with Project Variant 1, the Caltrain corridor would only be electrified to just south of Tamien Station and there would be approximately 1.2 fewer miles of construction activities and, thus, fewer construction emissions. Under Project Variant 2, the electrification of the storage tracks at the 4th and King Station in San Francisco would be deferred. Therefore, there would similarly be fewer construction emissions. However, Mitigation Measures AQ-2a through AQ-2c would still apply and implementation of either or both of these project variants would not change this impact's level of significance.

Impact AQ-3b	Cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment under an applicable federal or state ambient air quality standard during Proposed Project operation
Level of Impact	Less than significant

As shown in Table 3.2-7, implementation of the Proposed Project would reduce criteria pollutant emissions relative to the existing Caltrain service. This would be an air quality benefit and contribute to cumulative criteria pollutant reductions within the SFBAAB. Accordingly, this impact is considered less than significant.

With Project Variant 1, the Caltrain corridor would only be electrified to just south of Tamien Station. Under the Proposed Project, EMUs would only operate to just south of Tamien Station. Therefore, there would be no changes to operational emissions. Under Project Variant 2, the electrification of the storage tracks at the 4th and King Station in San Francisco would be deferred. Operational emissions would be slightly higher because a diesel train would be required to push or pull EMUs onto and back from the storage tracks. Diesel emissions for these moves to the storage tracks would be the same as No Project conditions and would be limited in extent and duration. Thus neither of these variants would change the impact conclusion regarding air quality.

Impact AQ-4a	Expose sensitive receptors to substantial pollutant concentrations during Proposed Project construction
Level of Impact	Less than significant

Diesel-fueled engines, which generate DPM, would be used during Project construction. BAAQMD considers ultra-fine particle (PM2.5) emissions to be the DPM of greatest health concern. Cancer health risks associated with exposure to diesel exhaust are typically associated with chronic exposure, in which a 70-year exposure period is assumed. In addition, DPM concentrations, and thus cancer health risks, dissipate as a function of distance from the emissions source. BAAQMD has determined that construction activities occurring at distances of greater than 1,000 feet from a sensitive receptor likely do not pose a significant health risk.

Multiple sensitive receptors (e.g., residences) are located within 1,000 feet of construction locations. The nearest receptors are directly adjacent to the Caltrain ROW. Therefore, exposure to construction DPM emissions were assessed by predicting the health risks in terms of excess cancer, non-cancer hazard impacts, and elevated DPM (PM2.5) concentrations.

A screening-level HRA was performed using the AERSCREEN dispersion model and the mitigated PM10 and PM2.5 exhaust emissions (see Table 3.2-6). The results of the HRA are summarized in Table 3.2-~~8~~10 and are compared with BAAQMD's project-level DPM thresholds. Note that Table 3.2-~~8~~10 presents the maximum health risks associated with Proposed Project construction along the corridor, which occur at approximately 164 feet (50 meters) from the construction fence line. Detailed information on emissions modeling may be found in Appendix B.

Table 3.2-~~8~~10. Maximum Project-Level Health Risks during Construction[a]

Construction Phase and Location	Maximum Project Health Risks: Annual Non-Cancer Hazard Index	Increased Cancer Risk (per million)[b]	Annual PM2.5 Concentration ($\mu g/m^3$)
Utilities	0.004	0.149	0.000
Traction Power Substation	0.010	1.302	0.001
Overhead Contact System	0.010	1.046	0.002
Signal & Grade Crossings	0.003	0.190	0.000
Communications	0.001	0.068	0.000
Integration/Commissioning	0.000	0.009	0.000
Total for All Construction	0.023 (for worst-year)	2.76	0.003 (for worst-year)
BAAQMD Thresholds	1	10	0.3
Exceed Thresholds?	*No*	*No*	*No*

[a] Analysis assumes implementation of all applicable onsite mitigation (Mitigation Measures AQ-2b and AQ-2c).

[b] Health risks were determined by taking the worst-year emissions for each construction element and multiplying by the years of activity for total construction. This approach likely overstates actual emissions.

