Regional Connector Transit Corridor
Draft Environmental Impact Statement/
Draft Environmental Impact Report

APPENDIX R

CLIMATE CHANGE

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Regional Connector Transit Corridor
Climate Change
Technical Memorandum

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Prepared for

Los Angeles County Metropolitan Transportation Authority

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ACRONYMS

AB	Assembly Bill
BART	San Francisco Bay Area Rapid Transit
BAU	Business-as-usual
BRT	Bus Rapid Transit
CAHSR	California High Speed Rail
CALEPA	California Climate Action Team
CARB	California Air Resources Board
CBC	California Building Code
CCA	Clean Air Act
CCAR	California Climate Action Registry
CEC	California Education Code
CEQA	California Environmental Quality Act
CH_4	Methane
CNG	Compressed Natural Gas
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalents
eGRID	USEPA Emissions & Generation Resource Integrated Database
EIR	Environmental Impact Report
EMFAC	Emission Factor Model for Onroad Motor Vehicles
GCC	Global Climate Change
GHG	Greenhouse Gases

GWP	Global warming potential
HFC	Hydrofluorocarbons
IPCC	United Nations Intergovernmental Panel on Climate Change
kWH/mi	Kilowatt Hours per Mile
LADWP	Los Angeles Department of Water and Power
LRT	Light Rail Transit
Metro	Los Angeles County Metropolitan Transportation Authority (LACMTA)
$MMTCO_2e$	Million Metric Tons of Carbon Dioxide Equivalent
MPO	Metropolitan Planning Organization
Muni	San Francisco Municipal Railway
NEPA	National Environmental Policy Act
N_2O	Nitrous oxide
NTD	National Transit Database
OAL	Office of Administrative Law
OFFROAD	Emission Factor Model for Offroad Mobile Equipment
PFC	Perfluorocarbons
RPS	Renewable Portfolio Standard
RTAC	Regional Targets Advisory Committee
RTP	Regional Transportation Plan
SAR	Second Assessment Report
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District

SCoAB	South Coast Air Basin
SCS	Sustainable Community Strategies
SEM	Sequential Excavation Method
SF_6	Sulfur hexafluoride
TSM	Transportation Management System
USEPA	United States Environmental Protection Agency
VMT	Vehicle Miles Traveled

1.0 SUMMARY

This technical memorandum discusses the results of a climate change analysis of the proposed Regional Connector Transit Corridor project completed in compliance with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). Potential climate change-related impacts associated with greenhouse gas (GHG) emissions from the proposed construction and operation of the Regional Connector Transit Corridor project are summarized in this section. The analysis considers emissions inventories for electricity used for light rail operations, regional traffic, bus operations, construction, and calculations of potential contributions by build alternatives to GHG reduction.

This analysis considers three common GHG pollutants typically included in mandatory and voluntary reporting programs: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Non-CO_2 pollutants are modified by global warming potential (GWP) factors that reflect the degree to which these pollutants affect climate change compared to CO_2. The addition of each GHG with its GWP is known as CO_2 equivalent (CO_2e).

This memo discusses potential impacts from both construction activities and operations. For operations-related impacts, the analysis provides a comparison between the climate change conditions that currently exist without the proposed project (i.e., existing conditions in 2009)and climate change conditions projected to occur in the future with implementation of each alternative being considered for the proposed project (i.e., full implementation of each alternative in the future horizon year of 2035). The focus of the operations impact analysis is on the change in vehicle traffic and light rail transit vehicles, and associated air pollutant emissions, that would result from implementation of each alternative. While this type of direct comparison can help characterize how existing climate change conditions may be different in the future with implementation of the proposed project, it is not a true representation of the impacts directly attributable to the project. This is because background traffic conditions will change substantially between 2009 and 2035 due to regional population growth and development that is anticipated to occur irrespective of the Regional Connector Transit Corridor project. A more accurate and meaningful delineation of climate change impacts directly attributable to project-related changes in traffic is achieved through a comparison of a proposed future alternative (2035) and the No Build Alternative (2035).

1.1 Operational Emissions

A summary of operational emissions from regional traffic, compressed natural gas (CNG) buses, and electricity used to power trains and new stations for each alternative is presented in Table 1-1. A summary of incremental emissions as compared to existing conditions (2009) is provided in Table 1-2 for informational purposes only, and a summary of incremental emissions as compared to the No Build Alternative (2035) is provided in Table 1-

3. GHG emissions for each future scenario, including the No Build Alternative, are greater than emissions in 2009 because of a forecasted increase in automobile vehicle miles traveled (VMT) between future conditions and the baseline.

A future increase in emissions beyond those for existing conditions stems from predicted growth in regional traffic as a result of a forecasted increase in population in the region and other factors unrelated to the proposed project. According to the Southern California Association of Government's (SCAG's) Regional Transportation Plan (2008), the SCAG region is the second most populated metropolitan area in the United States.

Half of the population in California lives in the SCAG region, and 1 in 17 people in the United States resides in the area. SCAG predicts that 5.9 million people would be added to the SCAG region's population between 2005 and 2035, bringing the State's population to 24 million people in 2035. As shown in Table 1-3, the project is expected to reduce emissions when compared to the No Build Alternative and would have a beneficial impact on GHG emissions. If not for the project, emissions in the horizon year (2035) would likely be greater than what is currently shown in Table 1-2.

This type of quantitative analysis does not fully show the expected benefits from improved public transit in the region. As shown by the reduction in VMT between the build alternatives and No Build Alternative, increasing public transportation options in an urban area is expected to reduce automobile usage and associated emissions in a four-county region (Los Angeles, Orange, Riverside, and San Bernardino). Studies, including a twenty-year study evaluating land-use development in the vicinity of the San Francisco Bay Area Rapid Transit (BART) system, indicate that growth in commercial, industrial, mixed use, and residential areas may occur near certain transit corridors (Cervero and Landis 1997).

International experience has shown that a high-quality, urban, regional transportation system can promote environmentally sustainable, livable communities, especially when part of wider regional policies such as those that discourage car traffic through a city or promote road pricing (Priemus and Konings 2001). The Regional Connector Transit Corridor project would support development projects stressing density and pedestrian activity along the proposed alignment.

The proposed Regional Connector Transit Corridor project is a key link in the regional light rail network. The proposed project would provide a direct connection from the underground 7th Street/Metro Center Station to the Metro Gold Line, thereby avoiding multiple transfers under the current rail and bus network. Additionally, the proposed project would ultimately improve connections with the Metro Gold Line to the San Gabriel Valley and the Metro Expo Line to Santa Monica as well as additional projects proposed for the region.

The proposed project would increase ridership by improving the light-rail connections across the region. As shown in Figure 1-1, each of the build alternatives is expected to increase the number of transit trips (i.e., bus, urban rail, and commuter rail) as compared to the No Build TSM Alternative. Consequently, automobile-related trips would decrease. This relationship highlights the importance of the Regional Connector Transit Corridor project in reducing regional VMT and encouraging area residents to use transit options other than the automobile. The proposed project is consistent with the overall goals stated in Metro's Baseline Sustainability Report (2009).

The addition of light rail stations can provide benefits to local housing and mixed land uses, providing residents an alternative to automobile transportation. The proposed Regional Connector Transit Corridor project is consistent with the City of Los Angeles' *Green LA Plan* (City of Los Angeles 2007). The Plan seeks to extend the regional rail network to increase regional mobility and as a method to reduce impacts associated with climate change.

Table 1-1. Summary of Operational GHG Emissions for Each Alternative

Alternative	Annual Operational GHG Emissions (metric tons CO_2e per year)			
	CO_2	CH_4	N_2O	Total[4]
Existing Conditions (2009)[1, 2]	40,552,000	65,100	5,952,000	46,569,100
No Build Alternative (2035)[1, 2]	106,521,100	58,800	9,858,000	116,437,900
TSM Alternative (2035)[3]				
Regional Traffic	106,463,200	58,800	9,858,000	116,380,000
CNG Buses	3,100	500	50	3,650
Total	106,466,300	59,300	9,858,050	116,383,650
At-Grade Emphasis LRT Alternative (2035)[2]				
Light Rail Operation	1,100	1	2	1,100
New Station Operation	100	<1	<1	100
Regional Traffic	106,457,400	58,800	9,858,000	116,374,200
Total	106,458,600	58,800	9,858,000	116,375,400

Table 1-1. Summary of Operational GHG Emissions for Each Alternative

Alternative	Annual Operational GHG Emissions (metric tons CO_2e per year)			
	CO_2	CH_4	N_2O	Total[4]
Underground Emphasis LRT Alternative (2035)[2]				
Light Rail Operation	1,100	1	2	1,100
New Station Operation	100	<1	<1	100
Regional Traffic	106,455,200	58,800	9,858,000	116,372,000
Total	106,456,400	58,800	9,858,000	116,373,200
Fully Underground LRT Alternative – Little Tokyo Variation 1 (2035)[2]				
Light Rail Operation	1,000	1	2	1,000
New Station Operation	200	<1	<1	200
Regional Traffic	106,453,200	58,800	9,858,000	116,370,000
Total	106,454,400	58,800	9,858,000	116,371,200
Fully Underground LRT Alternative – Little Tokyo Variation 2 (2035)[2]				
Light Rail Operation	1,000	1	2	1,000
New Station Operation	200	<1	<1	200
Regional Traffic	106,453,000	58,800	9,858,000	116,369,800
Total	106,454,200	58,800	9,858,000	116,371,000

Notes:
[1] *Operational emissions only include those associated with regional traffic.*
[2] *Emissions associated with buses not included because the alternatives would not cause a change in bus operation or routes.*
[3] *The TSM Alternative would add bus rapid transit (BRT) lanes and additional bus routes but would not include improvements to the light rail network.*
[4] *Totals may vary slightly due to rounding*

Table 1-2. Summary of Incremental Emissions for Each Alternative as Compared to Existing Conditions (2009)

Alternative	Annual Operational GHG Emissions (metric tons CO_2e per year)			
	CO_2	CH_4	N_2O	Total
No Build Alternative	65,969,100	(6,300)	3,906,000	69,868,800
TSM Alternative	65,914,300	(5,800)	3,906,050	69,814,550
At-Grade Emphasis LRT Alternative	65,906,600	(6,300)	3,906,000	69,806,300
Underground Emphasis LRT Alternative	65,904,400	(6,300)	3,906,000	69,804,100
Fully Underground LRT Alternative – Little Tokyo Variation 1	65,902,400	(6,300)	3,906,000	69,802,100
Fully Underground LRT Alternative – Little Tokyo Variation 2	65,902,200	(6,300)	3,906,000	69,801,900

Note: Operational emissions include regional traffic (Los Angeles, Orange, Riverside, and San Bernardino Counties), CNG buses (TSM Alternative only), and light rail plus new stations (excluding No Build and TSM Alternatives). Totals may vary slightly due to rounding.

Table 1-3. Summary of Incremental Emissions for Each Alternative As Compared to No Build Alternative (2035)

Alternative	Annual Operational GHG Emissions (metric tons CO_2e per year)			
	CO_2	CH_4	N_2O	Total
TSM Alternative	(54,800)	500	50	(54,250)
At-Grade Emphasis LRT Alternative	(62,500)	1	2	(62,500)
Underground Emphasis LRT Alternative	(64,700)	1	2	(65,700)
Fully Underground LRT Alternative – Little Tokyo Variation 1	(66,700)	1	2	(66,700)

Table 1-3. Summary of Incremental Emissions for Each Alternative As Compared to No Build Alternative (2035)

Alternative	Annual Operational GHG Emissions (metric tons CO_2e per year)			
	CO_2	CH_4	N_2O	Total
Fully Underground LRT Alternative – Little Tokyo Variation 2	(66,900)	1	2	(66,900)

Note: Operational emissions include regional traffic (Los Angeles, Orange, Riverside, and San Bernardino Counties), CNG buses (TSM Alternative only), and light rail plus new stations (excluding No Build and TSM Alternatives). Totals may vary slightly due to rounding.

