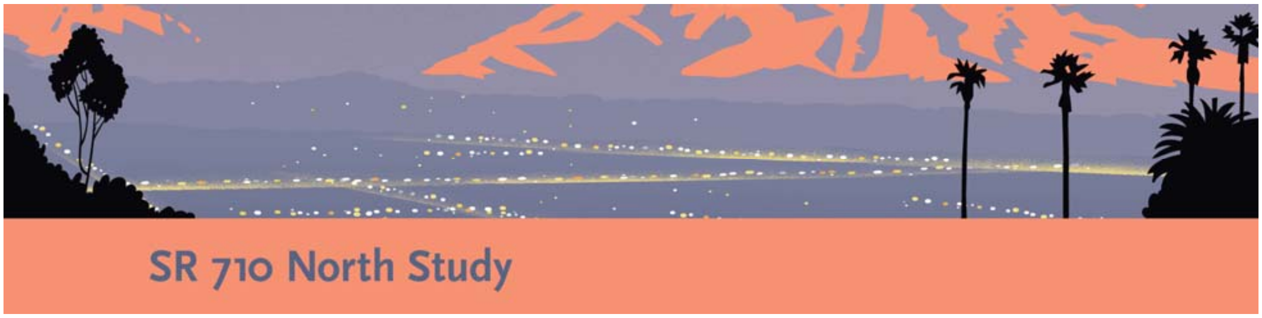

Energy Technical Report

Prepared for

Caltrans
CALIFORNIA DEPARTMENT OF TRANSPORTATION

Metro
Los Angeles County
Metropolitan Transportation Authority

October 2014

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Abstract

Transportation-related activities account for approximately half of all the petroleum products consumed in California (California Department of Transportation, Environmental Impact Report/Environmental Impact Statement Annotated Outline. 2009. http://www.dot.ca.gov/ser/forms.htm). While State and federal policies (e.g., the California Low-Emission Vehicle Program and the Federal Energy Policy Act of 1992) are increasing the use of alternative-fuel and low-emission vehicles, the consumption of non-renewable resources (e.g., fossil fuels) remains high and points to the need to conserve such energy resources. Both the National Environmental Policy Act (NEPA) (i.e., Section 102(2)) and the California Environmental Quality Act (CEQA) Guidelines (i.e., Appendix F) require the identification of potentially substantial (significant) energy impacts.

The need to develop energy efficient projects is also highlighted in the California Department of Transportation (Caltrans) Director's Policy on Energy Efficiency, Conservation, and Climate Change (DP-23-R1 June 2007), which states:

> "Caltrans incorporates energy efficiency, conservation, and climate change measures into transportation planning, project development, design, operations, and maintenance of transportation facilities, fleets, buildings, and equipment to minimize use of fuel supplies and energy sources and reduce greenhouse gas (GHG) emissions.
>
> The intent of this policy is to implement a comprehensive, long-term departmental energy policy, interagency collaboration, and a coordinated effort in energy and climate policy, planning, and implementation."

Caltrans, in cooperation with the Los Angeles County Metropolitan Transportation Authority (Metro) proposes transportation improvements to improve mobility and relieve congestion in the area between State Route 2 (SR 2) and Interstates 5, 10, 210 and 605 (I-5, I-10, I-210, and I-605, respectively) in east/northeast Los Angeles and the western San Gabriel Valley. The study area for the State Route 710 (SR 710) North Study is approximately 100 square miles and generally bounded by I-210 on the north, I-605 on the east, I-10 on the south, and I-5 and SR 2 on the west. Caltrans is the Lead Agency under NEPA and CEQA.

The lack of continuous north-south transportation facilities in the study area has the following consequences, which have been identified as the elements of need for the project:

- Degradation of the overall efficiency of the larger regional transportation system
- Congestion on freeways in the study area
- Congestion on the local streets in the study area
- Poor transit operations within the study area

The purpose of the proposed action is to effectively and efficiently accommodate regional and local north-south travel demands in the study area of the western San Gabriel Valley and east/northeast Los Angeles, including the following considerations:

- Efficiency improvement of the existing regional freeway and transit networks
- Congestion reduction on local arterials adversely affected due to accommodating regional traffic volumes
- Environmental impact minimization related to mobile sources

The proposed alternatives for the project include the No Build Alternative, the Transportation System Management/Transportation Demand Management (TSM/TDM) Alternative, the Bus Rapid Transit (BRT) Alternative, the Light Rail Transit (LRT) Alternative, and the Freeway Tunnel Alternative. Components of the TSM/TDM Alternative will also be included with the BRT, the LRT and the Freeway Tunnel Alternatives.

The No Build Alternative includes projects/planned improvements through 2035 that are contained in the Federal Transportation Improvement Program (FTIP), as listed in the Southern California Association of Governments (SCAG) 2012 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) Measure R and the funded portion of Metro's 2009 Long Range Transportation Plan (LRTP). The No Build Alternative does not include any planned improvements to the SR 710 Corridor.

The TSM/TDM Alternative consists of strategies and improvements to increase efficiency and capacity for all modes in the transportation system with lower capital cost investments and/or lower potential impacts. The TSM/TDM Alternative is designed to maximize the efficiency of the existing transportation system by improving capacity and reducing the effects of bottlenecks and chokepoints. TSM strategies include Intelligent Transportation Systems (ITS), local street and intersection improvements, and Active Traffic Management (ATM). The TDM strategies include expanded bus service, bus service improvements, and bicycle improvements.

The BRT Alternative would provide high-speed, high-frequency bus service through a combination of new, dedicated, and existing bus lanes, and mixed-flow traffic lanes to key destinations between the community of East Los Angeles and the City of Pasadena.

The LRT Alternative would include passenger rail operated along a dedicated guideway, similar to other Metro light rail lines. The LRT Alternative would begin on Mednik Avenue adjacent to the existing East Los Angeles Civic Center Station on the Metro Gold Line and end at Raymond Avenue adjacent to the existing Fillmore Station on the Metro Gold Line.

The Freeway Tunnel Alternative would start at the existing southern stub of SR 710 in the City of Alhambra, just north of I-10, and connect to the existing northern stub of SR 710, south of the I-210/ State Route 134 (SR 134) interchange in the City of Pasadena. The Freeway Tunnel Alternative has two design variations: a dual-bore tunnel and a single-bore tunnel. Five operational variations for the Freeway Tunnel Alternative include the freeway tunnel alternative without tolls, the freeway tunnel alternative with trucks excluded, the freeway tunnel alternative with tolls, the freeway tunnel alternative with tolls and trucks excluded, and the freeway tunnel alternative with toll and express bus.

This energy analysis is based on the methodology described in detail in the Caltrans Standard Environmental Reference (SER), Volume 1, Chapter 13 – Energy (updated March 11, 2013). The energy analysis addresses three elements: direct and indirect energy consumption and service parameters. Direct energy refers to the fuel consumed by vehicles using a transportation facility.

Indirect energy refers to energy associated with construction and operation of a transportation facility. Service parameters concern the actual transportation service versus the potential transportation service. Potential service of a vehicle would be the maximum rated capacity for passengers or cargo, and actual service is the real number it does carry. The ratio of actual service rendered versus potential service is called the “load factor.”

Direct transportation energy consumption and service parameters impacts were estimated for the project using traffic forecasts and the California Air Resources Board (ARB) EMFAC2011 air quality model, which provides estimated gasoline and diesel fuel consumption rates. Estimated energy consumption in 2035 is expected to represent the most conservative (i.e., highest) energy consumption because population and employment are projected to be higher in that year than in any earlier year. In addition, this analysis does not reflect the benefit of energy efficiency and conservation measures that are likely to be adopted by 2035 and which would result in lower energy consumption than projected in these estimates (i.e., new California Environmental Protection Agency [Cal/EPA]/United States Environmental Protection Agency [EPA] fuel economy standards, bus rapid transit programs reducing personal vehicle use, and increased use of high-occupancy vehicles [HOVs]).

Project-related indirect energy impacts were estimated using standard Caltrans approximation factors, as described in the SER. Implementation of the project would affect the use of energy resources in the Los Angeles County region. The analysis of these impacts is at the regional level and, therefore, by its nature, an analysis of cumulative impacts. Three main areas of impact have been identified: (1) energy demands for construction; (2) energy demands for operation of the regional transportation system as of 2035; and (3) the cumulative impacts of the growing energy demand associated with implementation of the project.

For the tunneling equipment demand, the Los Angeles Department of Water and Power (LADWP) and the Pasadena Water and Power Utility have committed to build electrical substations at the southern tunnel portal and the northern tunnel portal, respectively, for the Freeway Tunnel Alternative and its design variations. The LADPW has committed to build a substation at the southern tunnel portal for the LRT Alternative. Thus, it is anticipated that the construction energy demands from the Freeway Tunnel and LRT Alternatives will be accommodated by both these utility providers. Therefore, no avoidance, minimization, or mitigation measures would be required.

Regarding the third energy impact element – service parameters, the proposed project would not alter the ratio of the actual transportation service versus the potential transportation service within the project region; thus, the proposed project would have no effect on service parameters.

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Acronyms and Abbreviations

°F	degrees Fahrenheit
AB	Assembly Bill
AFV	alternative fuel vehicle
ARB	California Air Resources Board
ATM	Active Traffic Management
BioGas	biomethane
BRT	Bus Rapid Transit
BTUs	British thermal units
Cal State LA	California State University, Los Angeles
Cal/EPA	California Environmental Protection Agency
Caltrans	California Department of Transportation
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CMS	changeable message signs
CNG	compressed natural gas
CPA	Consumer Power and Conservation Financing Authority
CPUC	California Public Utilities Commission
DGE	diesel gallon equivalent
DOE	United States Department of Energy
E85	ethanol, 85 percent
EIA	United States Energy Information Administration
EIR	Environmental Impact Report
ELAC	East Los Angeles College
EPA	United States Environmental Protection Agency
EV	electric vehicles
ft	foot/feet
FTIP	Federal Transportation Improvement Program
GGE	gasoline gallon equivalent
GHG	greenhouse gas
HOV	high-occupancy vehicle
I-5	Interstate 5
I-10	Interstate 10
I-105	Interstate 105
I-210	Interstate 210
I-405	Interstate 405
I-605	Interstate 605
I-710	Interstate 710
IEN	Information Exchange Network
IEPR	Integrated Energy Policy Report

ITS	Intelligent Transportation Systems
LADWP	Los Angeles Department of Water and Power
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LRT	Light Rail Transit
LRTP	Long Range Transportation Plan
LRV	light rail vehicle
Metro	Los Angeles County Metropolitan Transportation Authority
mi	mile/miles
mph	miles per hour
MSA	Metropolitan Statistical Area
MW	megawatts
NEPA	National Environmental Policy Act
O&M	operations and maintenance
OCS	Outer Continental Shelf
PS&E	Plans, Specifications and Estimates
ROW	right of way
RTP	Regional Transportation Plan
SCAG	Southern California Association of Governments
SCS	Sustainable Communities Strategy
SER	Standard Environmental Reference
SONGS	San Onofre Nuclear Generating Station
SR 2	State Route 2
SR 22	State Route 22
SR 57	State Route 57
SR 60	State Route 60
SR 91	State Route 91
SR 110	State Route 110
SR 118	State Route 118
SR 134	State Route 134
SR 170	State Route 170
SR 710	State Route 710
TAP	Transit Access Pass
TDM	Transportation Demand Management
TSM	Transportation System Management
TSSP	Traffic Signal Synchronization Program
US-101	United States Route 101
USC	United States Code
VMT	vehicle miles traveled

1. Project Description

1.1 Introduction

The California Department of Transportation (Caltrans), in cooperation with the Los Angeles County Metropolitan Transportation Authority (Metro) proposes transportation improvements to improve mobility and relieve congestion in the area between State Route 2 (SR 2) and Interstates 5, 10, 210 and 605 (I-5, I-10, I-210, and I-605, respectively) in east/northeast Los Angeles and the western San Gabriel Valley. The study area for the State Route 710 (SR 710) North Study as depicted on Figure 1-1 is approximately 100 square miles and generally bounded by I-210 on the north, I-605 on the east, I-10 on the south, and I-5 and SR 2 on the west. Caltrans is the Lead Agency under the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

1.2 Purpose and Need

1.2.1 Purpose of the Project

Due to the lack of continuous north-south transportation facilities in the study area, there is congestion on freeways, cut-through traffic that affects local streets, and low-frequency transit operations in the study area. Therefore, the following project purpose has been established.