$\mu g/m^3$ = Micrograms per cubic meter

BAAQMD = Bay Area Air Quality Management District

PM2.5 = PM that is 2.5 microns in diameter or less

As shown in Table 3.2-~~8~~10, Proposed Project construction would not result in significant increases of the non-cancer HI, cancer risk, or annual PM2.5 concentrations. Therefore, the project-level impact is considered less than significant.

With Project Variant 1, the Caltrain corridor would only be electrified to just south of Tamien Station and there would be approximately 1.2 fewer miles of construction activities and, thus, fewer construction emissions. Under Project Variant 2, the electrification of the storage tracks at the 4th and King Station in San Francisco would be deferred. Therefore, there would similarly be fewer construction emissions. Implementation of either or both Project Variants would not change this impact's level of significance.

Impact AQ-4b	Expose sensitive receptors to substantial pollutant concentrations during Proposed Project operation
Level of Impact	Less than significant

~~Operational~~ CO Emissions from Onroad Vehicles

Changes in regional traffic patterns associated with the Proposed Project have the potential to create CO hotspots at intersections in the study area. Existing (2013) and 2020 and 2040 traffic (with and without the Proposed Project) were modeled to evaluate CO concentrations relative to the state and federal air quality standards (see Table 3.2-1). CO concentrations were modeled at the following study area intersections, as identified in the traffic impact assessment prepared by Fehr & Peers (see Appendix D, *Transportation Analysis*):

- 7th Street & 16th Street in San Francisco.

- El Camino Real & Millbrae Avenue in Millbrae.
- 31st Avenue & El Camino Real in San Mateo.
- El Camino Real & Fair Oaks Lane in Atherton.
- Central Expressway & North Rengstorff Avenue in Mountain View.
- Kifer Road & Lawrence Expressway in Santa Clara.

Table 3.2-~~9~~11 presents the results of the CO hotspot modeling and indicates that CO concentrations are not expected to contribute to any new localized violations of the 1-hour or 8-hour ambient air quality standards. This impact is therefore considered less than significant.

Table 3.2-~~9~~11. Modeled CO Concentrations at Affected Intersections (parts per million)

		Existing (2013)[b]		Project (2020)[b]				Future (2040)[b]			
				No Project		Project		No Project		Project	
Intersection	RE[a]	1-hr[c]	8-hr[e]	1-hr[c]	8-hr[e]	1-hr[c]	8-hr[e]	1-hr[c]	8-hr[e]	1-hr[c]	8-hr[e]
7th Street & 16th Street	1	5.2	3.1	4.6	2.7	4.6	2.7	4.4	2.6	4.4	2.6
	2	5.0	3.0	4.3	2.5	4.3	2.5	4.1	2.4	4.1	2.4
	3	5.1	3.1	4.5	2.6	4.5	2.6	4.2	2.4	4.2	2.4
	4	5.0	3.0	4.5	2.6	4.5	2.6	4.2	2.4	4.2	2.4
El Camino Real & Millbrae Avenue	5	6.8	4.3	5.8	3.6	5.8	3.6	5.1	3.1	5.1	3.1
	6	6.2	3.8	5.5	3.3	5.5	3.3	4.9	2.9	4.9	2.9
	7	6.4	4.0	5.3	3.2	5.4	3.3	4.9	2.9	5.0	3.0
	8	6.5	4.0	5.6	3.4	5.6	3.4	5.1	3.1	5.1	3.1
31st Avenue & El Camino Real	9	5.8	3.6	4.9	2.9	4.9	2.9	4.5	2.6	4.5	2.6
	10	6.0	3.7	5.0	3.0	5.0	3.0	4.6	2.7	4.6	2.7
	11	5.6	3.4	4.8	2.9	4.8	2.9	4.4	2.6	4.4	2.6
	12	5.9	3.6	5.0	3.0	5.0	3.0	4.6	2.7	4.6	2.7
El Camino Real & Fair Oaks Lane	13	6.0	3.7	4.9	2.9	4.9	2.9	4.6	2.7	4.6	2.7
	14	6.8	4.3	5.4	3.3	5.3	3.2	4.9	2.9	4.8	2.9
	15	5.2	3.1	4.5	2.6	4.5	2.6	4.2	2.4	4.2	2.4
	16	6.9	4.3	5.4	3.3	5.4	3.3	4.8	2.9	4.8	2.9
Central Expressway & N Rengstorff Avenue	17	6.3	3.9	5.1	3.1	5.2	3.1	4.7	2.8	4.8	2.9
	18	5.7	3.5	4.9	2.9	4.9	2.9	4.7	2.8	4.7	2.8
	19	6.2	3.8	5.2	3.1	5.2	3.1	4.7	2.8	4.7	2.8
	20	5.7	3.5	4.9	2.9	4.9	2.9	4.6	2.7	4.6	2.7
Kifer Road & Lawrence Expressway	21	7.2	4.5	5.5	3.3	5.5	3.3	4.9	2.9	5.0	3.0
	22	8.1	5.2	6.0	3.7	6.1	3.8	5.3	3.2	5.3	3.2
	23	7.3	4.6	5.6	3.4	5.6	3.4	5.1	3.1	5.1	3.1
	24	7.5	4.7	5.8	3.6	5.7	3.5	5.0	3.0	5.0	3.0