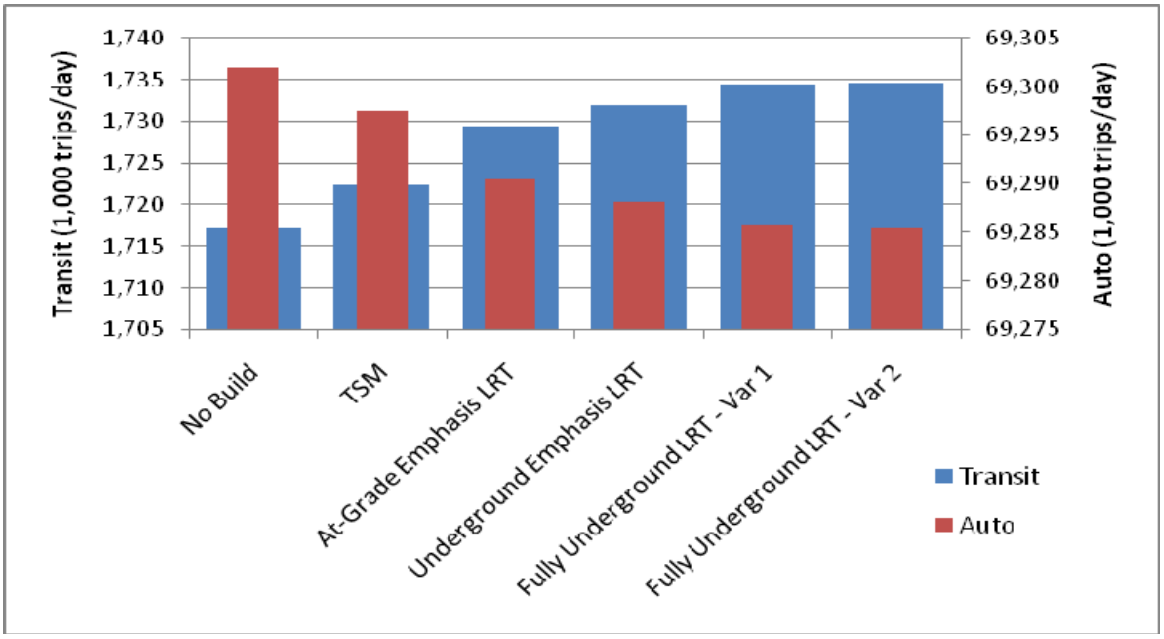

Figure 1-1. Travel Forecasting by Mode Choice (System-Wide Linked Trips)

Key:
TSM = Transportation System Management
LRT = Light rail transit

A 2008 study by Mikhail Chester and Arpad Horvath reviewed the life-cycle impacts of various transit modes including automobiles, buses, rail, and air. The study estimated GHG emissions from the life-cycle of a transit mode, including operations, maintenance, infrastructure, and other emission sources. Figure 1-2 shows the relative GHG emissions by each transit mode.

Light rail transportation, such as the San Francisco Municipal Railway (Muni) and the Massachusetts Bay Transportation Authority Green Line, as shown in Figure 1-2, produces substantially lower emissions than those associated with automobile travel. Based on this study, it would be expected that increases in light rail networks in the Los Angeles region would substantially offset GHG emissions associated with automobile travel.

1.2 Construction Emissions

Construction activities required for all build alternatives, (defined as all alternatives except the No Build Alternative and the TSM Alternative), would result in GHG emissions from diesel-fueled construction equipment, construction worker commuting, and haul trucks. Table 1-4 provides a summary of GHG emissions from these emission sources.

Table 1-4. Summary of Annual Construction GHG Emissions

Alternative	Annual CO_2e Emissions (metric tons per year)					
	2014	2015	2016	2017	Total[1]	Amortized[2]
At-Grade Emphasis LRT Alternative	2,700	23,300	36,500	13,900	76,400	2,500
Underground Emphasis LRT Alternative						
2nd/Hope Street station + 2nd Street station - Broadway Option (SEM)	1,900	17,500	47,300	32,400	99,100	3,300
2nd/Hope Street station + 2nd Street station -Broadway Option (Cut & Cover)	1,900	17,700	48,100	32,900	100,600	3,400
2nd/Hope Street station + 2nd Street station - Los Angeles Street Option (SEM)	1,900	17,500	47,200	32,300	98,900	3,300
2nd/Hope Street Station + 2nd Street station -Los Angeles Street Option (Cut & Cover)	1,900	17,700	48,000	32,800	100,400	3,300
Fully Underground LRT Alternative – Little Tokyo Variation 1						
2nd/Hope Street station (SEM)	1,800	18,400	54,600	40,700	115,400	3,800

Table 1-4. Summary of Annual Construction GHG Emissions						
Alternative	Annual CO_2e Emissions (metric tons per year)					
	2014	2015	2016	2017	Total[1]	Amortized[2]
2nd/Hope Street station (Cut & Cover)	1,800	18,900	56,000	41,600	118,300	3,900
Fully Underground LRT Alternative – Little Tokyo Variation 2						
2nd/Hope Street station (SEM)	1,800	17,600	54,600	40,700	114,800	3,800
2nd/Hope Street station (Cut & Cover)	1,800	18,000	56,100	41,700	117,600	3,900

Notes:
[1] *Annual emissions from each year of construction (2014-2017) are added to estimate the total project emissions. Totals may vary slightly due to rounding.*
[2] *Total project emissions are divided by 30 (30-year average) in estimating amortized emissions.*

Since construction emissions are temporary, total project construction emissions are amortized over thirty years (defined as a 30-year average), following South Coast Air Quality Management District (SCAQMD) recommendations (SCAQMD 2008). To estimate total project impact, these amortized construction-related emissions are added to the incremental project-related operational emissions for each build alternative. The adjusted total project impact is provided in Table 1-5 as compared to estimated 2009 emissions for informational purposes only and in Table 1-6 as compared to the estimated 2035 No Build condition.

Several build alternatives could be constructed by multiple methods. For example, the proposed 2nd/Hope Street station could be constructed by either the Sequential Excavation Method (SEM) or Cut & Cover method. Certain build alternatives also include a choice of possible station locations. For example, the Underground Emphasis LRT Alterative offers the option for a station at 2nd Street and either Broadway or Los Angeles Street.

As such, multiple construction options are shown in the tables below. The No Build Alternative and the TSM Alternative do not require construction to move forward and are not included in the summary table. Operational impacts for these two alternatives are provided in Table 1-1.

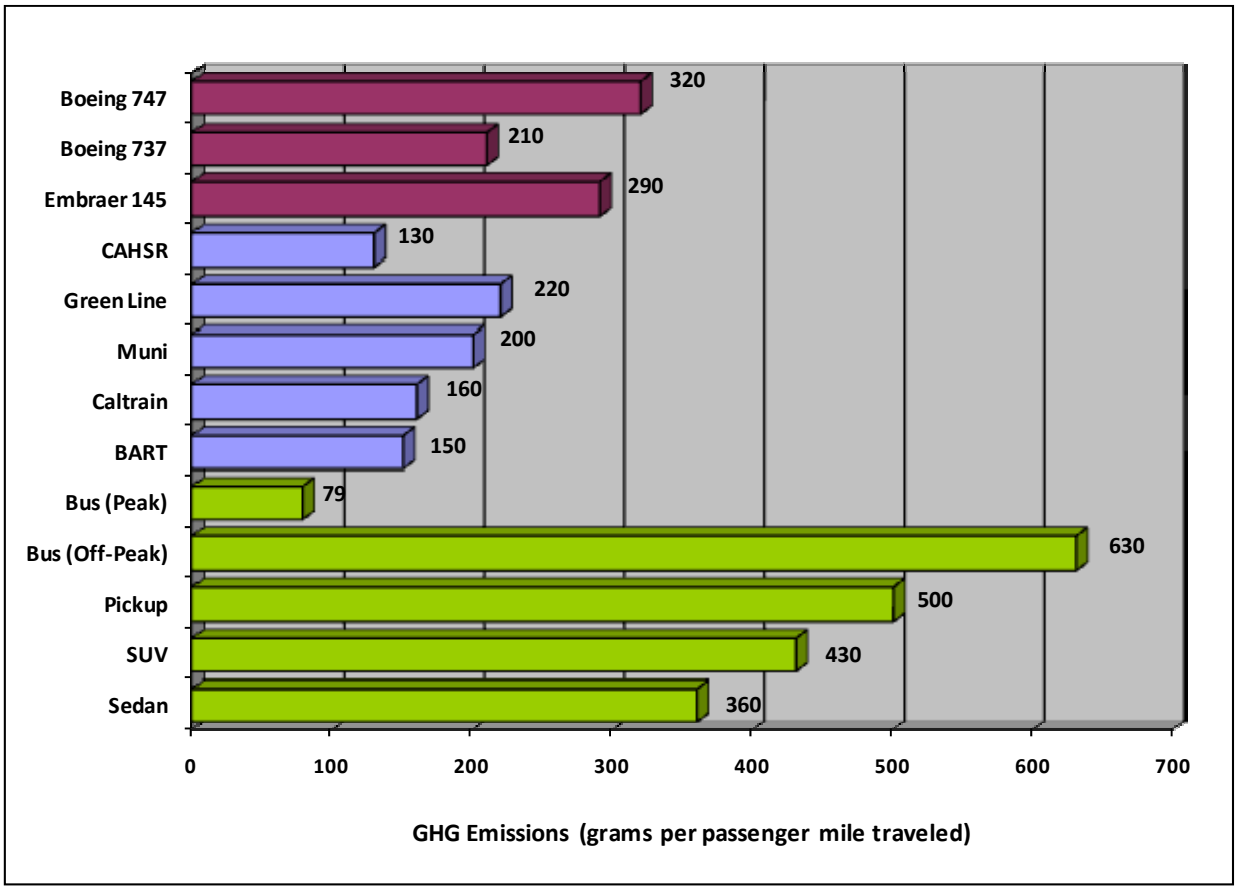

Figure 1-2. Life-Cycle GHG Emissions for Various Transit Modes

Source: Chester and Horvath (2008).
Key:
Boeing 747 = long-haul aircraft (305 passengers per flight)
Boeing 737 = medium-haul aircraft (94 passengers per flight)
Embraer 145 = short-haul aircraft (34 passengers per flight)
CAHSR = California High Speed Rail
Green Line = Massachusetts Bay Transportation Authority Green Line Light Rail
Muni = San Francisco Municipal Railway Light Rail
Caltrain = Diesel-powered heavy rail Amtrak-style commuter train (Gilroy to San Francisco)
BART = Bay Area Rapid Transit
Notes:
Red bars – Air travel
Blue bars – Rail
Green bars – Automobile and

Table 1-5. Summary of Incremental GHG Emissions (Operational and Construction) Compared to Existing Conditions (2009)

Alternative	Annual CO_2e Emissions (metric tons per year)		
	Construction[1]	Operations[2]	Amortized Total[3]
No Build Alternative	NA	69,876,000	69,876,000
TSM Alternative	NA	69,816,400	69,816,400
At-Grade Emphasis LRT Alternative	2,500	69,807,500	69,810,100
Underground Emphasis LRT Alternative			
2nd/Hope Street station + 2nd Street station - Broadway Option (SEM)	3,300	69,805,100	69,808,400
2nd/Hope Street station + 2nd Street station – Broadway Option (Cut & Cover)	3,400	69,805,100	69,808,500
2nd/Hope Street station + 2nd Street station - Los Angeles Street Option (SEM)	3,300	69,805,100	69,808,400
2nd/Hope Street station + 2nd Street station - Los Angeles Street Option (Cut & Cover)	3,300	69,805,100	69,808,500
Fully Underground LRT Alternative – Little Tokyo Variation 1			
2nd/Hope Street station (SEM)	3,800	69,803,000	69,806,800
2nd/Hope Street station (Cut & Cover)	3,900	69,803,000	69,806,900
Fully Underground LRT Alternative – Little Tokyo Variation 2			
2nd/Hope Street station (SEM)	3,800	69,802,700	69,806,600
2nd/Hope Street station (Cut & Cover)	3,900	69,802,700	69,806,700