The purpose of the proposed action is to effectively and efficiently accommodate regional and local north-south travel demands in the study area of the western San Gabriel Valley and east/northeast Los Angeles, including the following considerations:

- Improve efficiency of the existing regional freeway and transit networks.
- Reduce congestion on local arterials adversely affected due to accommodating regional traffic volumes.
- Minimize environmental impacts related to mobile sources.

1.2.2 Need for the Project

The study area is centrally located within the extended urbanized area of Southern California. With few exceptions, the area from Santa Clarita in the north to San Clemente in the south (a distance of approximately 90 miles [mi]) is continuously urbanized. Physical features such as the San Gabriel Mountains and Angeles National Forest on the north, and the Puente Hills and Cleveland National Forest on the south, have concentrated urban activity between the Pacific Ocean and these physical constraints. This urbanized area functions as a single social and economic region that is identified by the Census Bureau as the Los Angeles-Long Beach-Santa Ana Metropolitan Statistical Area (MSA).

There are seven major east-west freeway routes:

- State Route 118 (SR 118)
- United States Route 101 (US-101)/State Route 134 (SR 134)/I-210
- I-10
- State Route 60 (SR 60)

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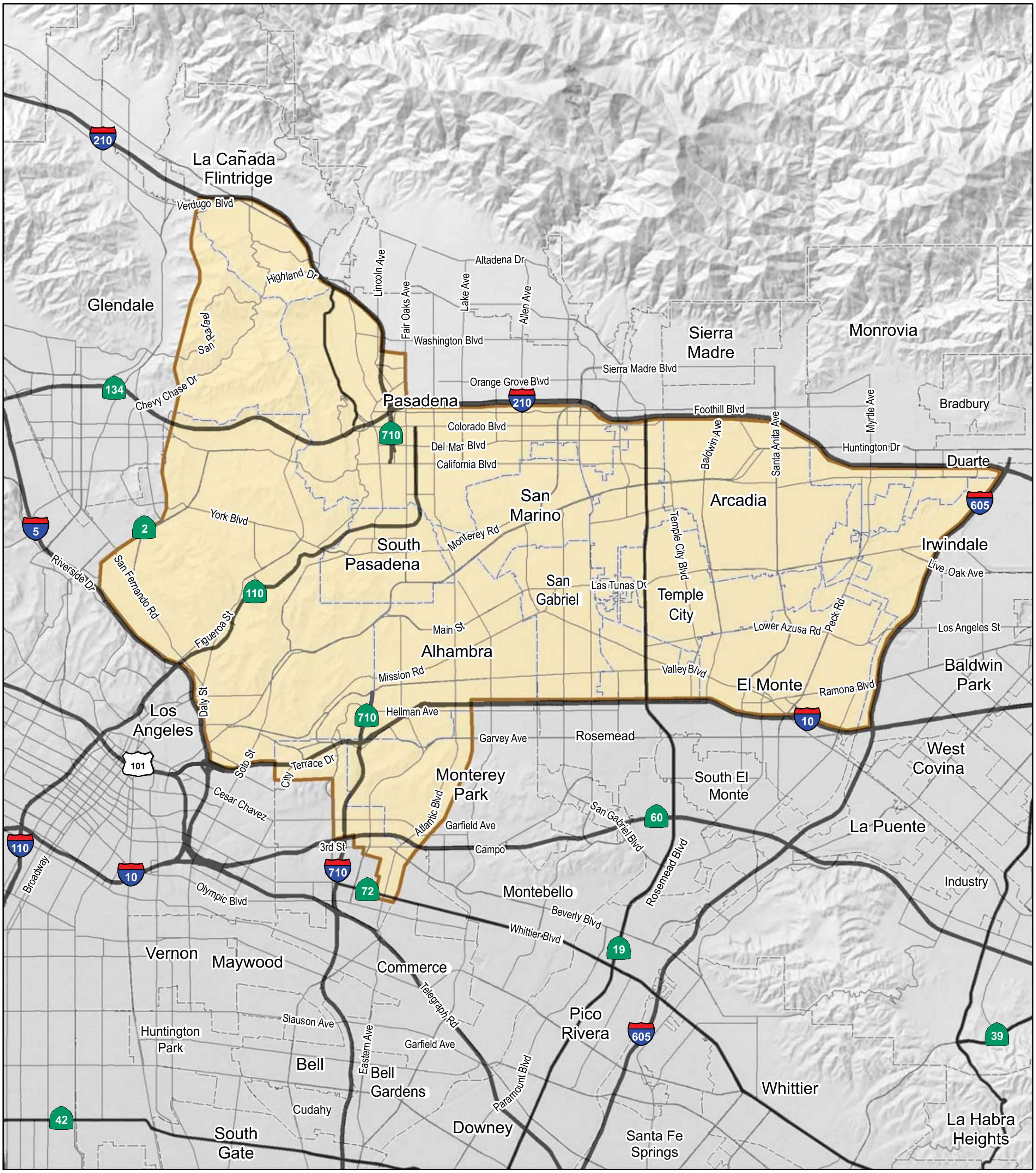

FIGURE 1-1

LEGEND

SR 710 North Study Area

N

0 1.25 2.5

MILES

SOURCE: ESRI (2008); LSA (2013)

SR 710 North Study

Project Location

07-LA-710 (SR 710)
EA 187900
EFIS 0700000191

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- Interstate 105 (I-105)
- State Route 91 (SR 91)
- State Route 22 (SR 22)

There are seven major north-south freeway routes:

- Interstate 405 (I-405)
- US-101/State Route 170 (SR 170)
- I-5
- State Route 110 (SR 110)
- Interstate 710 (I-710)
- I-605
- State Route 57 (SR 57)

All of these major routes are located in the central portion of the Los Angeles-Long Beach-Santa Ana MSA. Of the seven north-south routes, four are located partially within the study area (I-5, SR 110, I-710, and I-605), two of which (SR 110 and I-710) terminate within the study area without connecting to another freeway. As a result, a substantial amount of north-south regional travel demand is concentrated on a few freeways, or diverted to local streets within the study area. This effect is exacerbated by the overall southwest-to-northeast orientation of I-605, which makes it an unappealing route for traffic between the southern part of the region and the urbanized areas to the northwest in the San Fernando Valley, the Santa Clarita Valley, and the Arroyo-Verdugo region.

The lack of continuous north-south transportation facilities in the study area has the following consequences, which have been identified as the elements of need for the project:

- Degradation of the overall efficiency of the larger regional transportation system
- Congestion on freeways in the study area
- Congestion on the local streets in the study area
- Poor transit operations within the study area

1.3 Alternatives

The proposed alternatives include the No Build Alternative, the Transportation System Management/Transportation Demand Management (TSM/TDM) Alternative, the Bus Rapid Transit (BRT) Alternative, the Light Rail Transit (LRT) Alternative, and the Freeway Tunnel Alternative. These alternatives are each discussed below.

1.3.1 No Build Alternative

The No Build Alternative includes projects/planned improvements through 2035 that are contained in the Federal Transportation Improvement Program (FTIP), as listed in the Southern California Association of Governments (SCAG) 2012 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), Measure R, and the funded portion of Metro's 2009 Long Range Transportation

Plan (LRTP). The No Build Alternative does not include any planned improvements to the SR 710 Corridor. Figure 1-2 illustrates the projects in the No Build Alternative.

1.3.2 Transportation System Management/Transportation Demand Management (TSM/TDM) Alternative

The TSM/TDM Alternative consists of strategies and improvements to increase efficiency and capacity for all modes in the transportation system with lower capital cost investments and/or lower potential impacts. The TSM/TDM Alternative is designed to maximize the efficiency of the existing transportation system by improving capacity and reducing the effects of bottlenecks and chokepoints. Components of the TSM/TDM Alternative are shown on Figure 1-3. TSM strategies increase the efficiency of existing facilities (i.e., TSM strategies are actions that increase the number of vehicle trips which a facility can carry without increasing the number of through lanes).

1.3.2.1 Transportation System Management

TSM strategies include Intelligent Transportation Systems (ITS), local street and intersection improvements, and Active Traffic Management (ATM):

- **ITS Improvements:** ITS improvements include traffic signal upgrades, synchronization and transit prioritization, arterial changeable message signs (CMS), and arterial video and speed data collection systems. The TSM/TDM Alternative includes signal optimization on corridors with signal coordination hardware already installed by Metro's Traffic Signal Synchronization Program (TSSP). These corridors include Del Mar Avenue, Rosemead Boulevard, Temple City Boulevard, Santa Anita Avenue, Fair Oaks Avenue, Fremont Avenue, and Peck Road. The only remaining major north-south corridor in the San Gabriel Valley in which TSSP has not been implemented is Garfield Avenue; therefore, TSSP on this corridor is included in the TSM/TDM Alternative. The locations are shown in Table 1.1. The following provide a further explanation of the ITS elements listed above:
  - Traffic signal upgrades include turn arrows, vehicle and/or bicycle detection, pedestrian countdown timers, incorporation into regional management traffic center for real-time monitoring of traffic and updating of signal timing.
  - Synchronization is accomplished through signal coordination to optimize travel times and reduce delay.
  - Transit signal prioritization includes adjusting signal times for transit vehicles to optimize travel times for public transit riders.
  - Arterial CMS are used to alert travelers about unusual road conditions, special event traffic, accident detours, and other incidents.
  - Video and speed data collection includes cameras and other vehicle detection systems that are connected to a central monitoring location, allowing for faster detection and response to traffic incidents and other unusual traffic conditions.