[a] Receptors 1 through 16 were placed 3 meters from the traveled way at each intersection corner.
[b] Background concentrations of 3.7 and 2.1 ppm were added to the modeling 1- and 8-hour results, respectively.
[c] The federal and state 1-hour standards are 35 and 20 ppm, respectively.
[d] The federal and state 8-hour standards are 9 and 9.0 ppm, respectively.
[e] Concentrations modeled using CALINE4.
RE = Receptor

~~Operational~~ DPM Emissions from Locomotive Diesel Combustion

As described above, the Proposed Project would substantially reduce PM emissions compared with ~~both~~ existing conditions (2013) ~~and with the No Project 2020 and 2040 scenarios~~. Assuming 100 percent of PM10 emissions associated with diesel locomotives is DPM, annual DPM emissions along the Caltrain corridor between San Jose and San Francisco would be reduced with the Proposed Project by 87 ~~71~~ percent in 2020 and by 100 percent in 2040 (assuming 100 percent electrified service between San Jose and San Francisco). Relative to the No Project scenarios, the Proposed Project would reduce DPM emissions along the ROW by 12 percent in 2020 and by 100 percent in 2040.

As an example of the localized health benefit of the Proposed Project, a 2011 HRA for the EIR for a residential and mixed use development ~~project~~ associated with the Menlo Park *El Camino Real Downtown Specific Plan* (Menlo Park 2012) along the Caltrain corridor was reviewed to identify the potential risks of current and No Project DPM emissions. The plan includes residential, commercial and mixed use development along the Caltrain corridor in Menlo Park. Based on current and projected diesel locomotive emissions into the future (taking into account the effects of current regulations that will reduce locomotive particulate emissions over time [refer to section 3.2.1.1]), the HRA conducted for the project's EIR identified that the unmitigated cancer risks of new residents 50 feet from the Caltrain ROW would be up to 58 ~~51~~ in a million (outdoors) and 38.6 ~~34~~ in a million (indoors). The estimated non-cancer HI for receptors near Caltrain was identified as 0.036 ~~0.032~~ and is considered less than significant (less than hazard index of 1.0). The project's EIR identified that the cancer risk health impacts could be reduced with project level mitigation requiring air filtration systems for new residences.

Under 2020 No Project Conditions, DPM emissions would be reduced by 85 percent along the Caltrain corridor between San Jose and San Francisco compared with existing conditions. Using the study results above, an 85 percent reduction in the unmitigated indoor cancer risk would roughly correlate to a cancer risk of only 5.7 in a million, which would be a reduction of 33 in a million. There would similar scale reductions in non-cancer health risks associated with DPM.