Key:
NA = not applicable
Notes:
[1] *Construction emissions include the total emissions that would occur over the life of the construction phase (2014-2017) amortized over 30 years.*
[2] *Incremental project-related operational emissions (i.e., increment between future build alternative and existing conditions).*

[3] *Amortized construction emissions added to incremental operational emissions. Totals may vary slightly due to rounding.*

Table 1-6. Summary of Incremental GHG Emissions (Operational and Construction) Compared to the No Build Alternative (2035)

Alternative	Annual CO_2e Emissions (metric tons per year)		
	Construction[1]	Operations[2]	Amortized Total[3]
TSM Alternative	NA	(59,600)	(59,600)
At-Grade Emphasis LRT Alternative	2,500	(68,400)	(65,900)
Underground Emphasis LRT Alternative			
2nd/Hope Street station + 2nd Street station - Broadway Option (SEM)	3,300	(70,800)	(67,500)
2nd/Hope Street station + 2nd Street station Broadway option (Cut & Cover)	3,400	(70,800)	(67,500)
2nd/Hope Street station + 2nd Street station Los Angeles Street Option (SEM)	3,300	(70,800)	(67,500)
2nd/Hope Street station + 2nd Street station - Los Angeles Street Option (Cut & Cover)	3,300	(70,800)	(67,500)
Fully Underground LRT Alternative – Little Tokyo Variation 1			
2nd/Hope Street station (SEM)	3,800	(73,000)	(69,100)
2nd/Hope Street station (Cut & Cover)	3,900	(73,000)	(69,000)
Fully Underground LRT Alternative – Little Tokyo Variation 2			
2nd/Hope Street station (SEM)	3,800	(73,200)	(69,400)
2nd/Hope Street station (Cut & Cover)	3,900	(73,200)	(69,300)

Key:
NA = not applicable
Notes:

[1] *Construction emissions include total emissions that would occur over the life of the construction phase (2014-2017) amortized over 30 years.*
[2] *Incremental project-related operational emissions (i.e., increment between future build alternative and No Build Alternative).*
[3] *Amortized construction emissions added to incremental operational emissions. Totals may vary slightly due to rounding.*

The proposed Regional Connector Transit Corridor project is consistent with SB 375 because it establishes a key part of the regional transportation network that serves to remove vehicles from the roadways. The proposed project decreases VMT and GHG when compared to the No Build Alternative. Although each of the proposed project alternatives here foresees increased GHG emissions when compared to existing conditions, this can be attributed to a forecasted growth in population unrelated to this proposal. The quantitative analysis here does not take into account several additional requirements identified in the Scoping Plan including the Pavley regulations[1] and the low carbon fuel standard[2]. Thus, when the Scoping Plan and SB 375 are fully implemented, regional emissions could be reduced to below existing conditions.

Lastly, no mitigation measures would be required to reduce emissions. The proposed Regional Connector Transit Corridor project is also identified in the SCAG 2008 Regional Transportation Plan, and the Regional Connector Transit Corridor project is consistent with regional and statewide plans to reduce GHG emissions.

[1] The Pavley regulations (Assembly Bill 1493) reduce GHG emissions in new passenger vehicles from 2009 through 2016. The Pavley regulations reflect tailpipe emission standards for specific vehicle model years. The United States Environment Protection Agency (USEPA) decided to grant a waiver of Clean Air Act preemption on June 30, 2009, which allows California to implement the GHG emission standards (74 FR 32744).

[2] The Low Carbon Fuel Standard, adopted by the Office of Administrative Law (OAL) on January 12, 2010, requires a reduction of at least 10 percent in the carbon intensity of California's transportation fuels by 2020 (17 CCR 95480).

2.0 INTRODUCTION

Briefly stated, global climate change (GCC) is a change in the average climatic conditions of the earth, characterized by changes in wind patterns, storms, precipitation, and temperature. The baseline by which these changes are measured originates in historical records identifying temperature changes that have occurred in the past, such as during previous ice ages. Analyzing these records shows a statistically significant difference in the rate and magnitude of GCC in the last 150 years (the Industrial Age) as compared to historical climate change.

The United Nations Intergovernmental Panel on Climate Change (IPCC) calculated GHG emission projections that would be needed to stabilize global temperatures and GCC impacts. The IPCC predicted that the range of global mean temperature increases from 1990 to 2100, given six scenarios, could range from 1.4 to 5.8 degrees Celsius (°C) (IPCC 2001). Regardless of analytical methodology, global average temperature and mean sea level are expected to rise under all scenarios.

Climate models for California project that temperatures in California will increase anywhere from 3 to 10.5 degrees Fahrenheit (°F) (California Climate Change Center 2006). Almost all climate change scenarios include a continuing trend of warming through the end of the 21st century due to substantial amounts of GHG already released and the difficulty of reducing emissions to a level that would stabilize the climate. According to the 2006 California Climate Action Team Report (CalEPA 2006), the following climate change effects are predicted in California over the course of the 21st century.

- A diminishing Sierra snowpack declining by 70 to 90 percent, threatening the State's water supply.
- Increasing temperatures of up to approximately 10 °F under the higher emission scenarios, leading to a 25 to 35 percent increase in the number of days ozone pollution levels are exceeded in most urban areas.
- Coastal erosion along the length of California and seawater intrusion into estuarine areas from a 4- to 33-inch rise in sea level. This would exacerbate flooding in already vulnerable regions.
- Increased vulnerability of forests due to pest infestation and increased temperatures.
- Increased challenges for the State's important agricultural industry from water shortages, increasing temperatures, and saltwater intrusion.
- Increased electricity demand, particularly in the hot summer months.

Temperature increases would lead to adverse environmental impacts in a wide variety of areas, including sea level rise, reduced snowpack resulting in changes to existing water resources, increased risk of wildfires, public health hazards associated with higher peak temperatures, heat waves, and deteriorated air quality.

In December 2008, the California Air Resources Board (CARB) released a Climate Change Scoping Plan (CARB 2008a) outlining the State's strategy to achieve the 2020 GHG emissions limit mandated by Assembly Bill 32 (AB 32). AB 32 requires the State to reduce GHG emissions to 1990 levels by 2020. As is shown in Figure 2-1, GHG emissions in the State are expected to increase by nearly 30 percent between the 2002-2004 levels (average emissions) and 2020 levels under the business-as-usual (BAU) conditions. Transportation emissions are expected to increase nearly 25 percent between now and 2020 in the BAU scenario (i.e., in the absence of AB 32).

In a staff report entitled "California 1990 Greenhouse Gas Emissions Level and 2020 Emissions Limit," CARB estimated the 1990 emission level as approximately 427 million metric tons of carbon dioxide equivalent ($MMTCO_2e$) (CARB 2007a). The State would need to reduce emissions by 169 $MMTCO_2e$ in 2020 as compared to BAU to meet the emission targets; a nearly 30 percent decrease in emissions from BAU.

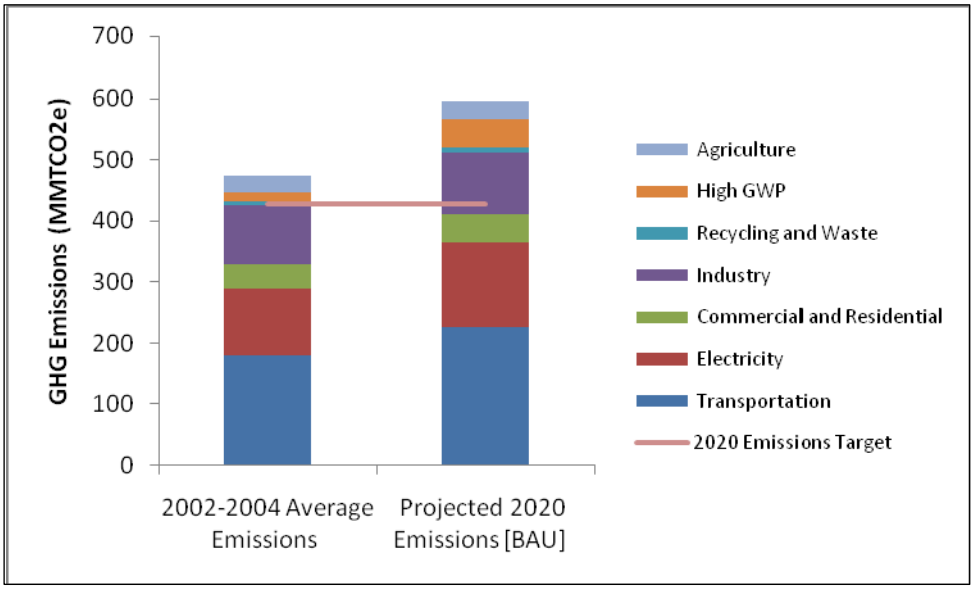

Figure 2-1. Current Emissions Compared to 2020 Business-as-Usual

In its Scoping Plan, CARB proposed a series of measures to reduce GHG emissions, several of which relate to transportation. The California Light-Duty Vehicle GHG Standards ("Pavley Regulations"), for example, are predicted to reduce emissions by 31.7 $MMTCO_2e$ or 18 percent of the total emission reductions included in the Scoping Plan[3]. Other reductions include the Low Carbon Fuel Standard (15 $MMTCO_2e$ reduction), regional transportation-related GHG targets[4] (5 $MMTCO_2e$ reduction), and medium/heavy-duty vehicle reduction measures (1.4 $MMTCO_2e$ reduction).

The measures included in the Scoping Plan are not included in the various models used to quantify emissions in this report. Since it is difficult to quantify the exact amount of emissions reductions the Scoping Plan will achieve by 2035, its effect is discussed only qualitatively. GHG emissions are typically reported in units of $MMTCO_2e$, and it may be difficult to understand the magnitude of such high levels of emissions. To put GHG emissions in perspective, the following examples illustrate measures that would create reductions in one $MMTCO_2e$ (CARB 2007b):

- 216,000 passenger cars not driven for one year
- 179,000 passenger cars and light trucks not driven for one year
- 114 million gallons of gasoline saved
- 13,400 tanker trucks of gasoline saved
- One year of electricity use by 193,000 California households
- The energy savings in one year from replacing 13 million standard light bulbs with compact fluorescent lamps
- 26,000,000 tree seedlings grown for 10 years

[3] The Scoping Plan includes measures to reduce emissions by 174 $MMTCO_2e$, which is slightly above the target reduction goal of 169 MMTCO2e.

[4] This reduction measure is an estimate of reductions that may be achieved from local land use changes. It is not the SB 375 regional target.

3.0 METHODOLOGY FOR IMPACT EVALUATION

The Regional Connector Transit Corridor project would provide a direct link between the Metro Gold Line, Metro Blue Line, and Metro Expo Line in downtown Los Angeles. The project is anticipated to produce regional benefits in the South Coast Air Basin (SCoAB) by increasing regional mobility, minimizing transfers on the LRT system, and allowing connections to future new rail lines. The project is predicted to reduce VMT and associated GHG emissions by providing an alternative to single occupancy vehicle travel.

Mass transit has been identified at the regional, state and national levels as a crucial tool to reduce GHG emissions and climate change. Additionally, Metro has committed to, and is implementing a strong environmental sustainability policy focused on reducing CO_2 emissions through efficient uses of fuels and electricity (Metro 2007). The proposed project, in addition to improving transit access and mobility, would be developed consistent with Metro's sustainability policy.

The following section describes the methodology for analysis of potential project benefits and impacts relating to GHG emissions during both construction and operation.

3.1 Regulatory Framework

The current regulatory setting related to climate change and GHG emissions is summarized below.