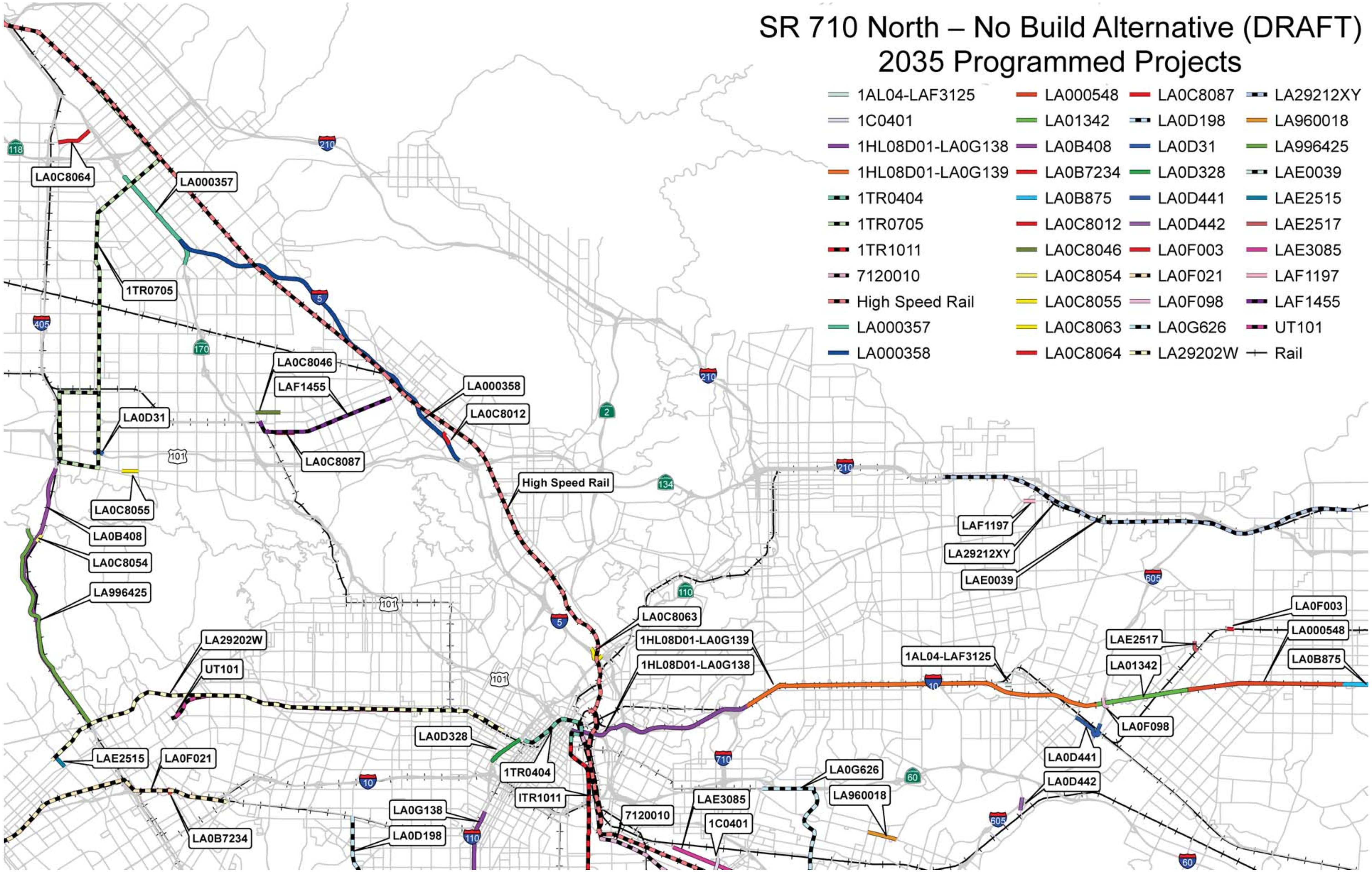

FIGURE 1-2

N

NOT TO SCALE

SOURCE: CH2M HILL (2013)

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SR 710 North Study

No Build Alternative

07-LA-710 (SR 710)
EA 187900
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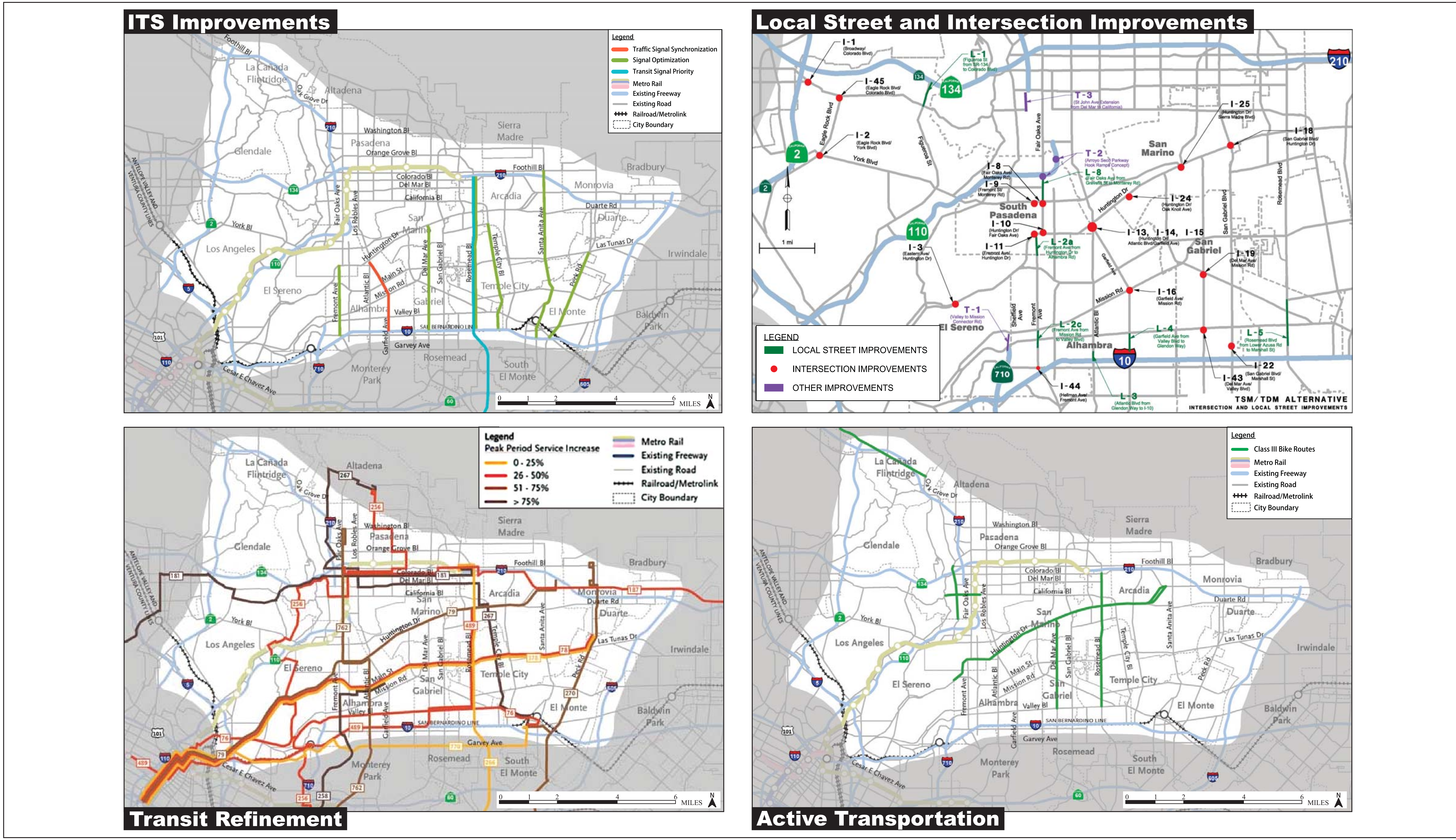

FIGURE 1-3

SR 710 North Study

TSM/TDM Alternative

07-LA-710 (SR 710)
EA 187900
EFIS 0700000191

SOURCE: CH2M HILL (2013)
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TABLE 1.1:
TSM/TDM Alternative Elements

ID No.	Description	Location
ITS Improvements		
ITS-1	Transit Signal Priority	Rosemead Boulevard (from Foothill Boulevard to Del Amo Boulevard)
ITS-2	Install Video Detection System on SR 110	SR 110 north of US-101
ITS-3	Install Video Detection System at Intersections	At key locations in study area
ITS-4	Arterial Speed Data Collection	On key north/south arterials
ITS-5	Install Arterial CMS	At key locations in study area
ITS-6	Traffic Signal Synchronization on Garfield Avenue	Huntington Drive to I-10
ITS-7	Signal optimization on Del Mar Avenue	Huntington Drive to I-10
ITS-8	Signal optimization on Rosemead Boulevard	Foothill Boulevard to I-10
ITS-9	Signal optimization on Temple City Boulevard	Duarte Road to I-10
ITS-10	Signal optimization on Santa Anita Avenue	Foothill Boulevard to I-10
ITS-11	Signal optimization on Peck Road	Live Oak Avenue to I-10
ITS-12	Signal optimization on Fremont Avenue	Huntington Drive to I-10

CMS = changeable message signs
I-10 = Interstate 10
ITS = Intelligent Transportation Systems
SR 110 = State Route 110
TDM = Transportation Demand Management
TSM = Transportation System Management
US-101 = United States Route 101

- **Local Street and Intersection Improvements:** The local street and intersection improvements are within the Cities of Los Angeles, Pasadena, South Pasadena, Alhambra, San Gabriel, Rosemead, and San Marino. Table 1.2 outlines the location of the proposed improvements to local streets, intersections, and freeway ramps as well as two new local roadways.
- **Active Traffic Management:** ATM technology and strategies are also included in the TSM/TDM Alternative. The major elements of ATM are arterial speed data collection and CMS. Data on arterial speeds would be collected and distributed through Los Angeles County's Information Exchange Network (IEN). Many technologies are available for speed data collection or the data could be purchased from a third-party provider. Travel time data collected through this effort could be provided to navigation system providers for distribution to the traveling public. In addition, arterial CMS or "trailblazer" message signs would be installed at key locations to make travel time and other traffic data available to the public.

1.3.2.2 Transportation Demand Management

TDM strategies focus on regional means of reducing the number of vehicle trips and vehicle miles traveled as well as increasing vehicle occupancy. TDM strategies facilitate higher vehicle occupancy or reduce traffic congestion by expanding the traveler's transportation options in terms of travel method, travel time, travel route, travel costs, and the quality and convenience of the travel experience. The TDM strategies include reducing the demand for travel during peak periods, reducing the use of motor vehicles, shifting the use of motor vehicles to uncongested times of the day, encouraging rideshare and transit use, eliminating trips (i.e., telecommuting), and improved transportation options. The TDM strategies include expanded bus service, bus service improvements, and bicycle improvements:

TABLE 1.2:
Local Street and Intersection Improvements of the TSM/TDM Alternative

ID No.	Description	Location
Local Street Improvements		
L-1	Figueroa Street from SR 134 to Colorado Boulevard	City of Los Angeles (Eagle Rock)
L-2a	Fremont Avenue from Huntington Drive to Alhambra Road	City of South Pasadena
L-2c	Fremont Avenue from Mission Road to Valley Boulevard	City of Alhambra
L-3	Atlantic Boulevard from Glendon Way to I-10	City of Alhambra
L-4	Garfield Avenue from Valley Boulevard to Glendon Way	City of Alhambra
L-5	Rosemead Boulevard from Lower Azusa Road to Marshall Street	City of Rosemead
L-8	Fair Oaks Avenue from Grevelia Street to Monterey Road	City of South Pasadena
Intersection Improvements		
I-1	West Broadway/Colorado Boulevard	City of Los Angeles (Eagle Rock)
I-2	Eagle Rock Boulevard/York Boulevard	City of Los Angeles (Eagle Rock)
I-3	Eastern Avenue/Huntington Drive	City of Los Angeles (El Sereno)
I-8	Fair Oaks Avenue/Monterey Road	City of South Pasadena
I-9	Fremont Street/Monterey Road	City of South Pasadena
I-10	Huntington Drive/Fair Oaks Avenue	City of South Pasadena
I-11	Fremont Avenue/Huntington Drive	City of South Pasadena
I-13	Huntington Drive/Garfield Avenue	Cities of Alhambra/South Pasadena/San Marino
I-14	Huntington Drive/Atlantic Boulevard	Cities of Alhambra/South Pasadena/San Marino
I-15	Atlantic Boulevard/Garfield Avenue	Cities of Alhambra/South Pasadena/San Marino
I-16	Garfield Avenue/Mission Road	City of Alhambra
I-18	San Gabriel Boulevard/Huntington Drive	City of San Marino/Unincorporated Los Angeles County (East Pasadena/East San Gabriel)
I-19	Del Mar Avenue/Mission Road	City of San Gabriel
I-22	San Gabriel Boulevard/Marshall Street	City of San Gabriel
I-24	Huntington Drive/Oak Knoll Avenue	City of San Marino
I-25	Huntington Drive/San Marino Avenue	City of San Marino
I-43	Del Mar Avenue/Valley Boulevard	City of San Gabriel
I-44	Hellman Avenue/Fremont Avenue	City of Alhambra
I-45	Eagle Rock Boulevard/Colorado Boulevard	City of Los Angeles (Eagle Rock)
Other Road Improvements		
T-1	Valley Boulevard to Mission Road Connector Road	Cities of Alhambra/Los Angeles (El Sereno)
T-2	SR 110/Fair Oaks Avenue Hook Ramps	Cities of South Pasadena/Pasadena
T-3	St. John Avenue Extension between Del Mar Boulevard and California Boulevard	City of Pasadena

I-10 = Interstate 10
I-710 = Interstate 710
NB = northbound
SB = southbound
SR 110 = State Route 110
SR 134 = State Route 134
TDM = Transportation Demand Management
TSM = Transportation System Management

- **Expanded Bus Service and Bus Service Improvements:** Transit service improvements included in the TSM/TDM Alternative are summarized in Tables 1.3 and 1.4 and illustrated on Figure 1-3. The transit service improvements enhance bus headways between 10 and 30 minutes during the peak hour and 15 to 60 minutes during the off-peak period. Bus headways are the amount of time between consecutive bus trips (traveling in the same direction) on the bus route. Some of the bus service enhancements almost double existing bus service.
- **Bicycle Facility Improvements:** The bicycle facility improvements include on-street Class III bicycle facilities that support access to transit facilities through the study area and expansion of bicycle parking facilities at existing Metro Gold Line stations. Proposed bicycle facility improvements are outlined in Table 1.4.

TABLE 1.3:
Transit Refinements of the TSM/TDM Alternative

Bus Route	Operator	Route Type	Route Description	Existing Headways		Enhanced Headways	
				Peak	Off-Peak	Peak	Off-Peak
70	Metro	Local	From Downtown Los Angeles to El Monte via Garvey Avenue	10-12	15	10	15
770	Metro	Rapid	From Downtown Los Angeles to El Monte via Garvey Avenue/Cesar Chavez Avenue	10-13	15	10	15
76	Metro	Local	From Downtown Los Angeles to El Monte via Valley Boulevard	12-15	16	10	15
78	Metro	Local	From Downtown Los Angeles to Irwindale via Las Tunas Drive	10-20	16-40	10	15
378	Metro	Limited	From Downtown Los Angeles to Irwindale via Las Tunas Drive	18-23	-	20	30
79	Metro	Local	From Downtown Los Angeles to Santa Anita via Huntington Drive	20-30	40-45	15	30
180	Metro	Local	From Hollywood to Altadena via Los Feliz/Colorado Boulevard	30	30-32	15	30
181	Metro	Local	From Hollywood to Pasadena via Los Feliz/Colorado Boulevard	30	30-32	15	30
256	Metro	Local	From Commerce to Altadena via Hill Avenue/Avenue 64/Eastern Avenue	45	45	30	40
258	Metro	Local	From Paramount to Alhambra via Fremont Avenue/ Eastern Avenue	48	45-55	20	30
260	Metro	Local	From Compton to Altadena via Fair Oaks Avenue/ Atlantic Boulevard	16-20	24-60	15	30
762[1]	Metro	Rapid	From Compton to Altadena via Atlantic Boulevard	25	30-60	15	30
266	Metro	Local	From Lakewood to Pasadena via Rosemead Boulevard/Lakewood Boulevard	30-35	40-45	15	30
267	Metro	Local	From El Monte to Pasadena via Temple City Boulevard/Del Mar Boulevard	30	30	15	30
485	Metro	Express	From Union Station to Altadena via Fremont/Lake Avenue	40	60	30	60
487	Metro	Express	From Westlake to El Monte via Santa Anita Avenue/ Sierra Madre Boulevard/San Gabriel Boulevard	18-30	45	15	30
489	Metro	Express	From Westlake to East San Gabriel via Rosemead Boulevard	18-20	-	15	-
270	Metro	Local	From Norwalk to Monrovia via Workman Mill/Peck Road	40-60	60	30	60
780	Metro	Rapid	From West LA to Pasadena via Fairfax Avenue/ Hollywood Boulevard/Colorado Boulevard	10-15	22-25	10	20
187	Foothill	Local	From Pasadena to Montclair via Colorado Boulevard/ Huntington Drive/Foothill Boulevard	20	20	15	15

[1] This route would not be included as part of the BRT Alternative because the BRT Alternative would replace this service.
BRT = Bus Rapid Transit
Express = Express Bus
Foothill = Foothill Transit
Metro = Los Angeles County Metropolitan Transportation Authority
Rapid = Bus Rapid Transit
TDM = Transportation Demand Management
TSM = Transportation System Management

TABLE 1.4:
Active Transportation and Bus Enhancements of the TSM/TDM Alternative

ID No.	Description	Location
Bus Service Improvements		
Bus-1	Additional bus service	See Table 1.3 and Figure 1-3
Bus-2	Bus stop enhancements	Along routes listed in Table 1.3
Bicycle Facility Improvements		
Bike-1	Rosemead Boulevard bike route (Class III)	Colorado Boulevard to Valley Boulevard (through Los Angeles County, Temple City, Rosemead)
Bike-2	Del Mar Avenue bike route (Class III)	Huntington Drive to Valley Boulevard (through San Marino, San Gabriel)
Bike-3	Huntington Drive bike route (Class III)	Mission Road to Santa Anita Avenue (through the City of Los Angeles, South Pasadena, San Marino, Alhambra, Los Angeles County, Arcadia)
Bike-4	Foothill Boulevard bike route (Class III)	In La Cañada Flintridge
Bike-5	Orange Grove bike route (Class III)	Walnut Street to Columbia Street (in Pasadena)
Bike-6	California Boulevard bike route (Class III)	Grand Avenue to Marengo Avenue (in Pasadena)
Bike-7	Add bike parking at transit stations	Metro Gold Line stations
Bike-8	Improve bicycle detection at existing intersections	Along bike routes in study area

Metro = Los Angeles County Metropolitan Transportation Authority
TDM = Transportation Demand Management
TSM = Transportation System Management

1.3.3 Bus Rapid Transit (BRT) Alternative

The BRT Alternative would provide high-speed, high-frequency bus service through a combination of new, dedicated, and existing bus lanes, and mixed-flow traffic lanes to key destinations between East Los Angeles and Pasadena. The proposed route length is approximately 12 mi. Figure 1-4 illustrates the BRT Alternative.

The BRT Alternative includes the BRT trunk line arterial street and station improvements, frequent bus service, new bus feeder services, and enhanced connecting bus services. BRT includes bus enhancements identified in the TSM/TDM Alternative, except for improvements to Route 762.

Buses are expected to operate every 10 minutes during peak hours and every 20 minutes during off-peak hours. The BRT service would generally replace, within the study area, the existing Metro Route 762 service. The 12 mi route would begin at Atlantic Boulevard and Whittier Boulevard to the south, follow Atlantic Boulevard, Huntington Drive, Fair Oaks Avenue, Del Mar Boulevard, and end with a terminal loop in Pasadena to the north. Buses operating in the corridor would be given transit signal priority from a baseline transit signal priority project that will be implemented separately by Metro.

Where feasible, buses would run in dedicated bus lanes adjacent to the curb, either in one direction or both directions, during peak periods. The new dedicated bus lanes would generally be created within the existing street rights of way (ROW) through a variety of methods that include restriping the roadway, restricted on-street parking during peak periods, narrowing medians, planted parkways, or sidewalks. Buses would share existing lanes with other traffic in cases where there is not enough ROW. The exclusive lanes would be exclusive to buses and right-turning traffic during a.m. and p.m. peak hours only. At other times of day, the exclusive lanes would be available for on-street parking use.

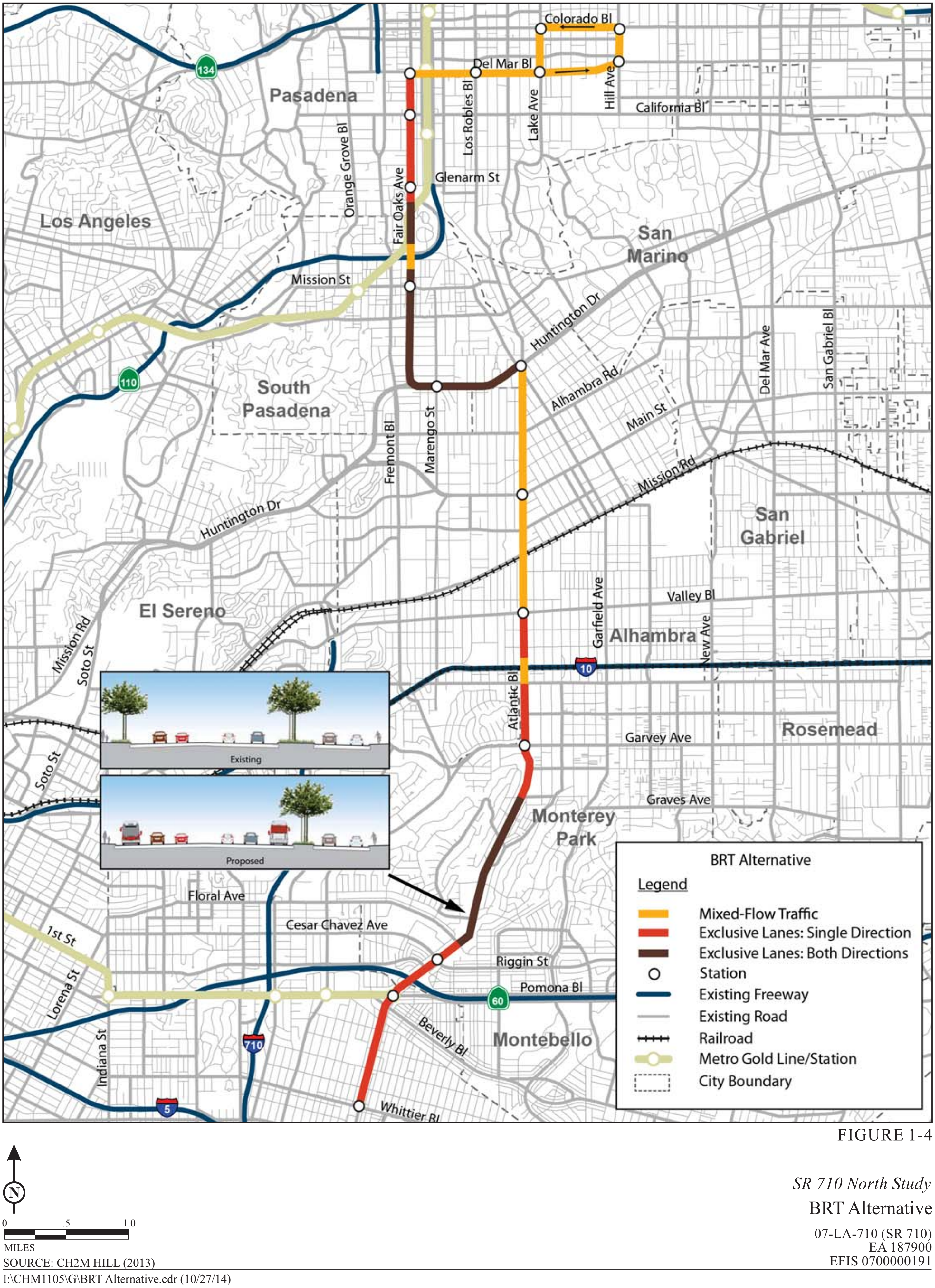

FIGURE 1-4

SOURCE: CH2M HILL (2013)
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SR 710 North Study
BRT Alternative