The Proposed Project would reduce DPM emissions by 87 ~~71~~ percent along the Caltrain corridor between San Jose and San Francisco compared with existing conditions ~~the No Project scenario~~, and by 100 percent between San Jose and San Francisco with full electrification between San Francisco and San Jose. A 87 ~~71~~ percent reduction in the unmitigated indoor cancer risk would roughly correlate to a cancer risk of only 5.0 ~~10~~ in a million, which would be a reduction of 34 ~~24~~ in a million.[4] There would similar scale reductions in non-cancer health risks associated with DPM (hazard index change from 0.036 ~~0.032~~ to 0.005 ~~0.009~~ a reduction in non-cancer risk of 0.031 ~~0.023~~).

As described above in the discussion of criteria pollutant emissions, trees would be removed with implementation of the project where they are within 18 to 21 feet of the electrified outer track. These trees may currently filter a portion of diesel particulates generated by the trains and buffer

[4] The actual risk reduction compared to existing conditions would be somewhat less than 87 ~~71~~ percent because the Menlo Park HRA included 70 years of risk associated with diesel locomotives, including some years before 2020. The Proposed Project would only affect operational risks associated with years of 2020 and after. Health risks under the No Project scenarios would reduce over time due to the effect of adopted federal regulations. ~~Thus, the amount of risk reduction would not apply to the entire risk, but only that part occurring after 2020. However, from a 2020 perspective, whatever the health risks going forward from that point are, they would be reduced by 71 percent with the Proposed Project.~~

adjacent residences from associated health risks. However, as discussed above, while there is some evidence that removal of existing trees could reduce filtration benefits; the research is variable, highly-location dependent, and limited with respect to real-world quantification. Furthermore, diesel particulate emissions from trains is not emitted horizontally but vertically and then dispersed laterally by prevailing winds, which means that the trees adjacent to the ROW likely do not provide much filtering of DPM from trains which is more likely to disperse outside the ROW and then settle vertically in a highly dispersed pattern away from the ROW.

Despite these real-world limitations, even if it were assumed that existing vegetation to be removed by the PCEP actually achieved a filtration rate of train DPM by the 2 to 26 percent range per Cahill (2008), electrification of the Caltrain system would still result in a substantial reduction in DPM, relative to the existing conditions and would likely result in a reduction relative to No Project conditions.

For 2020, Proposed Project PM10 train emissions along the ROW are 21 lbs./day, compared to the No Project condition of 23 pounds/day and the existing conditions of 159 lbs./day. If one were to apply a 2 to 26 percent reduction due to trees, which is a highly optimistic assumption given all the factors noted above concerning tree filtration effectiveness, then the adjusted existing conditions would be PM10 of 118 to 156 lbs./day and No Project conditions would be PM10 emissions of 17 to 23 lbs./day along the ROW. Thus, the Proposed Project would still reduce PM10 emissions along the ROW by 82 to 87 percent. Relative to No Project conditions, the Proposed Project would reduce PM10 emissions along the ROW by 7 percent in the low filtration scenario, but would increase PM10 emissions by 23 percent in the high filtration scenario. Even if the high filtration scenario were accurate (which the evidence suggests it is not), applying to the cancer health risks above, the adjusted No Project cancer health risk would be reduced to 4.2 in a million and the Proposed Project would only result in a theoretical increase of 0.8 in a million (to 5.0 in a million), which is far less than the BAAQMD threshold of 10 in a million and would be less than significant.

This conceptual calculation does not likely represent real-world conditions for all the reasons noted above in the discussion of criteria pollutants. It is more likely that the trees along the ROW only provide a very limited role in filtering DPM from trains and that in 2020 the Proposed Project will also result in reduced DPM emissions relative to the No Project conditions.

In any case, in the long run, with 100 percent EMUs, the project would completely eliminate train diesel emissions from Caltrain passenger trains and any associated health risks. Under No Project conditions, DPM emissions will also be substantially reduced after 2020 as the remaining older diesel trains are replaced with cleaner Tier 4 Diesel Locomotives, but diesel emissions will not be eliminated entirely.

Thus, the Proposed Project would result in a net reduction in DPM health risk along the Caltrain corridor.

Detailed information on emissions modeling may be found in Appendix B.