3.1.1 Federal

3.1.1.1 Massachusetts et al. v. Environmental Protection Agency et al.

Twelve U.S. states and cities (including California) in conjunction with several environmental organizations, brought suit to force the USEPA to regulate GHGs as a pollutant pursuant to the Federal Clean Air Act (CAA) (Massachusetts et al. v. Environmental Protection Agency et al. [U.S. Supreme Court No. 05–1120]; argued November 29, 2006—decided April 2, 2007). The Court ruled that the plaintiffs had standing to sue, that GHGs fit within the CAA's definition of an air pollutant, and that the USEPA's reasons for not regulating GHGs were insufficiently grounded in the CAA.

3.1.1.2 Mandatory GHG Reporting Rule

On October 30, 2009, the USEPA published the final mandatory greenhouse gas reporting rule in the Federal Register (74 FR 56260). This rule requires suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more of CO_2e per year to submit annual reports to the USEPA. Reporting will start in 2011 for the calendar year 2010 except for vehicle and engine manufacturers who will begin reporting for model year 2011.

3.1.1.3 Endangerment Finding

On December 15, 2009, the USEPA published its endangerment finding for GHGs in the Federal Register (74 FR 66496). The USEPA Administrator determined that six GHGs, taken in combination, endanger both the public health and welfare of current and future generations. Although the endangerment finding discusses the effects of six GHGs, it acknowledges that transportation sources only emit four of the key GHGs: CO_2, CH_4, N_2O, and HFCs. Further, the Administrator found that the combined emissions of these GHGs from new motor vehicles and new motor vehicle engines contribute to air pollution that endangers the public health and welfare under CAA Section 202(a). These findings are expected to pave the way for future regulations to control emissions of GHGs on a nationwide basis.

3.1.1.4 American Clean Energy and Security Act of 2009

On June 26, 2009, the American Clean Energy and Security Act of 2009 (HR 2454) was approved by the House of Representatives. This bill, also known as the Waxman-Markey Bill, requires entities to report their operational emissions if they exceed 10,000 tons (assumed to be metric tons) of CO_2e per year and to enter a cap-and-trade program if they exceed 25,000 tons of CO_2e per year. The cap-and-trade program aims to reduce emissions by 17 percent of 2005 levels by 2020 and by 83 percent of 2005 levels by 2050. The bill is waiting for Senate approval.

3.1.1.5 Clean Energy Jobs and American Power Act

On September 30, 2009, the Clean Energy Jobs and American Power Act (SB 1733) was introduced in the Senate. Also known as the Kerry-Boxer Bill, the bill provides for the establishment of a cap-and-trade system for GHG emissions and sets goals of reducing U.S. emissions by 20 percent from 2005 levels by 2020 and by 83 percent from 2005 levels by 2050. The bill was passed by the Committee on Environment and Public Works on November 5, 2009, but has since been stalled in the Senate.

3.1.2 State

3.1.2.1 California Assembly Bill 1493 (AB 1493)

California Assembly Bill (AB) 1493 required CARB to develop and adopt GHG emission standards for automobiles. The legislature declared in AB 1493 that global warming was a matter of increasing concern for public health and environment in the state. It cited several risks that California faces from climate change, including reduction in the State's water supply, increased air pollution creation by higher temperatures, harm to agriculture, increase in wildfires, damage to the coastline, and economic losses caused by higher food, water, energy, and insurance prices. Further, the legislation stated that technological solutions to reduce GHG emissions would stimulate the California economy and provide jobs.

Assembly Bill 1493 became law in 2002, and CARB enacted subsequent regulations in September 2004. States are prevented from adopting motor vehicle emission standards that are contrary to federal law; however, California is allowed to adopt its own motor vehicle emission standards that are at least as stringent as the federal requirements if the USEPA grants California a waiver request.

Other states can either elect to follow the California standards or continue to follow federal requirements. The USEPA originally declined California's waiver request in March 2008, citing a failure to demonstrate "compelling and extraordinary" conditions that would make the new regulations necessary. The USEPA then reversed its waiver denial on June 30, 2009, granting California authority to implement new standards.

3.1.2.2 California Executive Order S-3-05

California Executive Order S-3-05 established the following GHG emission reduction targets for California:

- Reduce GHG emissions to 2000 levels by 2010;
- Reduce GHG emissions to 1990 levels by 2020; and
- Reduce GHG emissions to 80 percent below 1990 levels by 2050.

3.1.2.3 Global Warming Solutions Act of 2006 (AB 32)

California AB 32, the Global Warming Solutions Act of 2006, codifies the State's GHG emissions target. It requires California to reduce GHG emissions to 1990 levels by 2020 and CARB to enforce a statewide cap on GHG that must be phased in by 2012. AB 32 was passed into on September 27, 2006. Key AB 32 milestones are as follows:

- June 30, 2007—Identification of "discrete" early action GHG emissions reduction measures.
- January 1, 2008—Identification of the 1990 baseline GHG emissions level and approval of a statewide limit equivalent to that level. Adoption of reporting and verification requirements concerning GHG emissions.
- January 1, 2009—Adoption of a scoping plan for achieving GHG emission reductions.
- January 1, 2010—Adoption and enforcement of regulations to implement the "discrete" actions.
- January 1, 2011—Adoption of GHG emission limits and reduction measures by regulation.

- January 1, 2012—GHG emission limits and reduction measures adopted in 2011 become enforceable.

3.1.2.4 Senate Bill 97 (SB 97)

Senate Bill 97 (SB 97) mandates that the Governor's Office of Planning and Research amend the State's CEQA Guidelines to address impacts from GHGs, and these amendments must be adopted by the California Natural Resources Agency. The California Natural Resources Agency adopted CEQA Guidelines Amendments on December 30, 2009. In the CEQA Guideline Amendments, the California Natural Resources Agency recommended the following criteria for determining significance of GHG emissions:

- The extent to which the project may increase or reduce GHG emissions as compared to the existing environmental setting;
- Whether the project emissions exceed a threshold of significance that the lead agency determines applies to the project; or
- The extent to which the project complies with the regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions.

3.1.2.5 CARB Interim Significance Thresholds

CARB released a Preliminary Draft Staff Proposal for Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under the California Environmental Quality Act (CEQA) in October 2008 (CARB 2008b). CARB's guidelines provide recommendations for assessing significance of operational and construction emissions from industrial and commercial/residential projects.

Although CARB's preliminary draft staff proposal suggests a quantitative threshold for assessing impacts from the operation of industrial projects, it prescribes the use of performance standards for construction-related emissions from all types of projects. CARB does not provide specific performance standards to address construction-related impacts. The California Natural Resources Agency is proceeding with amendments to the CEQA Guidelines that would better define the analytical requirements for climate change and GHG emissions in environmental documents (Ito 2009). As a result, CARB is currently taking no further action to define its interim thresholds of significance.

3.1.2.6 Senate Bill 375 (SB 375)

Senate Bill 375 (SB 375) requires CARB to set regional targets for 2020 and 2035 to reduce GHG emissions from passenger vehicles. A regional target will be developed for each of the 18 metropolitan planning organizations (MPOs) in the state; SCAG is the MPO that would have jurisdiction over the Regional Connector Transit Corridor project area. A Regional

Targets Advisory Committee (RTAC) was appointed by CARB to provide recommendations to be considered and methodologies to be used in CARB's target setting process. The final RTAC report was released on January 23, 2009. CARB is required to propose draft targets by June 30, 2010 and adopt final targets by September 30, 2010.

Each MPO is required to develop "Sustainable Community Strategies" (SCS) through integrated land use and transportation planning and to demonstrate an ability to attain the proposed reduction targets by 2020 and 2035. SCAG is proceeding with the SCS process on the tentative assumption that the region will have an approximate reduction target of 2.5 $MMCO_2e$ for 2020 (SCAG 2009). This target is based on the fact that the statewide reduction target is 5 $MMTCO_2e$, and the SCAG region accounts for roughly half of the State's population and emissions.

3.1.3 Local

The SCAQMD Governing Board adopted guidelines relating to GHG significance. The guidelines set a threshold of significance for industrial sources of 10,000 metric tons of CO_2e per year for operational emissions plus construction emissions amortized over 30 years. The guidelines do not provide guidance on non-industrial projects, such as for transportation-related projects.

3.2 Standards of Significance

3.2.1 NEPA Guidance

NEPA does not include specific requirements for analysis of potential impacts related to GCC, and a specific quantitative threshold of significance was not established for this project. However, incremental project emissions were determined for motor vehicles and project electricity use based on the change in VMT between each build alternative and the No Build Alternative. Changes in motor vehicle VMT were determined by the project traffic analysis for each alternative and include the potential project impacts for automobile VMT, transit bus VMT, and operation of light rail trains and new stations.

Although light rail would not contribute to local (direct) emissions, it would generate regional (indirect) emissions from the in-state generation of electricity used to operate the trains and new stations. Changes in the future fuel mix used to produce electricity by the Los Angeles Department of Water and Power (LADWP) were also taken into consideration. For example, LADWP intends to increase its renewable energy portfolio from eight percent in 2008 to 35 percent by 2020; therefore, GHG emissions from the regional generation of electricity would decrease in the future from the decreased reliance on fossil fuels.

As discussed in Section 4.0 below, the EMFAC2007 and OFFROAD2007 models were used to estimate emissions from regional highway traffic. Technical studies published by the CARB were used to estimate emission factors from CNG buses. Emissions from the generation of

electricity were calculated from emission factors obtained from LADWP and the USEPA's Emissions & Generation Resource Integrated Database (eGRID) (USEPA 2009a).

3.2.2 CEQA Guidance

3.2.2.1 South Coast Air Quality Management District (SCAQMD) Guidance

A tiered approach to evaluating the significance of GHG impacts was adopted by the SCAQMD Governing Board on December 5, 2008. The SCAQMD's Interim GHG Significance Threshold Staff Proposal (SCAQMD 2008) states that project GHG emissions analysis should include direct, indirect, and, if possible, life-cycle emissions during construction and operation. The SCAQMD's recommendations regarding the quantification of emissions were followed for this project; however, the SCAQMD interim thresholds are largely geared towards industrial, residential, and commercial projects, and do not specifically address transportation projects. Since a transportation-specific threshold of significance has not been established by the SCAQMD, a quantitative threshold was not established for the proposed project.

3.2.2.2 CEQA Guideline Amendments

In addition to the SCAQMD's guidance document, the California Natural Resources Agency released CEQA Guideline Amendments in December 2009 (Natural Resources Agency 2009). The Office of Administrative Law (OAL) finished its review of the amended CEQA guidelines on February 16, 2010 and submitted the amended CEQA Guidelines to the Secretary of State. The guidelines will be adopted as final on March 18, 2010. In the CEQA Guideline Amendments, the California Natural Resources Agency recommended the following criteria for determining the significance of GHG emissions (14 CCR §15064.4):

- The extent to which the project may increase or reduce GHG emissions as compared to the existing environmental setting;
- Whether the project emissions exceed a threshold of significance that the lead agency[5] determines applies to the project; or
- The extent to which the project complies with the regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions. Such requirements must be adopted by the relevant public agency through a public review process and must reduce or mitigate the project's incremental contribution of GHG emissions. If there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding

[5] The lead agency is defined as "the public agency which has the primary responsibility for carrying out or approving a project which may have a significant effect upon the environment" under CEQA (Pub. Resources Code, §21067). For the Regional Connector Transit Corridor project, the lead agency would be Metro.

compliance with the adopted regulations or requirements, an EIR must be prepared for the project.