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A total of 17 BRT stations with amenities would be placed on average, at approximately 0.8 mi intervals at major activity centers and cross streets. Typical station amenities would include new shelters, branding elements, seating, wind screens, leaning rails, variable message signs (next bus information), lighting, bus waiting signals, trash receptacles, and stop markers. Some of these stops will be combined with existing stops, while in some cases, new stops for BRT will be provided. The BRT service would include 60-foot (ft) articulated buses with three doors, and would have the latest fare collection technology such as on-board smart card (Transit Access Pass [TAP] card) readers to reduce dwell times at stations. The BRT stops would be provided at the following 17 locations:

- Atlantic Boulevard at Whittier Boulevard
- Atlantic Boulevard between Pomona Boulevard and Beverly Boulevard
- Atlantic Boulevard at Cesar Chavez Avenue/Riggin Street
- Atlantic Boulevard at Garvey Avenue
- Atlantic Boulevard at Valley Boulevard
- Atlantic Boulevard at Main Street
- Huntington Drive at Garfield Avenue
- Huntington Drive at Marengo Avenue
- Fair Oaks Avenue at Mission Street
- Fair Oaks Avenue at Glenarm Street
- Fair Oaks Avenue at California Boulevard
- Fair Oaks Avenue at Del Mar Boulevard
- Del Mar Boulevard at Los Robles Avenue
- Del Mar Boulevard at Lake Avenue
- Del Mar Boulevard at Hill Avenue (single direction only)
- Colorado Boulevard at Hill Avenue (single direction only)
- Colorado Boulevard at Lake Avenue (single direction only)

Additionally, this alternative would include bus feeder routes that would connect additional destinations with the BRT mainline. Two bus feeder routes are proposed: one that would run along Colorado Boulevard, Rosemead Boulevard, and Valley Boulevard to the El Monte transit station; and another bus feeder route that would travel from Atlantic Boulevard near the Gold Line station to the Metrolink stations in the City of Commerce and Montebello via Beverly Boulevard and Garfield Avenue. In addition, other existing bus services in the study area would be increased in frequency and/or span of service. The El Sol shuttle improvements are an existing bus service that would be increased in frequency. The headways on the El Sol shuttle “City Terrace/East Los Angeles College (ELAC)” route that connect ELAC to the proposed Floral Station would be reduced from 60 minutes to 15 minutes.

The TSM/TDM Alternative improvements would also be constructed as part of the BRT Alternative, except as noted below. These improvements would provide the additional enhancements to maximize the efficiency of the existing transportation system by improving capacity and reducing the effects of bottlenecks and chokepoints. Local Street Improvements L-8 (Fair Oaks Avenue from Grevelia Street to Monterey Road) and the reversible lane component of L-3 (Atlantic Boulevard from Glendon Way to I-10) would not be constructed with the BRT Alternative.

1.3.4 Light Rail Transit (LRT) Alternative

The LRT Alternative would include passenger rail operated along a dedicated guideway, similar to other Metro light rail lines. The LRT alignment is approximately 7.5 mi long, with 3 mi of aerial segments and 4.5 mi of bored tunnel segments. Figure 1-5 illustrates the LRT Alternative.

The LRT Alternative would begin at an aerial station on Mednik Avenue adjacent to the existing East Los Angeles Civic Center Station on the Metro Gold Line. The alignment would remain elevated as it travels north on Mednik Avenue, west on Floral Drive, north across Corporate Center Drive, and then along the west side of I-710, primarily in Caltrans ROW, to a station adjacent to the California State University, Los Angeles (Cal State LA). The alignment would descend into a tunnel south of Valley Boulevard and travel northeast to Fremont Avenue, north under Fremont Avenue, and easterly to Fair Oaks Avenue. The alignment would then cross under SR 110 and end at an underground station beneath Raymond Avenue adjacent to the existing Fillmore Station on the Metro Gold Line.

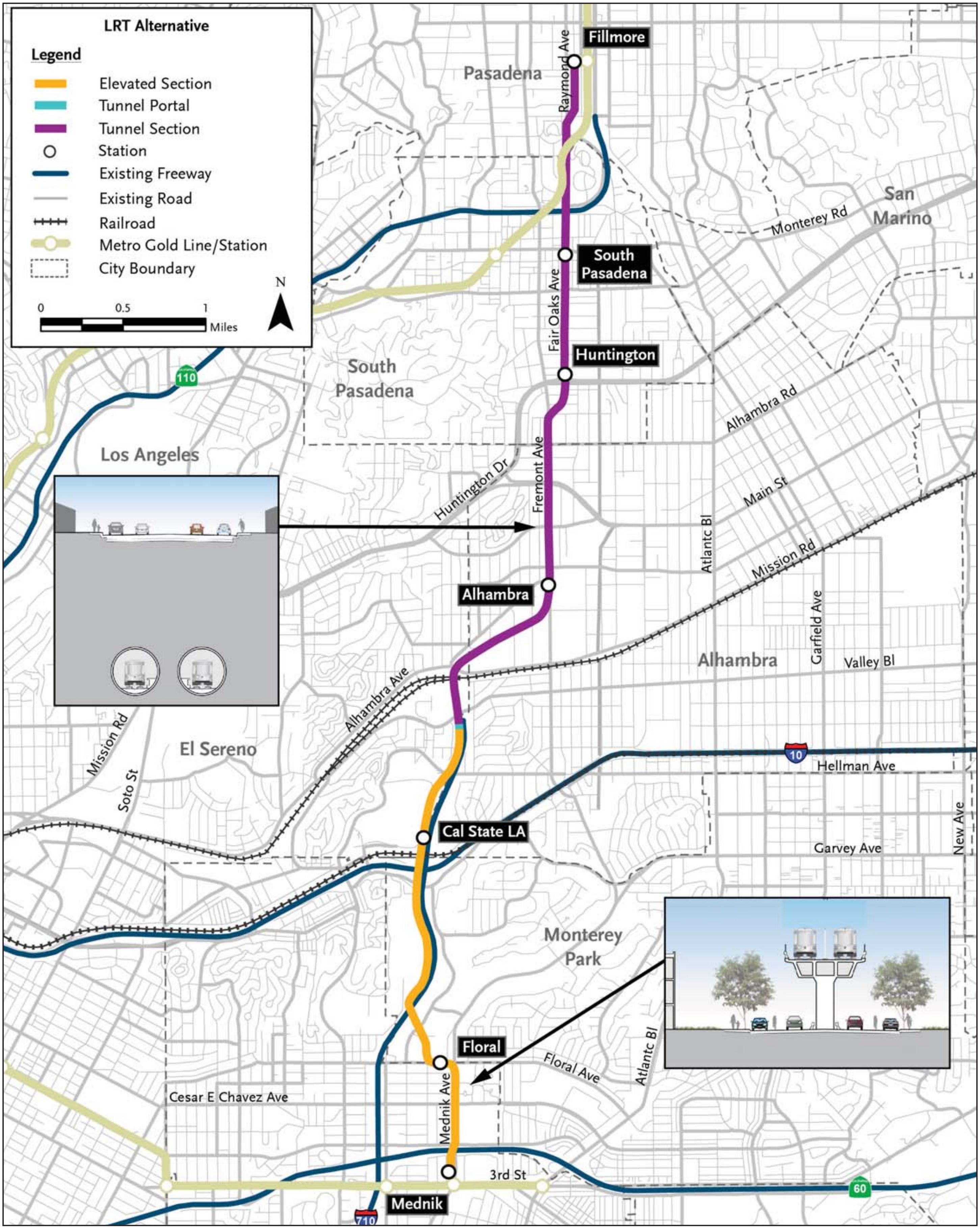
Two directional tunnels are proposed with tunnel diameters approximately 20 ft each, located approximately 60 ft below the ground surface. Other supporting tunnel systems include emergency evacuation cross passages for pedestrians, a ventilation system consisting of exhaust fans at each portal and an exhaust duct along the entire length of the tunnel, fire detection and suppression systems, communications and surveillance systems, and 24-hour monitoring, similar to the existing LRT system.

Trains would operate at speeds of up to 65 miles per hour (mph) approximately every 5 minutes during peak hours and 10 minutes during off-peak hours.

Seven stations would be located along the LRT alignment at Mednik Avenue in East Los Angeles, Floral Drive in Monterey Park, Cal State LA, Fremont Avenue in Alhambra, Huntington Drive in South Pasadena, Mission Street in South Pasadena, and Fillmore Street in Pasadena. The Fremont Avenue Station, the Huntington Drive Station, the Mission Street Station, and the Fillmore Street Station would be underground stations. New Park-and-Ride facilities would be provided at all of the proposed stations except for the Mednik Avenue, Cal State LA, and Fillmore Street stations.

A maintenance yard to clean, maintain, and store light rail vehicles would be located on both sides of Valley Boulevard at the terminus of SR 710. A track spur from the LRT mainline to the maintenance yard would cross above Valley Boulevard.

Two bus feeder services would be provided. One would travel from the Commerce Station on the Orange County Metrolink line and the Montebello Station on the Riverside Metrolink line to the Floral Station, via East Los Angeles College. The other would travel from the El Monte Bus Station to the Fillmore Station via Rosemead and Colorado Boulevards. In addition, other existing bus services in the study area would be increased in frequency and/or span of service.



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SOURCE: AECOM (2013)

FIGURE 1-5

SR 710 North Study

LRT Alternative

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As part of the LRT Alternative, the I-710 northbound off-ramp at Valley Boulevard would be modified.

The TSM/TDM Alternative improvements would also be constructed as part of the LRT Alternative. These improvements would provide the additional enhancements to maximize the efficiency of the existing transportation system by improving capacity and reducing the effects of bottlenecks and chokepoints. The only component of the TSM/TDM Alternative improvements that would not be constructed with the LRT Alternative is Other Road Improvement T-1 (Valley Boulevard to Mission Road Connector Road).

