3.7 Greenhouse Gas Emissions and Climate Change

This section addresses the greenhouse gas (GHG) and climate change impacts of the Proposed Project. The study area for GHGs is much broader than for the air quality analysis (see Section 3.2, *Air Quality*) due to the global nature of climate change. While the GHG analysis focuses along the project corridor, the analysis considers potential regional and global GHG effects. Primary GHGs are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and sulfur hexafluoride (SF_6). This section reports the type and quantity of emissions that would be generated by the operation of the Proposed Project.

Potential effects of sea level rise on the Proposed Project are addressed in Section, 3.9, *Hydrology and Water Quality*.

3.7.1 Existing Conditions

3.7.1.1 Regulatory Setting

This section summarizes federal, state, and local regulations related to GHG emissions and climate change that are applicable to the Proposed Project.

Federal

Environmental Protection Agency Endangerment and Cause or Contribute Findings (2009)

On December 7, 2009, the U.S. Environmental Protection Agency (EPA) signed the Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act (CAA). Under the Endangerment Finding, EPA finds that the current and projected concentrations of the six key well-mixed GHGs—CO_2, CH_4, N_2O, SF_6, perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs)—in the atmosphere threaten the public health and welfare of current and future generations. Under the Cause or Contribute Finding, EPA finds that the combined emissions of these well-mixed GHGs from new motor vehicles and new motor vehicle engines contribute to the GHG pollution that threatens public health and welfare.

These findings do not themselves impose any requirements on industry or other entities. However, this action was a prerequisite to finalizing EPA's proposed new corporate average fuel economy standards for light-duty vehicles, which EPA proposed in a joint proposal including the Department of Transportation's proposed corporate average fuel-economy standards.

United States Environmental Protection Agency Regulation of GHG Emissions under the Clean Air Act (ongoing)

Under the authority of the CAA, EPA is beginning to regulate GHG emissions, starting with large stationary sources. In 2010, EPA set GHG thresholds to define when permits under the New Source Review Prevention of Significant Deterioration (PSD) and Title V Operating Permit programs are required for new and existing industrial facilities. In 2012, EPA proposed a carbon pollution standard for new power plants.

State

Executive Order S-3-05 (2005)

Executive Order (EO) S-3-05 asserts that California is vulnerable to the effects of climate change. To combat this concern, EO S-3-05 established the following GHG emissions reduction targets for state agencies.

- By 2010, reduce GHG emissions to 2000 levels.
- By 2020, reduce GHG emissions to 1990 levels.
- By 2050, reduce GHG emissions to 80 percent below 1990 levels.

Executive orders are binding only on state agencies. Accordingly, EO S-03-05 guides state agencies' efforts to control and regulate GHG emissions but has no direct binding effect on local government or private actions. The secretary of the California Environmental Protection Agency (CalEPA) is required to report to the governor and state legislature biannually on the impacts of global warming on California, mitigation and adaptation plans, and progress made toward reducing GHG emissions to meet the targets established in this EO.

Senate Bills 1078/107/X 1-2 — Renewable Portfolio Standard and Renewable Energy Resources Act (2002, 2006, 2011)

Senate Bills (SBs) 1078 and 107, California's Renewables Portfolio Standard (RPS), obligated investor-owned utilities (IOUs), energy service providers (ESPs), and Community Choice Aggregations (CCAs) to procure an additional 1 percent of retail sales per year from eligible renewable sources until 20 percent is reached by 2010. The California Public Utilities Commission (CPUC) and California Energy Commission (CEC) are jointly responsible for implementing the program. SB X 1-2, called the California Renewable Energy Resources Act, obligates all California electricity providers to obtain at least 33 percent of their energy from renewable resources by 2020.

Assembly Bill 32, California Global Warming Solutions Act (2006)

AB 32 codified the state's GHG emissions target by requiring that the state's global warming emissions be reduced to 1990 levels by 2020. Since being adopted, the California Air Resources Board (ARB), CEC, CPUC, and the Building Standards Commission have been developing regulations that will help meet the goals of AB 32. The Scoping Plan for AB 32 identifies specific measures to reduce GHG emissions to 1990 levels by 2020, and requires ARB and other state agencies to develop and enforce regulations and other initiatives for reducing GHGs. Specifically, the Scoping Plan articulates a key role for local governments, recommending they establish GHG reduction goals for both their municipal operations and the community consistent with those of the state.