The plans addressed in the final bullet can include regional transportation plans, regional blueprint plans, and plans for the reduction of GHG emissions (14 CCR §15125). The CEQA Guidelines identify specific plan elements that must be considered for any plans developed to reduce GHG emissions. At the very least, the plan should do the following (14 CCR §15183.5):

- Quantify GHG emissions, both existing and projected over a specified time period, resulting from activities within a defined geographic area;
- Establish a level, based on substantial evidence, below which the contribution to GHG emissions from activities covered by the plan would not be cumulatively considerable;
- Identify and analyze the GHG emissions resulting from specific actions or categories of actions anticipated within the geographic area;
- Specify measures or a group of measures, including performance standards, that substantial evidence demonstrates, if implemented on a project-by-project basis, would collectively achieve the specified emissions level; and
- Establish a mechanism to monitor the plan's progress toward achieving the level and to require amendment if the plan is not achieving specified levels.

Although specific quantitative thresholds of significance for CEQA are not provided in any of the referenced guidance documents, incremental project emissions were calculated as the difference between each project alternative as of 2035 and existing conditions (2009). Changes in motor vehicle VMT, transit bus VMT, and operation of light rail vehicles and new stations were included in the analysis.

The Draft 2008 Regional Transportation Plan (RTP) Update Program Environmental Impact Report (PEIR) and Addendum analyzed GHG emissions and included all feasible mitigation measures. The PEIR is therefore consistent with the CEQA significance criteria discussed above. The proposed project was evaluated for compliance with the regional transportation plan (RTP). If the proposed project is found to be consistent with the RTP, then the project would not be significant for GHG emissions.

3.3 Area of Potential Impact

The area of potential impact was defined as the SCoAB, which includes all of Orange County and the urban, non-desert portions of Los Angeles, Riverside, and San Bernardino Counties. Although the area of potential impact is extensive, the analysis focused only on sources that

impact or are impacted by the project with regard to GHGs. Specifically, the analysis included the four-county region to capture the changes in VMT that could occur as a direct result of each project alternative as determined by the project traffic analysis. The analysis also covered emissions from project-related construction sources (construction equipment, haul and delivery trucks, and construction worker vehicles) in the SCoAB, as well as project sources located within construction sites and staging areas of the light rail alternatives.

3.4 Analysis Methodology

Although thresholds of significance for GHG are not well-established, methodologies and protocols for analyzing GHG emissions have been extensively documented and were used in this analysis. The analysis used protocols established by the California Climate Action Registry (CCAR), namely the General Reporting Protocol (CCAR 2009) and the Local Government Operations Protocol (CCAR 2008). Generally, GHG impact analyses follow the same quantification methodologies as air quality studies for criteria pollutants.

Greenhouse gas emissions were calculated for direct and indirect sources of GHG, including engine exhaust and purchased electricity. Emissions were estimated for three GHG pollutants regulated under the Kyoto Protocol: CO_2, CH_4, and N_2O. Although the Kyoto Protocol also regulated three other GHG pollutants (hydrofluorocarbons [HFCs], perfluorocarbons [PFCs], and sulfur hexafluoride [SF_6]), these pollutants are not emitted as products of engine exhaust or purchased electricity and are not analyzed further herein[6]. Emissions were converted to CO_2e using the GWPs in the IPCC's Second Assessment Report and documented in the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (USEPA 2009b).

Global warming potentials are defined by CARB as the radiative forcing impact (degree of warming to the atmosphere) of one mass-based unit of a given GHG relative to an equivalent unit of CO_2. For example, one ton of CH_4 is equivalent to approximately 21 tons of CO_2 in the atmosphere. Although the IPCC has released several updates to the Second Assessment Report (SAR) since its release in 1996, the international standard is to use the original SAR to maintain consistency with GHG emission inventories already compiled.

3.4.1 Construction Emissions

This analysis followed the SCAQMD's recommendation that construction emissions be amortized over 30 years (defined as life of a project) and added to the operational emissions.

Potential emissions of CO_2, CH_4, and N_2O from construction equipment (e.g., bulldozers, scrapers, graders, off-highway trucks, etc.) were calculated using the OFFROAD model,

[6] Although HFCs may be emitted from mobile sources from air conditioning (e.g., HFC-134a), methods for estimating these emissions are limited and are not included in this evaluation.

developed by CARB, for off-road engine exhaust emissions. Potential emissions of CO_2 and CH_4 were calculated using the EMFAC[7] model for on-road vehicles, and includes construction worker trips to the construction site, on-road haulage trucks, material delivery trucks, and equipment maintenance vehicles. Although N_2O emissions would also occur from the operation of on-road vehicles, the EMFAC model does not currently generate these emissions. Additionally, appropriate sources of GHG emissions were reviewed as part of this analysis to supplement the EMFAC model, as necessary.

3.4.2 Operational Emissions

3.4.2.1 Regional Traffic

Engine exhaust emissions were calculated to quantify predicted reductions in VMT in the region. As with construction emissions, the EMFAC model was used to quantify regional traffic emissions associated with the project. Any increase in transit rider trips to stations proposed under each alternative is assumed to be included in the regional traffic analysis. Regional traffic data was obtained from the project traffic analysis for each alternative.

3.4.2.2 Light Rail and New Station Operations

Although light rail vehicles do not emit GHG, the GHG analyses quantify emissions resulting from the remote generation of electricity to run the light rail vehicles and to power the facilities at the new stations. Emissions were calculated using the most recent LADWP CO_2 emission factor reported to CCAR; CH_4 and N_2O emissions were estimated from the USEPA's eGRID (USEPA 2009a).

Light Rail Operation

Since emission factors are reported in units of grams per mile (g/mi), it was necessary to estimate the total annual mileage associated with the proposed project. Headway information was used to estimate the number of trains that would occur during the year based on the weekday peak, weekday off-peak, and weekend service periods. The single trip distances for each service line were then used with the total number of trains to estimate the annual trip distance for each line. The single trip distances only included new track that would be installed as part of the proposed project.

New Station Operation

Several new stations would be built as part of the proposed project. Emissions associated with electricity at the stations to power lighting, escalators, train control, and general station maintenance were estimated using emission factors from a report prepared by Chester and

[7] The EMission FACtors (EMFAC) model is used to calculate emission rates from on-road motor vehicles in California. It is similar to the USEPA's MOVES2010 model but uses a fleet mix and assumptions specific to California.

Horvath (2008). The emission factors associated with each individual area are provided in units of kilowatts per station; therefore, the number of stations associated with each alternative was used to estimate emissions. Aboveground stations were conservatively estimated to require half the lighting of underground stations and would require minimal station maintenance. The station numbers were adjusted to reflect differences in above- and under-ground stations.

3.4.2.3 Bus Operations

The operating schedule for the proposed bus routes and headway information was used to estimate the number of bus trips that would occur for a weekday peak, weekday off-peak, and weekend service period. Information on the single trip distance for each line was then used to estimate the total annual miles traveled by all of the bus trips associated with the TSM Alternative.

The EMFAC model does not estimate emissions from alternative fuels like CNG; therefore, it was necessary to use research data published by CARB to estimate emissions resulting from the combustion of CNG. CARB provided a list of research reports that contain information on CNG combustion emissions. Several of the research reports contained information that was specific to Metro, predominantly from the New Flyer buses. Average emission factors from these Metro-specific reports were developed to be used in all subsequent calculations.

4.0 AFFECTED ENVIRONMENT

This section describes the existing conditions and affected environment/environmental setting for climate change effects.

4.1 Existing Conditions

Worldwide, California is the 12th to 16th largest emitter of CO_2, and is responsible for approximately two percent of the world's CO_2 emissions (CEC 2006).

As shown in Figure 4-1, transportation is responsible for 39 percent of the State's GHG emissions, followed by electricity generation (22 percent), the industrial sector (20 percent), agriculture and forestry (6 percent), commercial and residential (9 percent), and other sources (4 percent). Passenger vehicles and heavy-duty trucks represent approximately 35 percent of total emissions, with rail contributing only one percent. Rail is therefore a key element in reducing the State's GHG emissions by providing an alternative to passenger vehicles (see Figure 1-1).

Emissions of CO_2 and N_2O are largely byproducts of fossil fuel combustion. Methane, a highly potent GHG, results largely from off-gassing associated with agricultural practices and landfills. Sinks of CO_2 include uptake by vegetation and dissolution into the ocean. California GHG emissions in 2006 totaled approximately 485 $MMTCO_2e$ (CARB 2009).

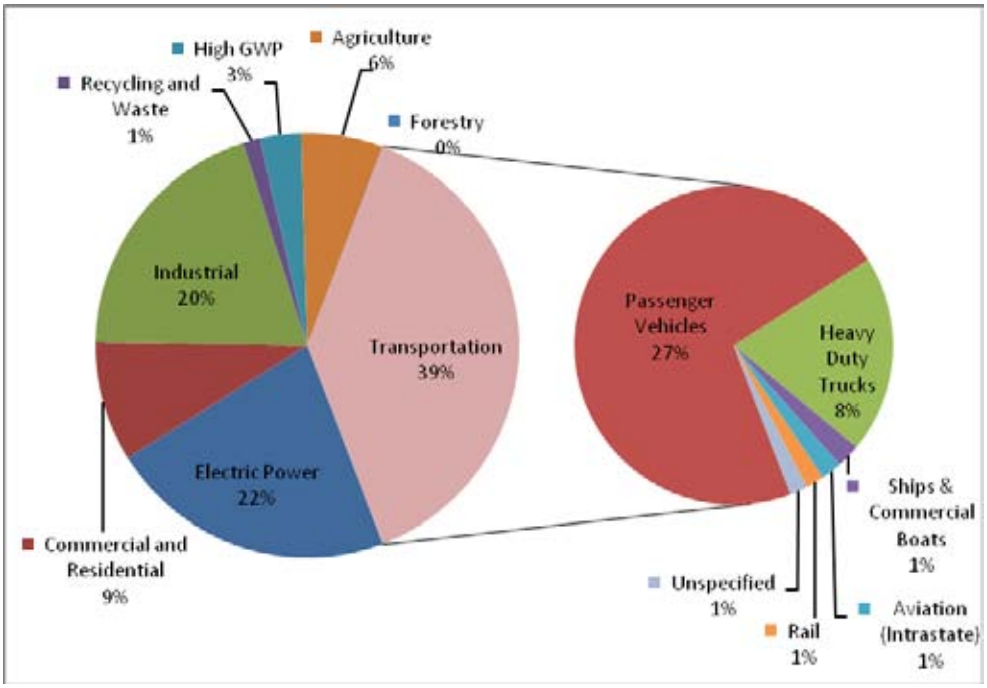

Figure 4-1. California GHG Inventory for 2006

4.1.1 Regional Traffic

As required by CEQA, existing (2009) emissions from regional traffic were estimated in the analysis to compare against future build alternatives. Data on VMT in the region and emission factors from the EMFAC2007 model were used to estimate emissions of GHG. The emissions calculations were based on the total VMT in the region and the average speed on the highway network. Since the EMFAC model only generates emissions of CO_2 and CH_4, the CCAR General Reporting Protocol was used to estimate emissions of N_2O. Table 4-1 summarizes the results of the baseline GHG emissions.

Table 4-1. Existing Conditions: 2009 Annual Highway Traffic GHG Emissions

	CO_2	CH_4	N_2O	Total[2]
Vehicle miles traveled (VMT)	n/a	n/a	n/a	304,212,400
Emission Factor (grams per mile)	365.210	0.028	0.173	N/A
Emissions (metric tons per year)	40,552,000	3,100	19,200	N/A
GWP	1	21	310	N/A
CO_2e Emissions[1] (metric tons per year)	40,552,000	65,100	5,952,000	46,569,100

Key:
CO_2 = carbon dioxide
CO_2e = carbon dioxide equivalent
CH_4 = methane
GWP = Global Warming Potential
N/A = not applicable
N_2O = nitrous oxide
Note:
[1] *CO_2e emissions are weighted by the global warming potential (GWP) for each non-CO_2 pollutant (i.e., CO_2e equals emissions of non-CO_2 pollutant x GWP)*
[2] *Totals may vary due to rounding*

5.0 IMPACTS

This section analyzes impacts associated with construction and operation of the proposed project alternatives.