1.3.5 Freeway Tunnel Alternative

The alignment for the Freeway Tunnel Alternative starts at the existing southern stub of SR 710 in Alhambra, just north of I-10, and connects to the existing northern stub of SR 710, south of the I-210/SR 134 interchange in Pasadena. The Freeway Tunnel Alternative would include the following tunnel support systems: emergency evacuation for pedestrians and vehicles, air scrubbers, a ventilation system consisting of exhaust fans at each portal, an exhaust duct along the entire length of the tunnel and jet fans within the traffic area of the tunnel, fire detection and suppression systems, communications and surveillance systems, and 24-hour monitoring. An operations and maintenance (O&M) building would be constructed at the northern and southern ends of the tunnel. There would be no operational restrictions for the tunnel, with the exception of vehicles carrying flammable or hazardous materials. As part of both design variations of the Freeway Tunnel Alternative, the I-710 northbound off-ramp and southbound on-ramp at Valley Boulevard would be modified.

The TSM/TDM Alternative improvements would also be constructed as part of the Freeway Tunnel Alternative, including either the dual-bore or single-bore design variations. These improvements would provide the additional enhancements to maximize the efficiency of the existing transportation system by improving capacity and reducing the effects of bottlenecks and chokepoints. The only components of the TSM/TDM Alternative improvements that would not be constructed with the Freeway Tunnel Alternative are Other Road Improvements T-1 (Valley Boulevard to Mission Road Connector Road) and T-3 (St. John Avenue Extension between Del Mar Boulevard and California Avenue).

1.3.5.1 Design Variations

The Freeway Tunnel Alternative includes two design variations. These variations relate to the number of tunnels constructed. The dual-bore design variation includes two tunnels that independently convey northbound and southbound vehicles. The single-bore design variation includes one tunnel that carries both northbound and southbound vehicles. Figure 1-6 illustrates the dual-bore and single-bore tunnel design variations for the Freeway Tunnel Alternative. Each of these design variations is described below.

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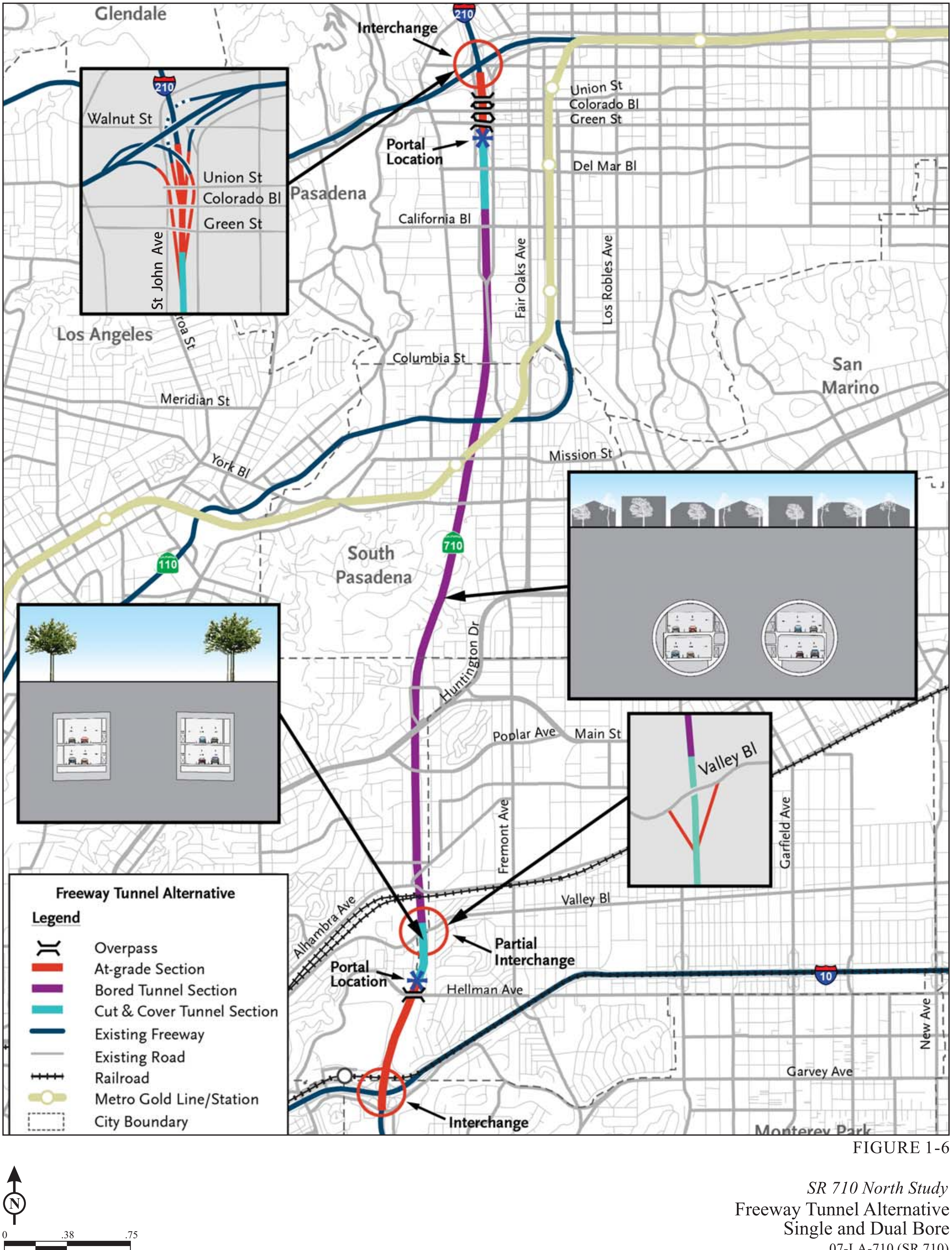

FIGURE 1-6

SR 710 North Study

Freeway Tunnel Alternative
Single and Dual Bore

07-LA-710 (SR 710)
EA 187900
EFIS 0700000191

SOURCE: CH2M HILL (2013)

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- **Dual-Bore Tunnel:** The dual-bore tunnel design variation is approximately 6.3 mi long, with 4.2 mi of bored tunnel, 0.7 mi of cut-and-cover tunnel, and 1.4 mi of at-grade segments. The dual-bore tunnel design variation would consist of two side-by-side tunnels (the east tunnel would convey northbound traffic, and the west tunnel would convey southbound traffic). Each tunnel would have two levels with traffic traveling in the same direction. Each tunnel would consist of two lanes of traffic on each level, traveling in one direction, for a total of four lanes in each tunnel. The eastern tunnel would be constructed for northbound traffic, and the western tunnel would be constructed for southbound traffic. Each bored tunnel would have an outside diameter of approximately 58.5 ft and would be located approximately 120 to 250 ft below the ground surface. Vehicle cross passages would be provided throughout this tunnel variation that would connect one tunnel to the other tunnel for use in an emergency situation. Figure 1-6 illustrates the dual-bore tunnel variation of the Freeway Tunnel Alternative.

  Short segments of cut-and-cover tunnels would be located at the south and north termini to provide access via portals to the bored tunnels. The portal at the southern terminus would be located south of Valley Boulevard. The portal at the northern terminus would be located north of Del Mar Boulevard. No intermediate interchanges are planned for the tunnel.

- **Single-Bore Tunnel:** The single-bore tunnel design variation is also approximately 6.3 mi long, with 4.2 mi of bored tunnel, 0.7 mi of cut-and-cover tunnel, and 1.4 mi of at-grade segments. The single-bore tunnel design variation would consist of one tunnel with two levels. Each level would have two lanes of traffic traveling in one direction. The northbound traffic would traverse the upper level, and the southbound traffic would traverse the lower level. The single-bore tunnel would provide a total of four lanes. The single-bore tunnel would also have an outside diameter of approximately 58.5 ft and would be located approximately 120 to 250 ft below the ground surface. The single-bore tunnel would be in the same location as the northbound tunnel in the dual-bore tunnel design variation. Figure 1-7 illustrates the single-bore tunnel variation cross section of the Freeway Tunnel Alternative.

1.3.5.2 Operational Variations

There were three different parameters related to the operational variations of the Freeway Tunnel Alternative:

- **Tolling:** Tolls could be charged for vehicles using the tunnel, or it could be free for all drivers (a freeway).
- **Trucks:** Trucks could be prohibited or allowed.
- **Express Bus:** A dedicated Express Bus could be operated using the tunnel. The Express Bus route would start at the Commerce Station on the Orange County Metrolink line, and then serve the Montebello Station on the Riverside Metrolink line and East Los Angeles College before entering I-710 at Floral Drive. The bus would travel north to Pasadena via the proposed freeway tunnel, making a loop serving Pasadena City College, the California Institute of Technology, and downtown Pasadena before re-entering the freeway and making the reverse trip.

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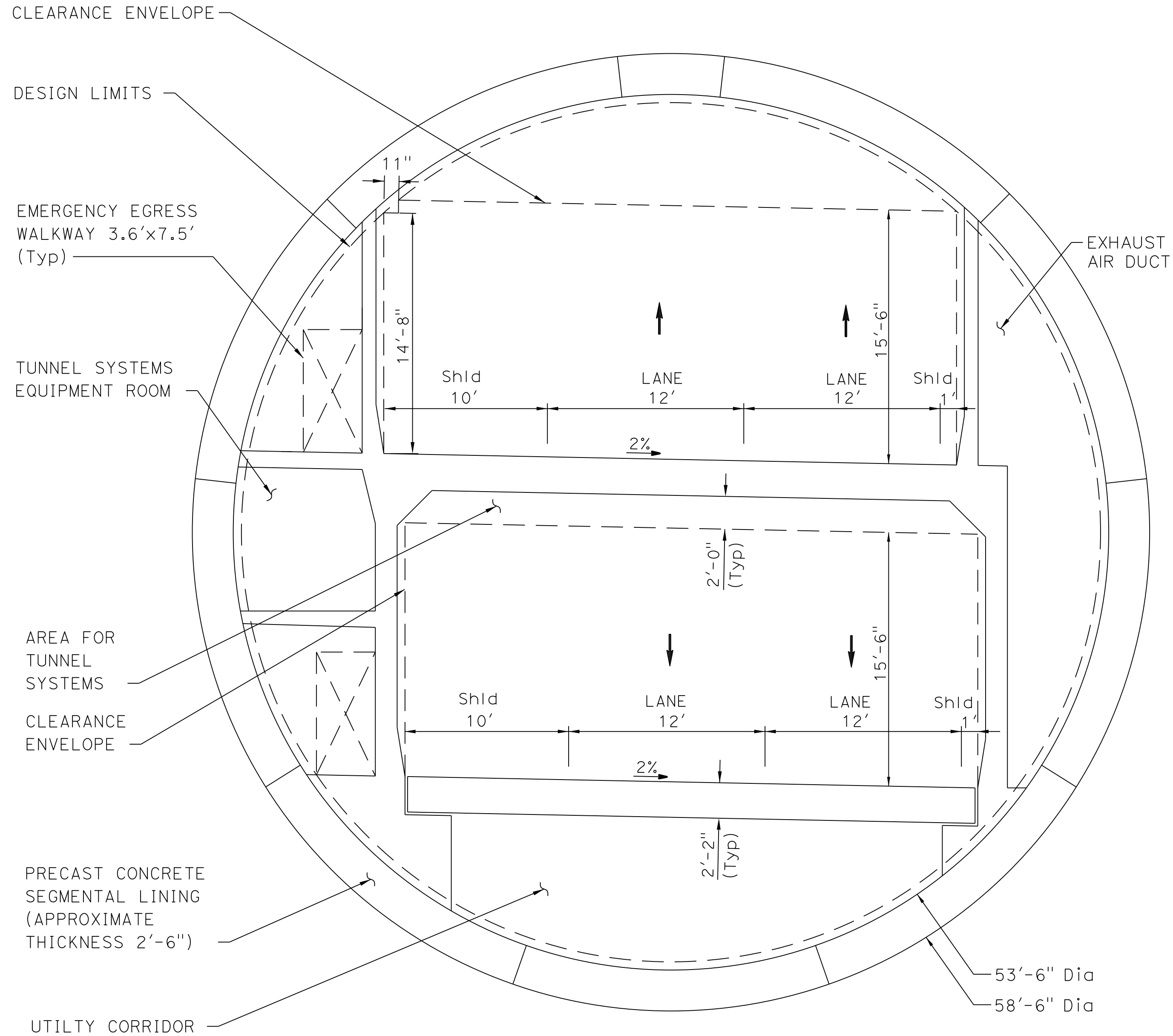