TAC Emissions from Power Plants

Concerning increased electricity generation emissions due to the Proposed Project, the potential exists for increased health risk at locations of increased power plant emissions if such power plants generate TACs. However, power plant emissions are highly regulated at both the state and federal level to manage health risks of adjacent communities. Further, California regulations (e.g., the Renewables Portfolio Standard or RPS) require an increasing share of electricity generation to come from sources that do not produce greenhouse gas emissions, meaning a substantial reduction in the use of fossil fuel-based electricity generation over time, which will reduce associated TAC emissions from fossil-fuel-based electrical power plants in the aggregate over time.

Metal Particulates from Wheel-Rail Contact

As noted above, particulate matter may be generated from friction between rail and locomotive wheels (wheel-rail interaction). This abrasion process can suspend metals such as iron, chromium, manganese, and copper, which can attach to the airborne particulates. While receptors adjacent to the Caltrain ROW may be exposed to these particulates, the contribution of metals to the overall PM10 composition is expected to be minimal and well below established exposure guidelines. For example, Gehrig et al. (2007) measured PM10 and its elemental composition near two busy railway stations that serve over 700 trains per day. Results of their study indicate that iron constituted only 1 $\mu g/m^3$ of the total PM10 concentration at a distance of 10 meters from the tracks. Contributions of copper, manganese, chromium, and other metals were far lower, ranging from 0.001 to 0.06 $\mu g/m^3$. Gehrig et al. (2007) also found no significant contributions from rock material (e.g., calcium, aluminum, sodium). PM10 concentrations were also noted to decrease rapidly a function of distance; measurements at 120 meters from the track showed PM10 concentrations that were less than 25% of the concentrations observed at 10 meters.

Exposure to concentrations reported by Gehrig et al. (2007) would also be well below recommended exposure levels published by OEHHA (2014). For example, the reference exposure level for copper is 100 $\mu g/m^3$ but the increased level over background found due to 700 trains range from 0.03 to 0.06 $\mu g/m^3$.[5] It is expected that elemental concentrations along the Caltrain ROW would be lower than those reported by Gehrig et al. (2007), which are based on over 700 trains per day. Moreover, since EMUs are lighter than the existing diesel locomotives, wheel-rail friction and resultant particle suspension may be reduced with implementation of the project, assuming all other variables (e.g., aerodynamic drag, track curvature), relative to existing conditions.

Other studies on wheel-rail interaction confirm that while elevated concentrations of metals can be observed along railways, the concentrations are minimal and may be lower than levels generated from tier and brake ware along freeways (Kam 2013).

Thus, the Proposed Project would not exposure receptors to significant concentrations of suspended metals as a result of wheel-rail contact.

Copper Emissions from Pantograph Collector Strip Wear

As described above, the pantograph contact strips on the EMUs consist of a carbon-copper matrix. The wear characteristics of in-use pantograph contact strips of New Jersey Transit (NJT) were used as the basis of evaluation for the EIR. Particulate emissions overall were analyzed above. Copper emissions were estimated by using the particulate emissions overall and adjusting for the average copper content of the contact strip of 12 percent. (LTK 2014-PANTO).

The threshold used for evaluation of copper emission is the acute reference exposure level (REL) from OEHHA (OEHHA 1999) of 100 $\mu g/m^3$ over a one-hour period. Based on the unrealistically

[5] Another example is total chromium, where the Gehrig study found increased levels due to 700 trains of 0.003 to 0.004 $\mu g/m^3$ compared to background compared to the California OEHHA inhalation REL for hexavalent chromium of 0.2 $\mu g/m^3$ (not to mention that the total chromium may not consist entirely of hexavalent chromium).

conservative assumptions used for the particulate emissions analysis of pantograph wear and using the 12 percent copper fraction noted above, hypothetical worst-case peak hour increase in copper concentrations within the ROW could be approximately 0.33 to 0.49 $\mu g/m^3$ on a one-hour basis (range is from 2020 to 2040) which is less than 0.5% of the threshold of concern of 100 $\mu g/m^3$. Twenty-four hour and annual averages would be lower than the peak hour and emissions outside the ROW would be far less with dispersion. The Gehrig et al. (2007) study of the increased daily particulate concentrations compared to background for 700 trains/day in Switzerland, all of which (or virtually all) are identified as electric trains (which utilize pantographs) indicated that the copper increase in ambient concentrations was only 0.03 to 0.06 $\mu g/m^3$. This shows that the hypothetical calculation above is unrealistic and overstates potential emissions. The Gehrig (2007) study is a more reasonable real-world source of data by which to conclude that pantograph wear-related copper emissions would be less than significant.