On December 11, 2008, pursuant to AB 32, ARB adopted the AB 32 Scoping Plan. This plan outlines how emissions reductions from significant sources of GHGs will be achieved via regulations, market mechanisms, and other actions. The Scoping Plan also describes recommended measures that were developed to reduce GHG emissions from key sources and activities while improving public health, promoting a cleaner environment, preserving our natural resources, and ensuring that the impacts of the reductions are equitable and do not disproportionately affect low-income and minority communities.

Executive Order S-01-07, Low Carbon Fuel Standard (2007)

EO S-01-07 mandates (1) that a statewide goal be established to reduce the carbon intensity of California's transportation fuels by at least 10 percent by 2020, and (2) that a low carbon fuel standard for transportation fuels be established in California. The EO initiates a research and regulatory process at ARB.

Senate Bill 375—Sustainable Communities Strategy (2008)

SB 375 provides for a new planning process that coordinates land use planning, regional transportation plans, and funding priorities in order to help California meet the GHG reduction goals established in AB 32. SB 375 requires regional transportation plans, developed by metropolitan planning organizations (MPOs) to incorporate a "sustainable communities strategy" (SCS) in their Regional Transportation Plans (RTPs). The goal of the SCS is to reduce regional vehicle miles traveled (VMT) through land use planning and consequent transportation patterns in combination with the RTP that provide for needed transportation investments, including transit. The Metropolitan Transportation Commission (MTC) and Association of Bay Area Governments (ABAG) adopted the Sustainable Communities Strategy and the 2040 Regional Transportation Plan, titled *Plan Bay Area*, on July 18, 2013. Along with other transit improvements, the Peninsula Corridor Electrification Project is identified as a key element in *Plan Bay Area*.

State CEQA Guidelines (2010)

The State CEQA Guidelines require lead agencies to describe, calculate, or estimate the amount of GHG emissions that would result from a project. Moreover, the State CEQA Guidelines emphasize the necessity to determine potential climate change effects of a project and propose mitigation as necessary. The State CEQA Guidelines confirm the discretion of lead agencies to determine appropriate significance thresholds, but require the preparation of an environmental impact report (EIR) if "there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding compliance with adopted regulations or requirements" (Section 15064.4).

State CEQA Guidelines Section 15126.4 includes considerations for lead agencies related to feasible mitigation measures to reduce GHG emissions, which may include, among others, measures in an existing plan or mitigation program for the reduction of emissions that are required as part of the lead agency's decision; implementation of project features, project design, or other measures that are incorporated into the project to substantially reduce energy consumption or GHG emissions; offsite measures, including offsets that are not otherwise required, to mitigate a project's emissions; and measures that sequester carbon or carbon-equivalent emissions.

Greenhouse Gas Cap-and-Trade Program (2010/2011)

On October 20, 2011, ARB adopted the final cap-and-trade program for California. The California cap-and-trade program will create a market-based system with an overall emissions limit for affected sectors. The program is currently proposed to regulate more than 85 percent of California's emissions and will stagger compliance requirements according to the following schedule: (1) electricity generation and large industrial sources (2012) and (2) fuel combustion and transportation (2015).

Regional

The Bay Area Air Quality Management District CEQA Guidelines (BAAQMD CEQA Guidelines) adopted in 2011 outline advisory thresholds for stationary source and land use development projects. The mass emissions threshold for stationary source projects is 10,000 metric tons (MT) per year of carbon dioxide equivalent (CO_2e). For non-stationary source projects, such as land use development projects, the guidelines establish three potential analysis criteria for determining project significance: compliance with a qualified Climate Action Plan, a mass emissions threshold of 1,100 MT per year of CO_2e, and a GHG efficiency threshold of 4.6 MT CO_2e per service population (project jobs + projected residents).

The BAAQMD CEQA Guidelines do not identify a GHG emission threshold for construction-related emissions. However, BAAQMD recommends that GHG emissions from construction be quantified and disclosed, and that a determination regarding the significance of these GHG emissions be made along with consideration of best management practices (BMPs).

The guidelines do not identify a GHG emissions threshold specific to transportation projects.

The BAAQMD CEQA Guidelines were challenged in court by the Building Industry Association. While a lower court ruling put the adoption of the guidelines on hold with a ruling that BAAQMD had to complete a CEQA analysis to adopt the guidelines, the lower court ruling was overturned by the appellate court. BAAQMD at present has no recommendation to local lead agencies on the use of the 2011 guidelines, but there is no court order constraining their use.