5.1 No Build Alternative

The No Build Alternative describes a future condition where none of the alternatives described in this document would be built. This section provides a summary of emissions associated with the No Build Alternative.

5.1.1 Operational Emissions

Under the No Build Alternative, no construction would occur. As a result, no emissions would result from operation of light rail vehicles. Any future increase in emissions under this scenario would result from projected growth in regional traffic.

5.1.1.1 Light Rail Operations

The No Build Alternative assumes that the proposed project would not be built. Thus, no emissions would result from production of electricity needed to operate LRT vehicles or new stations.

5.1.1.2 Regional Traffic

Emissions of GHG that would occur under the No Build Alternative are summarized in Table 5-1. Since the No Build Alternative assumes that the Regional Connector Transit Corridor project would not be built, the GHG emissions reported in this section represent the projected growth of traffic expected to occur in the region of analysis. Emission calculations were based on the total VMT in the region and the average speed on the highway network.

5.1.2 Construction Emissions

The No Build Alternative assumes the proposed project would not be constructed. As a result, no construction emissions would occur under the No Build Alternative.

5.1.3 Cumulative Impacts

The proposed project would not occur under the No Build Alternative. As a result, there would be no project-level emissions associated with the No Build Alternative. Any emissions that would result from regional traffic would also occur with any other project in the area. Thus, emissions would not be cumulatively significant.

Table 5-1. No Build Alternative 2035 Annual Highway Traffic GHG Emissions				
	CO_2	CH_4	N_2O	Total[2]
Vehicle Miles Traveled (VMT)	n/a	n/a	n/a	504,632,600
Emission Factor (grams per mile)	578.319	0.015	0.173	N/A
Emissions (metric tons per year)	106,521,100	2,800	31,800	N/A
GWP	1	21	310	N/A
CO_2e Emissions[1] (metric tons per year)	106,521,100	58,800	9,858,000	116,437,900
Increment (compared to Existing Conditions [2009]) (metric tons per year)	65,969,100	(6,300)	3,906,000	69,868,800

Key:
CO_2 = carbon dioxide
CO_2e = carbon dioxide equivalent
CH_4 = methane
GWP = Global Warming Potential
N/A = not applicable
N_2O = nitrous oxide
Note:
[1] *CO_2e emissions are weighted by the global warming potential (GWP) for each non-CO_2 pollutant (i.e., CO_2e equals emissions of non-CO_2 pollutant x GWP)*
[2] *Totals may vary due to rounding*

5.2 Transportation System Management (TSM) Alternative

The Transportation System Management (TSM) Alternative assumes that the proposed project would not occur. Rather, additional bus lines would be added to improve regional connections across downtown.

5.2.1 Operational Emissions

Emissions from operation of the new buses proposed under the TSM Alternative, and from regional traffic in the project area, were evaluated for operational emissions.

5.2.1.1 Light Rail Operations

An LRT project would not be built under the TSM Alternative. As a result, light rail operational emissions would be zero.

5.2.1.2 Regional Traffic

Emissions of GHG that would occur in the TSM Alternative are summarized in Table 5-2. Since the TSM Alternative assumes that an LRT project would not be built, GHG emissions reported in this section represent the projected growth of traffic in the region of analysis. The emission calculations were based on the total VMT in the region and the average speed on the highway network.

Table 5-2. TSM Alternative 2035 Annual Highway Traffic GHG Emissions

	CO_2	CH_4	N_2O	Total[2]
Vehicle Miles Traveled (VMT)	n/a	n/a	n/a	504,358,400
Emission Factor (grams per mile)	578.319	0.015	0.173	N/A
Emissions (metric tons per year)	106,463,200	2,800	31,800	N/A
GWP	1	21	310	N/A
CO_2e Emissions[1] (metric tons per year)	106,463,200	58,800	9,858,000	116,380,000

Key:
CO_2 = carbon dioxide
CO_2e = carbon dioxide equivalent
CH_4 = methane
GWP = Global Warming Potential
N/A = not applicable
N_2O = nitrous oxide
Note:
[1] *CO_2e emissions are weighted by the global warming potential (GWP) for each non-CO_2 pollutant (i.e., CO_2e equals emissions of non-CO_2 pollutant x GWP)*
[2] *Totals may vary slightly due to rounding*

5.2.1.3 Bus Operation

The TSM Alternative assumes that additional bus lines would be added to the downtown Los Angeles area making connections similar to those under the proposed build alternatives. Information on the methodology used to estimate emissions from bus operations is provided in Section 3.4.2.3. Emissions from the combustion of CNG were estimated for the TSM Alternative. Table 5-3 summarizes estimated emissions associated with bus operation.

5.2.1.4 Total Operational Emissions

Total operational emissions were estimated from CNG bus operation and regional traffic. Emissions were compared to existing conditions (2009) to evaluate significance under CEQA

and to the No Build Alternative (2035) to evaluate significance under NEPA. Total operational emissions are summarized in Table 5-4.

5.2.2 Construction Emissions

The TSM Alternative assumes an LRT project would not be constructed. As a result, no construction emissions would occur under the TSM Alternative.

Table 5-3. TSM Alternative 2035 Bus Operations GHG Emissions

Line #	Service Line	Emissions (metric tons CO_2e per year)			
		CO_2	CH_4	N_2O	Total
1	Upper Grand Southbound via Los Angeles	330	60	6	390
2	Upper Grand Northbound via Los Angeles	350	60	6	420
3	Upper Grand Southbound via Alameda	370	70	6	40
4	Upper Grand Northbound via Alameda	300	70	7	480
5	3rd Street Southbound	800	140	10	960
6	2nd Street Northbound	840	150	20	1,000
Total		3,100	550	50	3,700

Totals may vary slightly due to rounding

5.2.3 Cumulative Emissions

The TSM Alternative would result in a decrease in GHG emissions compared to the No Build Alternative and, because of regional growth, an increase in GHG emissions when compared to existing conditions (2009). The TSM Alternative is consistent with CARB's Scoping Plan requirement to reduce GHG emissions. It is assumed that other projects operating in 2035 would be consistent with the emission reduction targets of SB 375 and the Regional Transportation Plan. As a result, emissions would not be cumulatively significant.

5.3 At-Grade Emphasis LRT Alternative

The At-Grade Emphasis LRT Alternative would involve a light rail extension built partly aboveground. This section provides a summary of the emissions potentially associated with this alternative.

5.3.1 Operational Emissions

Operational emissions associated with the At-Grade Emphasis LRT Alternative would include indirect emissions from electricity needed to operate light rail vehicles and the new stations and direct emissions from highway traffic after construction is completed.

Table 5-4. Summary of Total Operational GHG Emissions for the TSM Alternative

Mode	Total Operational GHG Emissions (metric tons CO_2e per year)			
	CO_2	CH_4	N_2O	Total[3]
Regional Traffic	106,463,200	58,800	9,858,000	116,380,000
CNG Buses	3,100	500	50	3,650
Total Emissions	106,466,300	59,300	9,858,050	116,383,650
CEQA Increment[1]	65,914,300	(5,800)	3,906,050	69,814,550
NEPA Increment[2]	(54,800)	500	50	(54,250)

Notes:
[1] *CEQA Increment is defined as the difference between the proposed alternative (2035) and existing conditions (2009).*
[2] *NEPA Increment is defined as the difference between the proposed alternative (2035) and the No Build Alternative (2035).*
[3] *Totals may vary slightly due to rounding*

5.3.1.1 Light Rail Emissions

Emissions from power generation for electricity needed to operate light rail vehicles were estimated from the route distance, headway between trains, and the average energy intensity for the train operation. Based on data from the National Transit Database (NTD 2010) the average energy intensity for the Metro's light rail service is 23 kilowatt-hours per mile (kWh/mi). Additional information on the methodology used to estimate emissions is provided in Section 3.4.2.2.

Since the LADWP is a member of CCAR, data from the 2007 CCAR report was used to estimate the CO_2 emission factor for electricity. Data from the eGRID was used to obtain the emission factors for CH_4 and N_2O, because this information is not available in CCAR reports.

LADWP adopted a Renewable Energy Policy that has a long-term goal to achieve a Renewable Portfolio Standard (RPS) with 35 percent renewable energy by 2020. According to the LADWP's 2008 Green Power Annual Report, LADWP's current energy mix is 8 percent

renewable energy, including wind energy, hydropower, geothermal energy, biomass energy, and solar power. Since the emission factors used in this analysis were from the 2007 CCAR Report, emission factors were adjusted by increasing the renewable energy mix from 8 percent under existing conditions (2009) to 35 percent under future conditions (2035). Table 5-5 provides a summary of estimated emissions from light rail operations.

Table 5-5. At-Grade Emphasis LRT Alternative
2035 Project Area Light Rail Annual GHG Emissions

Alternative	Annual CO_2e Emissions (metric tons per year)			
	CO_2	CH_4	N_2O	Total
Current energy mix with 8% renewable energy	4,800	3	10	4,900
Expected Emissions with 35% Renewable Portfolio Standard	1,100	1	2	1,100

Totals may vary slightly due to rounding

5.3.1.2 New Station Emissions

In addition to emissions associated with propulsion of light rail vehicles, emissions would also be generated from the construction of new stations as part of the proposed project. Emissions from the operation of new stations were estimated based on figures from a similar light rail system, the Muni in San Francisco, as calculated in a study by Chester and Horvath (2008). Additional information on the methodology is provided in Section 3.4.2.2. As with light rail operation, emissions were adjusted by the expected 35 percent RPS that LADWP will achieve by 2035. Emissions are summarized in Table 5-6.

Table 5-6. At-Grade Emphasis LRT Alternative New Station Emissions

Infrastructure	Number of New Stations	Energy per Station (kWh/yr)	CO_2e Emissions (metric tons/yr)			
			CO_2	CH_4	N_2O	Total[3]
Station Lighting[1]	3	2,600	4	<1	<1	4
Station Escalators[2]	2	41,200	50	<1	<1	50
Train Control	4	127,200	300	<1	1	300
Station Maintenance[2]	2	159,700	200	<1	1	200

Table 5-6. At-Grade Emphasis LRT Alternative New Station Emissions						
Infrastructure	Number of New Stations	Energy per Station (kWh/yr)	CO_2e Emissions (metric tons/yr)			
			CO_2	CH_4	N_2O	Total[3]
Total			500	<1	1	500
Total (Adjusted for 35% RPS)			100	<1	<1	100

Notes:
[1] *One of the stations is a street-level platform on a one-way couplet. Electricity usage for station lighting for each platform was assumed to be half an underground station; therefore, the total number of stations estimated at 3.*
[2] *Two stations are underground, whereas the remaining station is at street-level.*
[3] *Totals may vary slightly due to rounding.*

5.3.1.3 Regional Traffic

Emissions of GHG from regional traffic under the At-Grade Emphasis LRT Alternative are summarized in Table 5-7. Emission calculations were based on the total VMT in the region and the average speed on the highway network.

Table 5-7. At-Grade Emphasis LRT Alternative 2035 Annual Highway Traffic GHG Emissions				
	CO_2	CH_4	N_2O	Total
Vehicle Miles Traveled (VMT)	n/a	n/a	n/a	504,330,800
Emission Factor (grams per mile)	578.319	0.015	0.173	N/A
Emissions (metric tons per year)	106,457,400	2,800	31,800	N/A
GWP	1	21	310	N/A
CO_2e Emissions[1] (metric tons per year)	106,457,400	58,800	9,858,000	116,374,200

Key:
CO_2 = carbon dioxide
CO_2e = carbon dioxide equivalent
CH_4 = methane
GWP = Global Warming Potential
N_2O = nitrous oxide
Note:
[1] *CO_2e emissions are weighted by the global warming potential (GWP) for each non-CO_2 pollutant (i.e., CO_2e equals emissions of non-CO_2 pollutant x GWP)*
[2] *Totals may vary slightly due to rounding.*

5.3.1.4 Bus Operation

Additional bus routes would not be added as part of this alternative. As a result, CNG bus emissions would be zero and are not included in this section.