FIGURE 1-7

SR 710 North Study
Freeway Tunnel Alternative
Single Bore Cross Section
07-LA-710 (SR 710)
EA 187900
EFIS 0700000191

SOURCE: CH2M HILL (2014)

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The following operational variations have been studied for the Freeway Tunnel Alternative:

- **Freeway Tunnel Alternative without Tolls:** The facility would operate as a freeway with lanes open to all vehicles. Trucks would be allowed and there would be no Express Bus service. This operational variation would be considered for only the dual-bore tunnel design variation.
- **Freeway Tunnel Alternative with Trucks Excluded:** The facility would operate as a freeway; however, trucks would be excluded from using the tunnel. There would be no Express Bus service. Signs would be provided along I-210, SR 134, I-710, and I-10 to provide advance notice of the truck restriction. This operational variation would be considered for the dual-bore tunnel only.
- **Freeway Tunnel Alternative with Tolls:** All vehicles, including trucks, using the tunnel would be tolled. There would be no Express Bus Service. This operational variation would be considered for both the dual- and single-bore tunnels described above.
- **Freeway Tunnel Alternative with Trucks Excluded and with Tolls:** The facility would be tolled for all automobiles. There would be no Express Bus service. Trucks would be excluded from using the tunnel. Signs would be provided along I-210, SR 134, I-710, and I-10 to provide advance notice of the truck restriction. This operational variation would be considered for the single-bore tunnel only.
- **Freeway Tunnel Alternative with Toll and Express Bus:** The freeway tunnel would operate as a tolled facility and include an Express Bus component. The Express Bus would be allowed in any of the travel lanes in the tunnel; no bus-restricted lanes would be provided. Trucks would be permitted. This operational variation would be considered for the single-bore tunnel only.

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2. Regulatory Setting

2.1 Federal Regulations

NEPA (42 United States Code [USC] Part 4332) requires the identification of all potentially substantial impacts to the environment, including energy impacts.

2.2 State Regulations

CEQA Guidelines, Appendix F, Energy Conservation, state that Environmental Impact Reports (EIRs) are required to include a discussion of the potential energy impacts of proposed projects, with particular emphasis on avoiding or reducing inefficient, wasteful, and unnecessary consumption of energy.

Each public utility and public services agency is directed by internal standards and policies that guide the provision of service to their customers. The California Public Utilities Commission (CPUC) regulates privately owned natural gas, electric, telephone, and water companies, as well as railroads and marine transportation companies. The CPUC does not regulate municipal or district-owned energy utilities, or mutual water companies.

The California Energy Commission (CEC) is California's primary energy policy and planning agency. The CEC was created by the legislature in 1974 and is located in Sacramento. Five major responsibilities of the CEC include:

- Forecasting future energy needs and keeping historical energy data
- Licensing thermal power plants 50 megawatts or larger
- Promoting energy efficiency through appliance and building standards
- Developing energy technologies and supporting renewable energy
- Planning for and directing State response to energy emergency

The CEC's role includes overseeing funding programs that support public interest energy research; advancing energy science and technology through research, development, and demonstration; and providing market support to existing, new, and emerging renewable technologies.

The CEC, the CPUC, and Consumer Power and Conservation Financing Authority (called the CPA, which is now defunct) approved the final State of California Energy Action Plan in 2003, which was proposed by a subcommittee of these three agencies. The Plan established shared goals and specific actions to ensure that adequate, reliable, and reasonably priced electrical power and natural gas supplies are achieved and provided through policies, strategies, and actions that are cost-effective and environmentally sound for California's consumers and taxpayers. In 2005, an updated Energy Action Plan was adopted by the CEC and the CPUC to reflect policy changes and actions after 2003.

The State's energy policies have been substantially influenced by the passage of Assembly Bill (AB) 32, the California Global Warming Solutions Act of 2006. The CEC's 2007 Integrated Energy Policy Report (IEPR) advanced policies that would enable the State to meet its energy needs in a carbon-constrained world (the CEC is currently developing the 2013 IEPR). That report also provides a comprehensive set of recommended actions to achieve these policies.

Rather than produce a new Energy Action Plan, the CEC and the CPUC have prepared instead the Energy Action Plan – 2008 Update that examines the State's ongoing actions in the context of global climate change. The update was prepared using the information and analysis prepared for the recent IEPR, as well as recent CPUC decisions.

3. Energy Utilization

The goal of conserving energy implies the wise and efficient use of energy. The means of achieving this goal include:

- Decreasing overall per capita energy consumption
- Decreasing reliance on natural gas and oil
- Increasing reliance on renewable energy sources

3.1 Energy Resources and Consumption[1]

California is rich in conventional and renewable energy resources. It has large crude oil and substantial natural gas deposits in six geological basins located in the Central Valley and along the Pacific Coast. Most of those reserves are concentrated in the southern San Joaquin Basin. Seventeen (17) of the 100 largest oil fields in the United States are located in California, including the Belridge South oil field (the third largest oil field in the contiguous United States). In addition, federal assessments indicate that large undiscovered deposits of recoverable oil and gas lie offshore in the federally administered Outer Continental Shelf (OCS), which in 2008 was reopened for potential oil and gas leasing. California's renewable energy potential is extensive. The State's hydroelectric power potential ranks second in the United States behind Washington State, and substantial geothermal and wind power resources are found along the coastal mountain ranges and the State's eastern border with Nevada. High solar energy potential is found in southeastern California's sunny deserts.

California is the most populous State in the United States, and its total energy demand is second only to Texas. Although California is a leader in the energy-intensive chemical, forest products, glass, and petroleum industries, the State has one of the lowest per capita energy consumption rates in the country. The California government's energy-efficiency programs have contributed to the low per capita energy consumption. Driven by high demand from California's many motorists, major airports, and military bases, the transportation sector is the State's largest energy consumer. More motor vehicles are registered in California than in any other State, and worker commute times are among the longest in the country.

3.1.1 Petroleum

California is one of the top producers of crude oil in the United States, with output accounting for more than one-tenth of total United States' production. Drilling operations are concentrated primarily in Kern County and the Los Angeles basin, although substantial production also takes place offshore in both State and federal waters. Concerns regarding the cumulative impacts of offshore oil and gas development, combined with a number of major marine oil spills throughout the world in recent years, have led to a permanent moratorium on offshore oil and gas leasing in California waters. However, development on existing State leases is not affected and may still occur within offshore areas leased prior to the effective date of the moratorium. A moratorium on oil and gas leasing in federal OCS waters expired in 2008.

[1] Section 3.1 from United States Energy Information Administration Profile Analysis, http://www.eia.gov/state/analysis.cfm?sid=CA. October 2013.

A network of crude oil pipelines connects production areas to refining centers in the Los Angeles area, the San Francisco Bay area, and the Central Valley. California refiners also process large volumes of Alaskan and foreign crude oil received at ports in Los Angeles, Long Beach, and the San Francisco Bay area. Crude oil production in California and Alaska is in decline, and California refineries have become increasingly dependent on foreign imports. Led by Saudi Arabia, Iraq, and Ecuador, foreign suppliers now provide more than two-fifths of the crude oil refined in California; however, California's dependence on foreign oil remains less than the national average.

California ranks third in the country in petroleum refining capacity and accounts for more than one-tenth of total United States capacity. California's largest refineries are highly sophisticated, are capable of processing a wide variety of crude oil types, and are designed to yield a high percentage of light products like motor gasoline. To meet strict federal and State environmental regulations, California refineries are configured to produce cleaner fuels, including reformulated motor gasoline and low-sulfur diesel.

Most California motorists are required to use a special motor gasoline blend called California Clean Burning Gasoline. In the ozone non-attainment areas of Imperial County and the Los Angeles metropolitan area, motorists are required to use California Oxygenated Clean Burning Gasoline. There are five ethanol production plants in Central and Southern California, but most of California's ethanol supply is transported by rail from corn-based producers in the Midwest. Some supply is also imported from abroad.

Due to the relative isolation and specific requirements of the California fuel market, California motorists are particularly vulnerable to short-term spikes in the price of motor gasoline. No pipelines connect California to other major refining centers in the United States, and California refineries often operate at near maximum capacity due to high demand for petroleum products. When an unplanned refinery outage occurs, replacement supplies must be brought in via marine tanker. Locating and transporting this replacement gasoline (which must conform to the State's strict fuel requirements) can take from 2 to 6 weeks.

3.1.2 Natural Gas

California natural gas production typically accounts for less than 2 percent of the total United States production and satisfies less than one-fifth of the State's demand. Production takes place in basins located in Northern and Southern California, as well as offshore in the Pacific Ocean. As with crude oil production, California natural gas production is in decline. However, State supply has remained relatively stable due to increases in net receipts from pipelines that supply California with natural gas produced in the Rocky Mountains, the Southwest, and western Canada. California markets are served by two key natural gas trading centers (the Golden Gate Center in Northern California and the California Energy Hub in Southern California), and the State has a dozen natural gas storage facilities that help stabilize supply. In part to help meet California's demand for natural gas, an offshore liquefied natural gas (LNG) import terminal in Southern California was proposed to the Maritime Administration and the United States Coast Guard on August 18, 2006. If approved, this terminal could import up to 1.4 billion cubic feet of natural gas per day. Two additional potential Southern California LNG import facility sites have been identified by project sponsors (i.e., the Clearwater Port offshore of Oxnard was proposed in 2006, and the Esperanza Port offshore of the Port of Long Beach was proposed in 2008).

3.1.3 Biomethane

Biomethane (aka, BioGas) has been identified as a potentially viable alternative to natural gas. Biomethane has the same chemical make-up and can be made to have the same fuel specifications as the compressed natural gas (CNG) currently being used for vehicle power. Biomethane, however, has the lowest carbon intensity among alternative fuels (including natural gas) because it does not come from fossil fuel raw materials but instead from dairies, landfills, and wastewater treatment plants, among others. Consequently, the use of biomethane would significantly reduce carbon emissions with no change to current fleet and fueling infrastructure.

3.1.4 Coal, Electricity, and Renewables

Natural gas-fired power plants typically account for more than one-half of State electricity generation. California is one of the largest hydroelectric power producers in the United States, and with adequate rainfall, hydroelectric power typically accounts for close to one-fifth of State electricity generation. While the contribution of renewable generation has been increasing, the role of nuclear generation has dropped considerably since the shutdown of the two-unit San Onofre Nuclear Generating Station (SONGS) in January 2012. Due to strict emission laws, only a few small coal-fired power plants operate in California.