Local

Local Climate Action Plans/Greenhouse Gas Reduction Plans

A number of cities in the project area have adopted or are in the process of developing climate action plans, greenhouse gas reduction plans or equivalent documents aimed at reducing local GHG emissions. Cities with adopted or in development climate action plans or greenhouse gas reduction plans for either municipal operations, community activities, or both include the cities of San Francisco, South San Francisco, Burlingame, Millbrae, San Mateo, Belmont, San Carlos, Redwood City, Atherton, Menlo Park, Palo Alto, Mountain View, Sunnyvale, Santa Clara and San Jose as well as San Mateo County and Santa Clara County (OPR 2012; Sustainable San Mateo 2013). These plans all call for reductions in GHG emissions below current levels and all call for actions to reduce vehicle miles travelled and associated transportation emissions. All include increased transit service as a key strategy in reducing local GHG emissions.

3.7.1.2 Environmental Setting

This section provides a discussion of global climate change and GHG emissions as they relate to the project area.

Climate Change

The phenomenon known as the *greenhouse effect* keeps the atmosphere near Earth's surface warm enough for the successful habitation of humans and other life forms. The greenhouse effect is created by sunlight that passes through the atmosphere. Some of the sunlight striking Earth is absorbed and converted to heat, which warms the surface. The surface emits a portion of this heat as infrared radiation, some of which is re-emitted toward the surface by GHGs. Human activities that

generate GHGs increase the amount of infrared radiation absorbed by the atmosphere, thus enhancing the greenhouse effect and amplifying the warming of Earth (Center for Climate and Energy Solutions n.d.).

Increases in fossil fuel combustion and deforestation have exponentially increased concentrations of GHGs in the atmosphere since the Industrial Revolution. Rising atmospheric concentrations of GHGs in excess of natural levels result in increasing global surface temperatures—a phenomenon commonly referred to as *global warming*. Higher global surface temperatures in turn result in changes to Earth's climate system, including increased ocean temperature and acidity, reduced sea ice, variable precipitation, and increased frequency and intensity of extreme weather events (Solomon et al. 2007). Large-scale changes to Earth's system are collectively referred to as *climate change.*

The Intergovernmental Panel on Climate Change (IPCC) has been established by the World Meteorological Organization and United Nations Environment Programme to assess scientific, technical, and socioeconomic information relevant to the understanding of climate change, its potential impacts, and options for adaptation and mitigation. The IPCC estimates that the average global temperature rise by 0.3° to 4.8° Celsius during the twenty-first century (Intergovernmental Panel on Climate Change 2013). Large increases in global temperatures could have substantial adverse effects on the natural and human environments on the planet and in California.

Greenhouse Gases Emissions and Reporting

The primary GHGs generated by the Proposed Project would be CO_2, CH_4, N_2O, and SF_6. CO_2 is the most important anthropogenic GHG and accounts for more than 75 percent of all GHG emissions caused by humans. The primary sources of anthropogenic CO_2 in the atmosphere include the burning of fossil fuels, gas flaring, cement production, and land use changes. CH_4 and N_2O are not as abundant as CO_2, but are significantly more powerful. Sources of CH_4 include growing rice, raising cattle, using natural gas, landfill outgassing, and mining coal. Source of N_2O include agricultural processes, nylon production, fuel-fired power plants, nitric acid production, and vehicle emissions. SF_6 is one of the most powerful GHGs and is primarily generated through electricity transmission.

To simplify reporting and analysis, methods have been set forth to describe emissions of GHGs in terms of a single gas. The most commonly accepted method to compare GHG emissions is the global warming potential (GWP) methodology defined in the IPCC reference documents (Intergovernmental Panel on Climate Change 1996, 2001, 2007). The IPCC defines the GWP of various GHG emissions on a normalized scale that recasts all GHG emissions in terms of CO_2e, which compares the gas in question to that of the same mass of CO_2 (CO_2 has a global warming potential of 1 by definition).

Table 3.7-1 lists the global warming potential of CO_2, CH_4, N_2O, and SF_6, their lifetimes, and abundances in the atmosphere.

Table 3.7-1. Lifetimes and Global Warming Potentials of Several Greenhouse Gases

Greenhouse Gases	Global Warming Potential (100 years)	Lifetime (years)	Current Atmospheric Abundance
CO_2 (ppm)	1	50–200	391
CH_4 (ppb)	25	9–15	1,871
N_2O (ppb)	298	120	323
SF_6 (ppt)	22,800	3,200	7.4

Source: Solomon et al. 2007.