5.3.1.5 Total Operational Emissions

Total operational emissions were estimated considering light rail operations and regional traffic. Emissions were compared to existing conditions (2009) to evaluate significance under CEQA and to the No Build Alternative (2035) to evaluate significance under NEPA. Total operational emissions are summarized in Table 5-8.

5.3.2 Construction Emissions

Construction of the At-Grade Emphasis LRT Alternative would result in GHG emissions from diesel-fueled construction equipment. Construction emissions were estimated using the OFFROAD emissions model and the construction schedule. Estimated emissions are provided in Table 5-9. The emissions shown indicate the total project emissions and emissions that have been amortized over 30 years as required by SCAQMD. Section 1.2 provides a summary of amortized construction emissions along with the operational emissions increment.

Table 5-8. Summary of Total Operational GHG Emissions for At-Grade Emphasis LRT Alternative

Mode	Total Operational GHG Emissions (metric tons CO_2e per year)			
	CO_2	CH_4	N_2O	Total[3]
Regional Traffic	106,457,400	58,800	9,858,000	116,374,200
Light Rail	1,100	1	2	1,100
New Stations	100	<1	<1	100
Total Emissions	106,458,600	58,800	9,858,000	116,375,400
CEQA Increment[1]	65,906,600	(6,300)	3,906,000	69,806,300
NEPA Increment[2]	(62,500)	1	2	(62,500)

[1] *CEQA Increment is defined as the difference between the proposed alternative (2035) and existing conditions (2009).*
[2] *NEPA Increment is defined as the difference between the proposed alternative (2035) and the No Build Alternative (2035).*
[3] *Totals may vary slightly due to rounding.*

Table 5-9. At-Grade Emphasis LRT Alternative Annual Construction GHG Emissions (2014-2017)						
Phase	Emissions of CO_2e (metric tons per year)					
	2014	2015	2016	2017	Project	Amortized Emissions
Construction Equipment Emissions (onsite)	2,500	21,700	34,100	13,100	71,400	2,400
Construction Worker Commuting (offsite)	90	400	600	200	1,300	40
Haul Truck Emissions (offsite)	200	1,200	1,800	600	3,800	100
Offsite Subtotal	300	1,600	2,400	800	5,000	200
Total (onsite + offsite)	2,700	23,300	36,500	13,900	76,400	2,500

Totals may vary slightly due to rounding

5.3.3 Cumulative Emissions

The At-Grade Emphasis LRT Alternative would result in a decrease in GHG emissions compared to the No Build Alternative and, because of regional growth unrelated to the project, an increase in GHG emissions compared to existing conditions (2009). The At-Grade Emphasis LRT Alternative is consistent with CARB's Scoping Plan requirement to reduce GHG emissions. It is expected that other projects operating in 2035 would be consistent with the emission reduction targets of SB 375 and the Regional Transportation Plan. As a result, emissions would not be cumulatively significant.

5.4 Underground Emphasis LRT Alternative

Under the Underground Emphasis LRT Alternative, operation of the proposed light rail extension would occur largely underground. This section provides a summary of the emissions associated with this alternative.

5.4.1 Operational Emissions

Operational emissions associated with the Underground Emphasis LRT Alternative would include both indirect emissions from electricity needed to operate light rail vehicles and new stations and direct emissions from highway traffic after construction is completed and the project is implemented.

5.4.1.1 Light Rail Emissions

To calculate indirect emissions from remotely generated electricity, the amount of electricity needed to operate the light rail vehicles was estimated based on the route distance, train headways, and the average energy intensity for train operation. The analysis assumed that LADWP would achieve the RPS of 35 percent renewable energy by 2020. Table 5-10 provides a summary of estimated emissions from light rail operation.

Table 5-10. Underground Emphasis LRT Alternative 2035 Project Area Light Rail Annual GHG Emissions

Alternative	Annual CO_2e Emissions (metric tons per year)			
	CO_2	CH_4	N_2O	Total
Current energy mix with 8% renewable energy	4,800	2	10	4,800
Expected Emissions with 35% Renewable Portfolio Standard	1,100	1	2	1,100

Totals may vary slightly due to rounding.

5.4.1.2 New Station Emissions

In addition to emissions associated with propulsion of light rail vehicles, emissions would be generated from operation of the proposed stations to be constructed. Emissions from the operation of new stations were estimated based on figures from a similar light rail system, the Muni in San Francisco, as calculated in a study by Chester and Horvath (2008). As with light rail operation, the analysis adjusted emissions by the 35 percent RPS that LADWP is expected to achieve by 2035. Emissions are summarized in Table 5-11.

5.4.1.3 Regional Traffic

Emissions of GHG that would occur from regional traffic in the Underground Emphasis LRT Alternative are summarized in Table 5-12. The emission calculations were based on the total VMT in the region and the average speed on the highway network.

5.4.1.4 Bus Operation

Additional bus routes would not be added as part of this alternative. CNG bus emissions would be zero and are not included in this section.

Table 5-11. Underground Emphasis LRT Alternative New Station Emissions						
Infrastructure	Number of New Stations	Energy per Station (kWh/yr)	CO_2e Emissions (metric tons/yr)			
			CO_2	CH_4	N_2O	Total
Station Lighting	3	2,600	4	<1	<1	4
Station Escalators	3	41,200	70	<1	<1	70
Train Control	3	127,200	200	<1	<1	200
Station Maintenance	3	159,700	300	<1	1	300
Total			600	<1	1	600
Total (Adjusted for 35% RPS)			100	<1	<1	100

Totals may vary slightly due to rounding.

Table 5-12. Underground Emphasis LRT Alternative 2035 Annual Highway Traffic GHG Emissions				
	CO_2	CH_4	N_2O	Total[2]
Vehicle Miles Traveled (VMT)	n/a	n/a	n/a	504,320,300
Emission Factor (grams per mile)	578.319	0.015	0.173	N/A
Emissions (metric tons per year)	106,455,200	2,800	31,800	N/A
GWP	1	21	300	N/A
CO_2e Emissions[1] (metric tons per year)	106,455,200	58,800	9,858,000	116,372,000

Key:
CO_2 = carbon dioxide
CO_2e = carbon dioxide equivalent
CH_4 = methane
GWP = Global Warming Potential
N/A = Not applicable
N_2O = nitrous oxide
Note:
[1] *CO_2e emissions are weighted by the global warming potential (GWP) for each non-CO_2 pollutant (i.e., CO_2e equals emissions of non-CO_2 pollutant x GWP)*
[2] *Totals may vary slightly due to rounding.*

5.4.1.5 Total Operational Emissions

Total operational emissions were estimated from light rail operation and regional traffic. Emissions were compared to existing conditions (2009) to evaluate significance under CEQA and compared to the No Build Alternative (2035) for significance under NEPA. Total operational emissions are summarized in Table 5-13.

5.4.2 Construction Emissions

Construction of the Underground Emphasis LRT Alternative would result in GHG emissions from diesel-fueled construction equipment. Construction emissions were estimated using the OFFROAD emissions model and the proposed construction schedule. The Underground Emphasis LRT Alternative could be realized in several ways. Four scenarios were compared, based on whether SEM or cut & cover is used in construction of the 2nd/Hope Street station and whether the proposed 2nd Street station is built at either Broadway or Los Angeles Street.

Estimated emissions are provided in Table 5-14. The emissions shown indicate the total project emissions and have also been amortized over 30 years as required by the SCAQMD. Section 1.2 provides a summary of amortized construction emissions along with the operational emissions increment.

5.4.3 Cumulative Emissions

The proposed project would result in a decrease in GHG emissions compared to the No Build Alternative and, due to regional growth unrelated to the project, an increase in GHG emissions compared to existing conditions (2009). The Underground Emphasis LRT Alternative is consistent with CARB's Scoping Plan requirement to reduce GHG emissions. It is expected that other projects operating in 2035 would be consistent with the emission reduction targets of SB 375 and the Regional Transportation Plan. As a result, potential emissions would not be cumulatively significant.

Table 5-13. Summary of Total Operational GHG Emissions for Underground Emphasis LRT Alternative

Mode	Total Operational GHG Emissions (metric tons CO_2e per year)			
	CO_2	CH_4	N_2O	Total[3]
Regional Traffic	106,455,200	58,800	9,858,000	116,372,000
Light Rail	1,100	1	2	1,100
New Stations	100	<1	<1	100

Table 5-13. Summary of Total Operational GHG Emissions for Underground Emphasis LRT Alternative				
Mode	Total Operational GHG Emissions (metric tons CO_2e per year)			
	CO_2	CH_4	N_2O	Total[3]
Total Emissions	106,456,400	58,800	9,858,000	116,373,200
CEQA Increment[1]	65,904,400	(6,300)	3,906,000	69,804,100
NEPA Increment[2]	(64,700)	1	2	(64,700)

Notes:
[1] *CEQA Increment is defined as the difference between the* proposed alternative *(2035) and existing conditions (2009).*
[2] *NEPA Increment is defined as the difference between the* proposed *alternative (2035) and the No Build Alternative (2035).*
[3] *Totals may vary slightly due to rounding.*

5.5 Fully Underground Alternative – Little Tokyo Variation 1

Under Fully Underground LRT Alternative – Little Tokyo Variation 1, the proposed light rail extension would occur entirely underground. Under this alternative, the proposed 2nd Street/Central Avenue station and junction would be on the same level underground. This section summarizes estimated emissions associated with this alternative.

5.5.1 Operational Emissions

Operational emissions associated with the Fully Underground LRT Alternative – Little Tokyo Variation 1 would include indirect emissions from electricity needed to operate light rail vehicles and new stations and direct emissions from highway traffic after construction is completed and the project is implemented.

Table 5-14. Underground Emphasis LRT Alternative Annual Construction GHG Emissions (2014-2017)

Phase	Emissions of CO_2e (metric tons per year)					
	2014	2015	2016	2017	Project	Amortized Emissions
2nd/Hope Street station + 2nd Street station – Broadway Option (SEM)	1,900	17,500	47,300	32,400	99,100	3,300
2nd/Hope Street station + 2nd Street station - Broadway Option (Cut & Cover)	1,900	17,700	48,100	32,900	100,600	3,400
2nd/Hope Street station + 2nd Street station - Los Angeles Street Option (SEM)	1,900	17,500	47,200	32,300	98,900	3,300
2nd/Hope Street station + 2nd Street station - Los Angeles Street Option (Cut & Cover)	1,900	17,700	48,000	32,800	100,400	3,300

Totals may vary slightly due to rounding

5.5.1.1 Light Rail Emissions

Emissions from power generation for electricity needed to operate light rail trains were estimated based on the route distance, train headways, and the average energy intensity for train operation. The analysis assumed that LADWP would achieve the RPS of 35 percent renewable by 2020. Table 5-15 provides a summary of estimated emissions from light rail operation.

5.5.1.2 New Station Emissions

In addition to emissions associated with propulsion of the light rail vehicles, emissions would also be generated from new stations. Emissions from the operation of stations were estimated based on figures from a similar light rail system, the Muni in San Francisco, as calculated in a study by Chester and Horvath (2008). As with light rail operation, emissions were adjusted by the expected 35 percent RPS that LADWP will achieve by 2035. Emissions are summarized in Table 5-16.

5.5.1.3 Regional Traffic

Emissions of GHG that would occur from regional traffic under the Fully Underground LRT Alternative – Little Tokyo Variation 1 are summarized in Table 5-17. The emission

calculations were based on the total VMT in the region and the average speed on the highway network.