Cumulative DPM Emissions

Some locations along the Caltrain corridor between San Jose and San Francisco have existing non-cancer and cancer risks due to existing toxic air contaminant emission sources, including Caltrain diesel trains, freight trains, other passenger trains, heavy trucks, marine vessels, and industrial sources. In the future, as explained in Section 4.1, *Cumulative Impacts*, there could be additional sources of toxic air contaminant emissions along the corridor. However, state and federal regulations of diesel and other emissions sources are getting much stricter over time in order to substantially reduce health risk associated with diesel and other toxic air contaminant emissions.

BAAQMD guidance recommends evaluation of cumulative health risks from cumulative projects and background sources when assessing a project's contribution to cumulative emissions. That guidance is applicable when a project increases toxic air contaminant emissions in order to evaluate whether a project increase is considerable in light of all cumulative emissions. Because the Proposed Project would lower operational emissions along the Caltrain corridor between San Jose and San Francisco, relative to both existing conditions and to the No Project scenarios, it can be concluded that the Proposed Project would have a cumulatively beneficial effect without the need for a quantitative analysis.

Project Variant Analysis

Neither Project Variant 1 or 2 would affect roadway volumes in any way and thus would not affect roadway CO levels compared to the Proposed Project. Neither Project Variant 1 nor 2 would change normal train service or operations or associated normal operational diesel engine emissions, TAC emissions from power plants, wheel-rail particulates, or pantograph wear emissions and thus would not change associated health risk.

Under Project Variant 2, the electrification of the storage tracks at the 4th and King Station in San Francisco would be deferred. Therefore, operational diesel emissions would be slightly higher than under the Proposed Project because a diesel train would be required to push or pull EMUs onto the storage tracks and then back to the electrified tracks after service or operations. Under No Project conditions, these moves would be made using diesel locomotives or diesel yard haulers and thus Variant 2 would not represent a change in conditions at the 4th and King Station yard and associated health risks. While emissions would be slightly higher than the Proposed Project, this would not result in additional impact compared to No Project conditions.

Impact AQ-5	Creation of objectionable odors affecting a substantial number of people
Level of Impact	Less than significant

Although offensive odors rarely cause any physical harm, they can be unpleasant and lead to considerable distress among the public. This distress may often generate citizen complaints to local governments and air districts. Any project with the potential to frequently expose the public to objectionable odors would be deemed as one having a significant impact.

According to ARB's (2005) *Air Quality and Land Use Handbook*, land uses associated with odor complaints typically include sewage treatment plants, landfills, recycling facilities, and manufacturing. Odor impacts on residential areas and other sensitive receptors, such as hospitals, daycare centers, and schools, warrant the closest scrutiny, but consideration should also be given to other land uses where people may congregate, such as recreational facilities, work sites, and commercial areas.

Potential odor sources during construction activities include diesel exhaust from heavy-duty equipment and the application of architectural coatings. Construction-related operations near existing receptors would be temporary in nature, and construction activities would not be likely to result in nuisance odors that would violate BAAQMD Regulation 7 (Odorous Substances).

Diesel-fueled locomotives would be the Proposed Project's primary potential odor sources. Because the existing Caltrain service includes substantially more diesel-powered trains than the Proposed Project would have, operation of the Proposed Project would reduce odors. Accordingly, Proposed Project operation is not expected to result in odor impacts that would exceed BAAQMD's odor thresholds (see Table 3.2-4). This impact would be less than significant.

Project Variants 1 and 2 described in Chapter 2, *Project Description*, would not result in any changes to odor impacts of the Proposed Project.