CH_4 = methane
CO_2 = carbon dioxide
N_2O = nitrous oxide
ppb = parts per billion
ppt = parts per trillion
SF_6 = sulfur hexafluoride

Greenhouse Gas Emissions Inventories

A GHG inventory is a quantification of all GHG emissions and sinks within a selected physical and/or economic boundary. GHG inventories can be performed on a large scale (i.e., for global and national entities) or on a small scale (i.e., for a particular building or person). Although many processes are difficult to evaluate, several agencies have developed tools to quantify emissions from certain sources.

Table 3.7-2 outlines the most recent national, statewide, and regional GHG inventories to help contextualize the magnitude of potential Project-related emissions.

Table 3.7-2. National, State, and Regional GHG Emissions Inventories

Emissions Inventory	CO_2e (metric tons)[a]
2012 EPA National GHG Emissions Inventory	6,526,800,000
2012 ARB State GHG Emissions Inventory	458,680,000
2007 SFBAAB GHG Emissions Inventory	95,800,000

Sources:
U.S. Environmental Protection Agency 2014; California Air Resources Board 2014; Bay Area Air Quality Management District 2010

[a] CO_2e = carbon dioxide equivalent

Potential Effects of Climate Change in California and in the Project Area

Even with the efforts of the municipalities along the San Francisco Peninsula, in the greater San Francisco Bay Area and in California as a whole, a certain amount of climate change is unavoidable due to existing and unavoidable future GHG emissions.

With respect to central western California, including the project corridor, climate change effects will be similar to California-wide impacts, and are expected to include the following conditions (PRBO Conservation Science 2011).

- Hotter and drier climate, with average annual temperatures increasing 1.6–1.9°F by 2070 and mean annual rainfall decreasing by 61–188 millimeters.

- More frequent and intense wildfires, with the area burned projected to increase by an estimated 10–50 percent by 2070–2090.
- Decreases in chaparral/coastal scrub (19–43 percent by 2070) and blue oak woodland/foothill pine (44–55 percent by 2070); increases in grassland (85–140 percent by 2070).
- Increased salinity in San Francisco Bay, with salinity increasing by 1–3 practical salinity units during dry years.
- Increase in estuarine flows into the San Francisco Bay estuary, with winter gains approximately balancing spring-summer losses.
- Increased heat and decreased air quality, with the result that public health will be placed at risk, and native plant and animal species may be lost.

In addition, as described in Section 3.9, *Hydrology and Water Quality*, sea level rise is expected to range from up to 24 inches by 2050 and 66 inches by 2100 (compared with 2000 conditions). As described in Section 3.9, parts of the Caltrain corridor are subject to coastal flooding at present and with expected sea level rise in the future. This impact is assessed in Section 3.9.

3.7.2 Impact Analysis

3.7.2.1 Methods for Analysis

GHG emissions associated with construction and operation of the Proposed Project were 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

Proposed Project construction would generate short-term emissions of CO_2, CH_4, and N_2O. Emissions would originate from mobile and stationary construction equipment exhaust, as well as employee haul truck vehicle exhaust. Mass emissions generated by these sources were estimated using CalEEMod, (version 2013.2.2), the ARB's EMFAC2011 model, and the methods summarized in the *Regulatory Setting* section of Section 3.2, *Air Quality*.

Operation

Proposed Project operation would generate long-term emissions of CO_2, CH_4, N_2O, and SF_6. Primary sources of emissions include vehicle exhaust (locomotive and onroad) and electricity usage. In addition, the Proposed Project would reduce passenger vehicle miles traveled and associated emissions due to forecasted increased ridership. As disused in Section 3.2, *Air Quality*, the difference in operational emissions between the existing Caltrain service and the Proposed Project represents the change with the Proposed Project over existing conditions. The change with the Proposed Project in 2020 and 2040 compared with No Project scenarios represents the Proposed Project's impact analyzed in this document. Because the Proposed Project would not affect operational emissions from existing transit stations or maintenance activities, these sources are not discussed further.