Table 5-15. Fully Underground LRT Alternative – Little Tokyo Variation 1 (2035) Project Area Light Rail Annual GHG Emissions

Alternative	Annual CO_2e Emissions (metric tons per year)			
	CO_2	CH_4	N_2O	Total
Current energy mix with 8% renewable energy	4,600	2	9	4,600
Expected Emissions with 35% Renewable Portfolio Standard	1,000	1	2	1,000

5.5.1.4 Bus Operation

Additional bus routes would not be added as part of this alternative. Therefore, CNG bus emissions would be zero and are not included in this section.

5.5.1.5 Total Operational Emissions

Total operational emissions were estimated from light rail operation and regional traffic. Emissions were compared to existing conditions (2009) to evaluate significance under CEQA and to the No Build Alternative (2035) for significance under NEPA. Total operational emissions are summarized in Table 5-18.

5.5.2 Construction Emissions

Construction of the Fully Underground LRT Alternative – Variation 1 would result in GHG emissions from diesel-fueled construction equipment. Construction emissions were estimated using the OFFROAD emissions model and the proposed construction schedule. Under this alternative, the 2nd/Hope Street station could be constructed either by SEM or cut & cover.

Estimated emissions for both construction methods are provided in Table 5-19. The emissions shown indicate total project emissions and have also been amortized by 30 years as required by the SCAQMD. Section 1.2 provides a summary of amortized construction emissions along with the operational emissions increment.

Table 5-16. Fully Underground LRT Alternative – Little Tokyo Variation 1 New Station Emissions						
Infrastructure	Number of New Stations	Energy per Station (kWh/yr)	CO_2e Emissions (metric tons/yr)			
			CO_2	CH_4	N_2O	Total
Station Lighting	4	2,600	6	<1	<1	6
Station Escalators	4	41,200	90	<1	<1	90
Train Control	4	127,200	300	<1	1	300
Station Maintenance	4	159,700	400	<1	1	400
Total			700	<1	2	700
Total (Adjusted for 35% RPS)			200	<1	<1	200

Table 5-17. Fully Underground LRT Alternative – Little Tokyo Variation 1 (2035) Annual Highway Traffic GHG Emissions				
	CO_2	CH_4	N_2O	Total[2]
Vehicle Miles Traveled (VMT)	n/a	n/a	n/a	504,311,000
Emission Factor (grams per mile)	578.319	0.015	0.173	N/A
Emissions (metric tons per year)	106,453,200	2,800	31,800	N/A
GWP	1	21	310	N/A
CO_2e Emissions[1] metric tons per year)	106,453,200	58,800	9,858,000	116,370,000

Key:
CO_2 = carbon dioxide
CO_2e = carbon dioxide equivalent
CH_4 = methane
GWP = Global Warming Potential
N/A = not applicable
N_2O = nitrous oxide
Note:

[1] *CO_2e emissions are weighted by the global warming potential (GWP) of each non-CO_2 pollutant (i.e., CO_2e equals emissions of non-CO_2 pollutant x GWP)*
[2] *Totals may vary slightly due to rounding*

5.5.3 Cumulative Emissions

The proposed alternative would result in a decrease in GHG emissions compared to the No Build Alternative and, due to regional growth unrelated to the project, an increase in GHG emissions compared to existing conditions (2009). The Fully Underground Alternative – Little Tokyo Variation 1 is consistent with CARB's Scoping Plan requirement to reduce GHG emissions. It is expected that other projects operating in 2035 would be consistent with the emission reduction targets of SB 375 and the Regional Transportation Plan. As a result, emissions would not be cumulatively significant.

Table 5-18. Summary of Total Operational GHG Emissions for Fully Underground LRT Alternative – Little Tokyo Variation 1

Mode	Total Operational GHG Emissions (metric tons CO_2e per year)			
	CO_2	CH_4	N_2O	Total[3]
Regional Traffic	106,453,200	58,800	9,858,000	116,370,000
Light Rail	1,000	1	2	1,000
New Station	200	<1	<1	200
Total Emissions	106,454,400	58,800	9,858,000	116,371,200
CEQA Increment[1]	65,902,400	(6,300)	3,906,000	69,800,100
NEPA Increment[2]	(66,700)	1	2	66,700

Notes:
[1] *CEQA Increment is defined as the difference between the proposed alternative(2035) and existing conditions (2009).*
[2] *NEPA Increment is defined as the difference between the proposed alternative (2035) and the No Build Alternative (2035).*
[3] *Totals may vary slightly due to rounding.*

Table 5-19. Fully Underground LRT Alternative – Little Tokyo Variation 1 Annual Construction GHG Emissions (2014-2017)						
Phase	Emissions of CO_2e (metric tons per year)					
	2014	2015	2016	2017	Project	Amortized Emissions
2nd/Hope Street station (SEM)	1,800	18,400	54,600	40,700	115,400	3,800
2nd/Hope Street station (Cut & Cover)	1,800	18,900	56,000	41,600	118,300	3,900

Totals may vary slightly due to rounding

5.6 Fully Underground Alternative – Little Tokyo Variation 2

Under the Fully Underground LRT Alternative – Little Tokyo Variation 2, the operation of the proposed light rail extension would occur entirely underground. With this alternative, the proposed 2nd/Central Avenue station and junction would be constructed on two levels. Unlike the single, double-track portal imagined in Fully Underground Alternative – Little Tokyo Variation 1, in this alternative, two single-track portals would be built in the median of 1st Street. This section provides a summary of estimated emissions associated with this alternative.

5.6.1 Operational Emissions

Operational emissions associated with the Fully Underground LRT Alternative – Little Tokyo Variation 2 would include indirect emissions from electricity generation needed to operate light rail vehicles and the stations and direct emissions from highway traffic after construction is completed and the project is implemented.

5.6.1.1 Light Rail and New Station Emissions

Operation of light rail vehicles and stations associated with the Fully Underground LRT Alternative – Little Tokyo Variation 2 would not differ from those estimated under Variation 1. Emissions from Variation 1 should be reviewed for Variation 2.

5.6.1.2 Regional Traffic

Emissions of GHG that would occur from regional traffic in the Fully Underground LRT Alternative – Little Tokyo Variation 2 are summarized in Table 5-20. Emission calculations were based on the total VMT in the region and the average speed on the highway network.

5.6.1.3 Bus Operation

Additional bus routes would not be added as part of this alternative. Therefore, CNG bus emissions would be zero and are not included in this section.

5.6.1.4 Total Operational Emissions

Total operational emissions were estimated from light rail operation and regional traffic. Emissions were compared to existing conditions (2009) to evaluate significance under CEQA and to the No Build Alternative (2035) for significance under NEPA. Total operational emissions are summarized in Table 5-21.

Table 5-20. Fully Underground LRT Alternative – Little Tokyo Variation 2 (2035) Annual Highway Traffic GHG Emissions

	CO_2	CH_4	N_2O	Total[2]
Vehicle Miles Traveled (VMT)	n/a	n/a	n/a	504,310,000
Emission Factor (grams per mile)	578.319	0.015	0.173	N/A
Emissions (metric tons per year)	106,453,000	2,800	31,800	N/A
GWP	1	21	310	N/A
CO_2e Emissions[1] (metric tons per year)	106,453,000	58,800	9,858,000	116,369,800

Key:
CO_2 = carbon dioxide
CO_2e = carbon dioxide equivalent
CH_4 = methane
GWP = Global Warming Potential
N/A = not applicable
N_2O = nitrous oxide
Note:
[1] *CO_2e emissions are weighted by the global warming potential (GWP) for each non-CO_2 pollutant (i.e., CO_2e equals emissions of non-CO_2 pollutant x GWP)*
[2] *Totals may vary slightly due to rounding*

5.6.2 Construction Emissions

Construction of the Fully Underground LRT Alternative – Variation 2 would result in GHG emissions from diesel-fueled construction equipment. Construction emissions were estimated using the OFFROAD emissions model and the proposed construction schedule. The 2nd/Hope street station in this build alternative could be constructed by either SEM or cut & cover.

Estimated emissions for both construction methods are provided in Table 5-22. The emissions shown indicate the total project emissions and have also been amortized over 30 years, as required by the SCAQMD. Section 1.2 provides a summary of amortized construction emissions along with the operational emissions increment.

5.6.3 Cumulative Emissions

The proposed project would result in a decrease in GHG emissions compared to the No Build Alternative and, due to regional growth unrelated to the project, an increase in GHG emissions compared to existing conditions (2009). This proposed alternative is consistent with CARB's Scoping Plan requirement to reduce GHG emissions. It is expected that other projects operating in 2035 would be consistent with the emission reduction targets of SB 375 and the Regional Transportation Plan. As a result, emissions would not be cumulatively significant.

Table 5-21. Summary of Total Operational GHG Emissions for Fully Underground LRT Alternative – Little Tokyo Variation 2

Mode	Total Operational GHG Emissions (metric tons CO_2e per year)			
	CO_2	CH_4	N_2O	Total[3]
Regional Traffic	106,453,000	58,800	9,858,000	116,369,800
Light Rail	1,000	1	2	1,000
New Station	200	<1	<1	200
Total Emissions	106,454,200	58,800	9,858,000	116,371,000
CEQA Increment[1]	65,902,200	(6,300)	3,906,000	69,800,900
NEPA Increment[2]	(66,900)	1	2	(66,900)

Notes:
[1] *CEQA Increment is defined as the difference between the proposed alternative (2035) and existing conditions (2009).*
[2] *NEPA Increment is defined as the difference between the proposed alternative (2035) and the No Build Alternative (2035).*
[3] *Totals may vary slightly due to rounding.*

Table 5-22. Fully Underground LRT Alternative – Variation 2 Annual Construction GHG Emissions (2014-2017)						
Phase	Emissions of CO_2e (metric tons per year)					
	2014	2015	2016	2017	Project	Amortized Emissions
2nd/Hope Street station (SEM)	1,800	17,600	54,600	40,700	114,800	3,800
2nd/Hope Street station (Cut & Cover)	1,800	18,000	56,100	41,700	117,600	3,900

Totals may vary slightly due to rounding.

6.0 POTENTIAL MITIGATION MEASURES

GHG emissions in each of the build alternatives, and the TSM alternative, are greater than those for existing conditions (see Table 1-2) but less than those for the No Build Alternative (see Table 1-3). The proposed Regional Connector Transit Corridor project is consistent with the requirements of CARB's Scoping Plan and SB 375 by increasing regional transportation capacity and decreasing emissions from passenger vehicles. The proposed alternatives are also consistent with SB 375 and the Regional Connector Transit Corridor project identified in SCAG's 2008 Regional Transportation Plan. Thus, no mitigation measures are required for the proposed project.

7.0 CONCLUSIONS

The build alternatives and the TSM Alternative would cause a decrease in GHG emissions compared to the No Build Alternative and an increase in GHG emissions compared to existing conditions. The build alternatives and the TSM Alternative would be consistent with the requirements of CARB's Scoping Plan and SB 375 to improve mobility in the region and to enhance the regional transportation network infrastructure without encouraging single-vehicle occupancy use.

The increase in GHG emissions among all alternatives in the horizon year (2035) compared to existing conditions is due to increases in the regional VMT from expected growth in the region. This growth is not related to the proposed Regional Connector Transit Corridor project.

Although not reflected quantitatively in this analysis, several of the additional requirements in the Scoping Plan, such as following the Pavley regulations and the low carbon fuel standard, would further reduce GHG emissions. This reduction would occur despite an increase in VMT expected in the region. Therefore, it is expected that GHG emissions would be even less than those calculated in this analysis and, by the horizon year of 2035, could even be less than those for existing conditions.

Since the project is consistent with the area's regional plans, including the Regional Transportation Plan, the project's climate change impacts would not be significant under CEQA. By decreasing the region's GHG emissions, the proposed project's climate change impacts would not be significant under NEPA.

The proposed project would have a net benefit with respect to climate change. Each of the project alternatives decreases overall GHG emissions, including reducing VMT and resulting emissions, when compared to the No Build Alternative (2035). By implementing the proposed project, GHG emissions in the area would be lower than would be expected under a business-as-usual scenario (i.e., No Build Alternative).

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