Emissions generated under existing (2013), No Project scenarios (2020 and 2040) and the Proposed Project (2020 and 2040) from locomotive diesel consumption were calculated using fuel

consumption data provided by Caltrain operations (Cocke pers. comm.) and emission factors from the Climate Registry (2013). Emissions generated by changes in onroad fuel consumption were estimated using regional VMT provided by the Santa Clara Valley Transportation Authority travel forecasting model (Naylor pers. comm.) and the ARB's EMFAC2011 model. Emissions associated with electricity generation and transmission were calculated based on expected energy demand and utility emission factors published by Pacific Gas and Electric Company (2013) and CalEEMod. Please refer to Appendix B for additional information on modeling assumptions and calculation methods.

3.7.2.2 Thresholds of Significance

Greenhouse Gas Emissions

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

- Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment.
- Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs.

There are currently no adopted quantitative GHG thresholds relevant to the Proposed Project.

The BAAQMD CEQA Guidelines do not identify a GHG emission threshold for construction-related emissions. Instead BAAQMD recommends that GHG emissions from construction be quantified and disclosed, and that a determination regarding the significance of these GHG emissions be made with respect to whether a project is consistent with the AB 32 GHG emission reduction goals. The BAAQMD further recommends incorporation of BMPs to reduce GHG emissions during construction, as feasible and applicable. BMPs may include use of alternative-fueled (e.g., biodiesel, electric) construction vehicles and equipment for at least 15 percent of the fleet, use of at least 10 percent of local building materials, and recycling or reusing at least 50 percent of construction waste or demolition materials.

BAAQMD has adopted 1,100 MT and 10,000 MT as significance thresholds to evaluate operational emissions from non-stationary and stationary source projects, respectively. The Proposed Project is a transportation project that does not fit into the land use development or stationary source project categories. Despite the lack of a truly relevant threshold, for purposes of this analysis only, direct and indirect GHG emissions from the Proposed Project are discussed with respect to both BAAQMD 1,100 and 10,000 MT thresholds.

Note that GHGs and climate change are exclusively cumulative impacts and there are no non-cumulative emission impacts from a climate change perspective. Therefore, in accordance with scientific consensus regarding the cumulative nature of GHGs[1], the analysis herein analyzes the cumulative contribution of project-related GHG emissions.

[1] Climate change is a global problem, and GHGs are global pollutants, unlike criteria air pollutants (such as ozone precursors), which are primarily pollutants of regional and local concern. Given their long atmospheric lifetimes (see Table 3.7.1), GHGs emitted by countless sources worldwide accumulate in the atmosphere. No single emitter of GHGs is large enough to trigger global climate change on its own. Rather, climate change is the result of the individual contributions of countless past, present, and future sources. Therefore, GHG impacts are inherently cumulative.

Impacts of Climate Change on the Proposed Project

The California Second District Court of Appeals has held that while an EIR must analyze the environmental effects that may result from a project, an EIR is not required to examine the effects of the environment, such as sea level rise (SLR), on a project (see *Ballona Wetlands Land Trust v. City of Los Angeles* (2011), 201 Cal. App. 4th 455). In its decision, the Court called into question the validity of portions of the State CEQA Guidelines that require consideration of impacts of the environment on a project. The *Ballona* decision potentially eliminates the need for lead agencies in the second appellate district to consider the impacts of climate change on proposed projects. The *Ballona* decision did not, however, call into question the State CEQA Guidelines amendments enacted in 2010 that establish how GHG emissions are to be analyzed and mitigated under CEQA.

Unless binding legislation that overturns the *Ballona* decision is adopted,[2] this decision is expected to be argued as precedent in CEQA cases throughout the state for the premise that CEQA does not need to examine the impacts of the environment on a project. Nonetheless, courts outside of the second appellate district will have the discretion to differ in their interpretation of the State CEQA Guidelines and may find that an analysis of the effects of climate change on proposed projects is required. Accordingly, a qualitative discussion of the issue has been provided below (except for impacts related to sea level rise, which are discussed separately in Section 3.9, *Hydrology and Water Quality*) using the following criteria: Would the project place people or structures at substantial risk of harm due to predicted climate change effects?

3.7.2.3 Impacts and Mitigation Measures

Changes resulting from Project Variants 1 and 2 are described below each impact analysis.

Impact GHG-1	Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment
Level of Impact	Less than significant (beneficial)

Construction of the Proposed Project would generate direct emissions of CO_2, CH_4, and N_2O from mobile and stationary construction equipment exhaust, as well as employee haul truck vehicle exhaust. Estimated construction emissions associated with the Proposed Project are summarized in Table 3.7-~~2~~3. Annual and total emissions are presented for each construction phase. GHG emissions for loss of carbon stock tree removal are shown as well as indirect GHG emissions from concrete manufacture and transport. Data for these calculations may be found in Appendix B, *Air Quality and Greenhouse Gas Analysis Technical Data*.

As shown in Table 3.7-3~~2~~, Proposed Project construction would generate a total of 5,216 MT of CO_2e during the construction period excluding indirect emissions associated with concrete manufacture and transport. Including indirect emissions associated with concrete manufacture and transport, construction would result in a total of 8,700 to 11,000 MT CO2e. This is equivalent to adding 1,800 to 2,400 to ~~1,050~~ typical passenger vehicles for 1 year (U.S. Environmental Protection Agency 2011). The construction emissions would primarily be the result of carbon stock loss due to tree removal the indirect emissions associated with concrete manufacture and transport, and the operation of diesel powered construction equipment and heavy-duty haul trucks. Because construction emissions would cease once construction is complete, they are considered short-term.

[2] On March 21, 2012, the California Supreme Court denied case review and depublication requests submitted by several environmental organizations.

Table 3.7-3. Estimated Operational Emissions (metric tons CO_2e per year)

Condition	CO_2e
Existing (2013)	
Caltrain Diesel Consumption	45,899
Caltrain Electricity Consumption	785
Total Caltrain System Emissions[a]	46,684
No Project (2020)	
Caltrain Diesel Consumption	45,899
Caltrain Electricity Consumption	531
Total Caltrain System Emissions[a]	46,430
Project (2020)	
Caltrain Diesel Consumption	11,586
Caltrain Electricity Consumption	11,192
Total Caltrain System Emissions[a]	22,778
Change in VMT from Increased Ridership	*-44,317*
Emissions Due to Loss in Carbon Sequestration Resulting From Tree Removal[b]	260
Total Project Emissions[c]	-21,279
Cumulative No Build (2040)	
Caltrain Diesel Consumption	45,899
Caltrain Electricity Consumption	531
Total Caltrain System Emissions[a]	46,430
Cumulative Project (2040)[d]	
Caltrain Diesel Consumption	1,511
Caltrain Electricity Consumption	14,117
Total Caltrain System Emissions[a]	15,628
Change in VMT from Increased Ridership	-146,241
Emissions Due to Loss in Carbon Sequestration Resulting From Tree Removal[b]	*260*
Total Project Emissions[b]	-130,353
2020 Caltrain System vs. Existing (2013)[e]	-23,906
2040 Caltrain System with Full Electrification vs. Existing (2013)[d,e]	-31,056
2020 Project vs. 2020 No Project[f]	-67,709
2040 Project with Full Electrification vs. 2020 No Project[d,f]	-176,783
Thresholds	1,100/10,000

[a] Includes diesel and electricity emissions; VMT-related reductions due to increased ridership are not included.

[b] Does not include increase in carbon sequestration resulting from tree replanting. Assuming a 1:1 minimum tree replanting ratio (see Section 3.3, *Biological Resources*, for proposed mitigation), the increase in carbon sequestration would result in lowering project emissions by 3 metric tons in 2020 (assumed 1 year after planting) and 216 metric tons in 2040 (21 years after planting).

[c] Includes the net change in VMT from No Project to Project Conditions associated with increased ridership.

[d] 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.

[e] Comparison of Caltrain system emissions only. Changes in VMT emissions and in carbon sequestration not included.

[f] Includes changes in Caltrain system emissions, VMT emissions, and carbon sequestration.

CO_2e = carbon dioxide equivalent
VMT = vehicle miles traveled

Table 3.7-~~32~~. Construction GHG Emissions (metric tons CO_2e)

Construction Phase	2015	2016	2017	2018	2019[1]	Phase Total
Utilities	105	42	0	0	0	146
Traction Power Substation Installation	0	157	211	153	67	589
Overhead Contact System	0	105	601	434	38	1178
Signal and At-Grade Crossings	0	19	31	56	34	140
Communications	0	0	0	83	33	115
Integration / Commissioning	0	0	0	0	13	13
Construction Subtotal	**105**	**323**	**844**	**726**	**184**	**2,181**
Loss of Carbon Stock Due to Tree Removal (one-time loss)						*3,035*
Indirect CO_2 emissions from Concrete Manufacture and Transport[3]						*3,406 to 6,084*[2]
Construction Total	**105**	**323**	**844**	**726**	**184**	**~~5,216~~ 8,702 to 11,300**

Notes:
[1] The analysis assumes construction completion by 2019 which is faster than current expected in that construction will likely be completed in 2020 or 2021. However, GHG emissions are estimated based on total activity and thus would not change with a more elongated schedule.
[2] Range for concrete is for different strengths of concrete (compressible strengths of 3,000 to 5,000 PSI).
[3] It is not standard professional practice for CEQA greenhouse gas inventories to include indirect emissions due to building materials. The CAPCOA white paper on CEQA and Climate Change (http://www.capcoa.org/wp-content/uploads/2012/03/CAPCOA-White-Paper.pdf) notes that "In many cases, only direct and indirect emissions may be addressed, rather than life-cycle emissions. A project applicant has traditionally been expected to only address emissions that are closely related and within the capacity of the project to control and/or influence." The BAAQMD CEQA guidelines (http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CEQA/BAAQMD%20CEQA%20Guidelines_Final_May%202012.ashx?la=en) do not require inclusion of such life-cycle emissions in project GHG emissions estimates. Thus, the inclusion of such indirect emissions is for informational purposes only.

With Project Variant 1, the Caltrain corridor would only be electrified to just south of the 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. Thus these two variants would result in less construction emissions than the Proposed Project.

Proposed Project operation has the potential to generate long-term GHG emissions from transit operations and changes in regional traffic patterns. Transit operations would generate GHG through diesel fuel and electricity consumption required to power the diesel and electric locomotives, respectively. 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 by the existing Caltrain service, including fuel consumption by the locomotives and electrical emissions for idling of trains (at which point they are plugged into the grid), represent existing conditions, against which the Proposed Project is evaluated.

Estimated operational emissions in 2020 (opening year) and 2040 (design) under both the No Project and Proposed Project scenarios are summarized in Table 3.7-~~43~~. Existing (2013) operational emissions currently generated by Caltrain are also presented for reference. The difference in operational emissions between the Proposed Project and the existing Caltrain service represents the change of emissions over existing conditions with the Proposed Project. The comparison between the No Project scenarios and Proposed Project scenarios represents the Proposed Project's impact.

Table 3.7-4. Estimated Operational GHG Emissions (metric tons CO_2e per year)

2020 GHG Emissions	Existing	No Project	Proposed Project
Caltrain Diesel Consumption	45,899	57,720	11,067
Caltrain Electricity Consumption	*839*	*567*	*11,958*
Total Caltrain System Emissions[a]	46,738	58,287	23,025
Change in VMT[b]	*NA*	*NA*	*-44,317*
Tree Sequestration GHG Loss[c]	NA	NA	260
Total 2020 Emissions	46,738	58,287	-21,032
PCEP 2020 vs. 2020 No Project			*-79,319*
2040 GHG Emissions	**Existing**	**No Project**	**Proposed Project**
Caltrain Diesel Consumption	45,899	59,011	1,511
Caltrain Electricity Consumption	839	567	15,100
Total Caltrain System Emissions[a]	46,738	59,579	16,611
Change in VMT[b]	*NA*	*NA*	*-146,241*
Tree Sequestration GHG Loss[c]	NA	NA	260
Total 2040 Emissions	**46,738**	**58,287**	**-129,370**
PCEP 2040 vs. 2020 No Project			*-188,949*

[a] Includes diesel and electricity emissions but not VMT-related reductions due to increased ridership.

[b] Change in VMT emissions relative to No Project conditions.

[c] Includes annual change in carbon sequestration due to tree loss but does not include increase in carbon sequestration with tree replanting required as mitigation. Assuming a minimum 1:1 tree replacement ratio (actual ratios described in Section 3.3, Biological Resources), carbon sequestration would also increase due to replanting by 3 metric tons of CO_2 in 2020 (1 year after assumed replanting) and by 216 metric tons of CO_2 in 2040 (21 years after replanting) and thus, in time, the mitigation replanting would offset the loss in annual sequestration due to tree removal. As discussed above, there would also be a one-time carbon stock loss due to tree removal during construction, but these one-time emissions would be offset by the Proposed Project within the first year of operation.

As shown in Table 3.7-~~3~~4, implementation of the Proposed Project would substantially reduce operational Caltrain system GHG emissions relative to the existing Caltrain service by 24,000 $MTCO_2e$ (in 2020) to 30,000 ~~31,000~~ $MTCO_2e$ (2040), excluding VMT emissions reductions associated with increased service. Relative to the No Project scenario, the Proposed Project would reduce emissions by 79,000 ~~68,000~~ $MTCO_2e$ (2020) to 189,000 ~~177,000~~ $MTCO_2e$, including reductions of VMT-related emissions from increased service. GHG benefits achieved through operation of the Proposed Project would offset the short-term construction emissions in ~~far~~ less than one year. Emissions savings achieved thereafter would contribute to reductions in GHG emissions. This would be an environmental benefit. Accordingly, this impact would be less than significant.

With Project Variant 1, the Caltrain corridor would only be electrified to just south of the Tamien Station but there would be no changes to normal train operations, so 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 and there would be slightly higher operational GHG emissions because a diesel train would be required to push or pull EMUs onto the storage tracks for maintenance or repair and to return the EMUs back to the electrified tracks. However, under No Project conditions, such moves would be done with diesel locomotives or diesel yard haulers and thus Variant 2 would not represent an increase over No Project conditions.

Impact GHG-2	Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs
Level of Impact	Less than significant

California adopted AB 32 in 2006, which codified the state's GHG emissions reduction targets for the future. In addition, several jurisdictions in the study area have adopted or are currently preparing climate action plans to reduce community GHG emissions. Consistency with these documents is evaluated in this impact.

The ARB adopted the AB 32 Scoping Plan as a framework for achieving AB 32. The Scoping Plan outlines a series of technologically feasible and cost-effective measures to reduce statewide GHG emissions. Some reductions will need to come in the form of changes pertaining to vehicle emissions and mileage standards. Some will come from changes pertaining to sources of electricity and increased energy efficiency at existing facilities. The remainder will need to come from state and local plans, policies, or regulations that will lower carbon emissions, relative to business as usual conditions. The local climate and energy action plans in the study area (see Section 3.7.1.1, *Regulatory Setting*), which identify strategies to reduce GHG emissions are examples of such plans.

Implementation of the Proposed Project would electrify the Caltrain system and help accommodate increased ridership through improved system operations. The AB 32 Scoping Plan and local climate action plans include strategies to reduce single occupancy vehicle usage and to increase alternative transportation. These benefits of the Proposed Project would also support implementation of the MTC's SCS, which was adopted pursuant to SB 375. Accordingly, implementation of the Proposed Project would facilitate attainment of regional and statewide GHG polices and reduction targets. Therefore, 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 this impact analysis.

Impact GHG-3	Place people or structures at substantial risk of harm due to predicted climate change effects (other than sea level rise)
Level of Impact	Less than significant

The Proposed Project is the electrification of an existing rail system with no new rail extensions or new stations. The Proposed Project would include new electrical infrastructure in the form of traction power facilities and overhead contact system improvements. The Proposed Project would also facilitate a service increase that would support increased ridership.

Unavoidable climate change may result in a range of potential impacts on the Caltrain corridor and adjacent areas, such as increased temperatures, increased heat events, worsened air quality, increased storm intensity, increased wildland fire frequency or intensity, changes in disease and pest vectors, and changes in water supply. Apart from sea level rise, and increased storm intensity and wildland fire, the Proposed Project has no potential to subject additional people or structures to harm from these potential effects of climate change. The Proposed Project would increase Caltrain ridership, but those riders would be present in the Bay Area with or without the Proposed Project and, thus, would be subject to general climate change effects regardless of the Proposed Project.

There are only three potential climate change effects for which the Proposed Project could potentially place people or structures at risk due to those effects: sea level rise, potential increased storm intensity and increased wildland fire. Sea level rise is addressed separately in Section 3.9,

Hydrology and Water Quality. While inland flooding might change with potential increase in storm intensity, there is insufficient data at this time to reasonably predict what future inland flooding risks may occur due to changes in storm intensity resultant from climate change. As to wildland fires, as discussed in Section 3.8, *Hazards and Hazardous Materials*, the Proposed Project is not located within a wildland area and, therefore, not considered to be a high fire risk.

Thus, separate from sea level rise, the Proposed Project would not result in significant increased risk to people or structures from climate change. The impact would be less than significant.

Project Variants 1 and 2 described in Chapter 2, *Project Description*, would not result in any changes to this impact analysis because they would not introduce any new facilities susceptible to sea level rise inundation or that would be more at risk to other potential effects of climate change.