California leads the United States in electricity generation from nonhydroelectric renewable energy sources. California generates electricity using wind, geothermal, solar, fuel wood, and municipal solid waste/landfill gas resources. California is the top producer of geothermal energy in the country with over 2,500 megawatts (MW) of capacity. A facility known as “The Geysers” (located in the Mayacamas Mountains north of San Francisco) is the largest complex of geothermal power plants in the world, with more than 700 MW of installed capacity. California is also a leading producer of wind energy and holds nearly 10 percent of United States capacity. The world’s largest solar power facility, completed in 1991, operates in California’s Mojave Desert. Eleven projects in California, totaling 7,341 MW of solar generating capacity, have been approved by the United States Bureau of Land Management since 2010. To further boost renewable energy use, California’s Energy Action Plan includes incentives that encourage Californians to install solar power systems on their rooftops.

Due to high electricity demand, California imports more electricity than any other state. States in the Pacific Northwest deliver power to California markets primarily from hydroelectric sources, while states in the Desert Southwest deliver power primarily from coal-fired sources. Hydroelectric power comes to California primarily through the Western United States of America (USA) interconnection, which runs from northern Oregon to southern California. The system, also known as the Pacific Intertie, is the largest single electricity transmission program in the United States. Although the Pacific Intertie was originally designed to transmit electricity south during California’s peak summer demand season, flow is sometimes reversed overnight and has occasionally been reversed during periods of reduced hydroelectric generation in the Northwest. California restricts the use of coal-fired generation within its boundaries. However, the Los Angeles Department of Water and Power (LADWP) operates the coal-fired Intermountain Power Plant in Utah (Intermountain), which delivers almost all of its output to LADWP and other California municipal utilities. A recent California law forbids utilities from entering into long-term contracts with conventional coal-fired power producers. Intermountain’s existing contracts with southern California cities are set to expire in 2027.

In 2000 and 2001, California suffered an energy crisis characterized by electricity price instability and four major blackouts that were caused by a supply and demand imbalance. Multiple factors contributed to this imbalance, including a heavy dependence on out-of-state electricity providers, drought conditions in the northwest that reduced hydroelectric power generation, a rupture on a major natural gas pipeline supplying California power plants, strong economic growth leading to increased electricity demand in western States, an increase in unplanned power plant outages, and unusually high temperatures that increased electricity demand for air conditioning and other cooling uses. Following the energy crisis, the State government created an Energy Action Plan designed to eliminate outages and excessive price spikes. To achieve these goals, the Energy Action Plan calls for optimizing energy conservation, building sufficient new generation facilities, upgrading and expanding the electricity transmission and distribution infrastructure, and ensuring that generation facilities can quickly come online when needed.

In 2006, California amended its renewable portfolio standard to require investor-owned utilities, electric service providers, small and multi-jurisdictional utilities, and community choice aggregators to provide at least 20 percent of retail sales from renewable sources by the end of 2010 and 33 percent by the end of 2020. California has also adopted other policies to promote energy efficiency and renewable energy, including energy standards for public buildings, power source disclosure requirements for utilities, and net metering.

3.2 Energy Consumption in California and Los Angeles County

The following statistics have been provided by the CEC. Statistics are the most recent available as of October 2013.

3.2.1 Electricity

Fueled by population growth, the demand for electricity in California is increasing. At the same time, the State is mandating to decrease greenhouse gas (GHG) emissions. California's electricity mix is generated by natural gas (53.4 percent), coal (1.7 percent), large hydroelectric (14.6 percent),[1] nuclear (15.7 percent), and renewable (14.6 percent). In 2011, California produced 71 percent of the electricity it uses; the rest was imported from the Pacific Northwest (8 percent) and the United States Southwest (21 percent). Under the Renewables Portfolio Standard, California's goal was to increase the amount of electricity generated from renewable energy resources to 20 percent by 2010, and legislation passed in 2011 pushed that goal to 33 percent by 2020. Currently, California's in-State renewable generation is comprised of biomass, geothermal, small hydroelectric, wind, and solar generation sites that make up approximately 17 percent of the total in-State generational output. Los Angeles County electrical usage in 2011 is shown in Table 3.1.

3.2.2 Natural Gas Consumption

Only 12 percent of the natural gas California used came from in-State production in 2010; the rest was delivered by pipeline from several production areas in the western United States and western

[1] California Energy Almanac, http://www.energyalmanac.ca.gov/overview/energy_sources.html. October 2013.

TABLE 3.1:
Annual Electric Consumption in Los Angeles County in 2011

Type of Consumer	Millions of kWh
Residential	19,292
Non-Residential	44,607
Total	**63,899**

Source: California Energy Commission. Energy Consumption Data Management System, http://www.ecdms.energy.ca.gov/elecbycounty.aspx (October 2013).
kWh = a unit of power equal to 1,000 watts of electricity consumed in an hour

Canada. California is at the stopping point of these pipelines, forcing the State to compete with other states for its natural gas supply. Once the gas arrives in California, it is distributed by the State's three major gas utility companies (San Diego Gas & Electric, Southern California Gas Company, and Pacific Gas and Electric), which together provide a collective total of 98 percent of the State's natural gas. The Cities of Long Beach and Palo Alto are the only municipal utilities in California that operate city-owned utility services for natural gas customers.

Natural gas is the second most widely used energy source in California. Depending on yearly conditions, 40 to 45 percent of the total amount used is burned for electricity generation, 10 percent is consumed in facilitating the extraction of oil and gas, and the rest is used for everything from space heating to fuel for bus fleets.[1] The residential sector in Los Angeles County uses 44 percent of the natural gas consumed (Table 3.2).

TABLE 3.2:
Natural Gas Consumption in Los Angeles County in 2011

Land Use	Millions of Therms
Residential	1,369
Non-Residential	1,752
Total	**3,121**

Source: California Energy Commission. Energy Consumption Data Management System, http://www.ecdms.energy.ca.gov/ (October 2013).
therm = a unit of heat containing 100,000 British thermal units (BTUs).

3.2.3 Liquid Petroleum Gas/Propane

Liquefied petroleum gas (LPG) is a mixture of gaseous hydrocarbons (mainly propane and butane) that change into liquid form under moderate pressure. LPG (usually called propane) is commonly used as a fuel for rural homes for space and water heating, as a fuel for barbecues and recreational vehicles, and as a transportation fuel. It is normally created as a by-product of petroleum refining and from natural gas production.

LPG is generally an unregulated fuel in California (except for storage and safety issues, which are regulated). Because it is an unregulated commodity, the State does not collect data on LPG sales or usage. The statistics for LPG in Section 3.2.5, Alternatives to Traditional Transportation Fuels, were provided by the United States Department of Energy (DOE), Energy Information Administration, Office of Coal, Nuclear, Electric, and Alternate Fuels. As such, statistics are unavailable for LPG as a fuel for rural homes, for space and water heating, or for barbecues, and none are contained in the body of this technical report.

1 California Energy Almanac, http://www.energyalmanac.ca.gov/naturalgas/overview.html. October 23, 2013.

3.2.4 Traditional Transportation Fuels (Fossil Fuels)

Fossil fuels are energy resources that come from the remains of plants and animals that are millions of years old. There are three fossil fuels: petroleum oil, natural gas, and coal. These fossil fuels provide the energy that powers our lifestyles and our economy, and are overwhelmingly responsible for fueling our transportation system. Our country's entire transportation infrastructure of pipelines and gas stations is built around fossil fuels. They are the foundation that we base our energy mix upon, but they are a limited resource. Once these resources are depleted, they will no longer be part of our energy mix.

The main challenges with fossil fuels, in addition to their unsustainability, are their negative environmental impacts. The burning of fossil fuels is responsible for emissions that contribute to global climate change, acid rain, and ozone problems. As such, the development of alternatives to traditional transportation fuels is a priority.

3.2.5 Alternatives to Traditional Transportation Fuels

Alternatives to traditional transportation fuels are being developed and introduced into the consumer marketplace. Alternative fuels and vehicles currently in use in the United States are:

- Biodiesel and Biogas
- CNG
- LNG
- LPG/propane
- Ethanol, 85 percent (E85) (used in flexible fuel vehicles)
- Hydrogen and fuel cell vehicles
- Electric vehicles (EV)

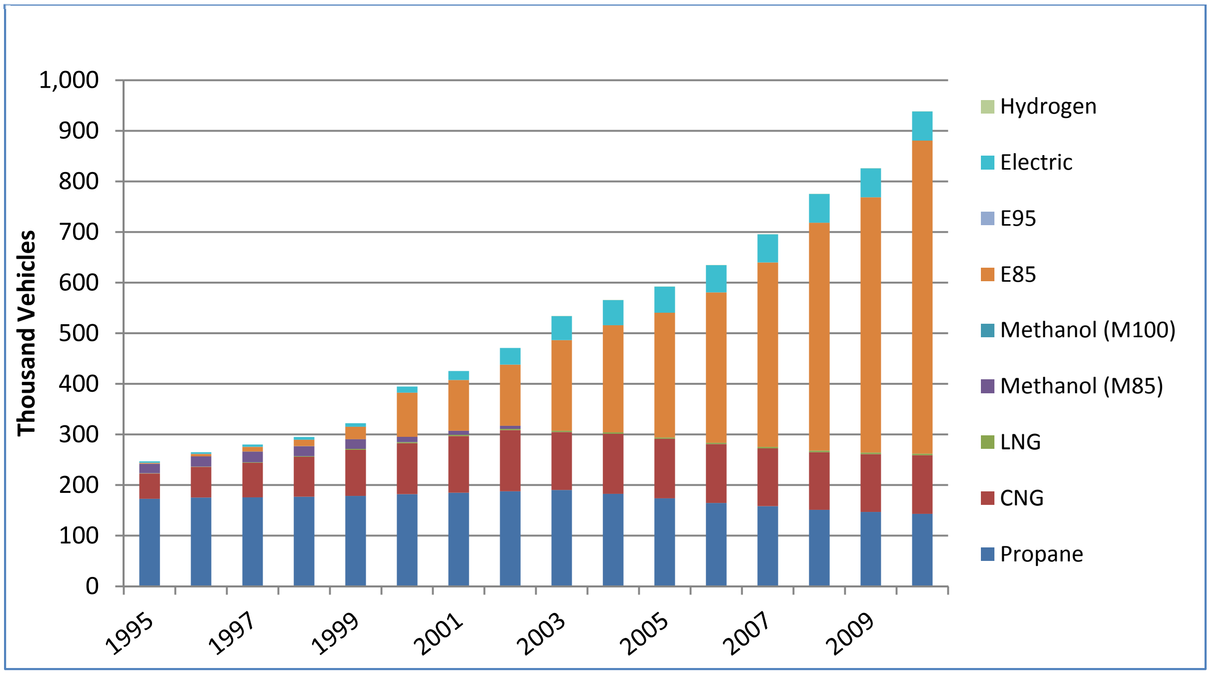
The following information was prepared by the Energy Information Administration (EIA), the independent statistical and analytical agency within the DOE. Each year, the EIA collects data on the number of alternative fuel vehicles (AFVs) supplied and, for a limited set of fleet user groups, the number of AFVs in use and the amount of alternative transportation fuel consumed. The user groups surveyed are federal and State governments, alternative fuel providers, and transit companies.

3.2.5.1 Alternative Fuel Vehicles in Use

The use of AFVs in the United States has steadily increased between 1995 and 2010, as shown on Figure 3-1. Overall an estimated 938,650 AFVs were in use in the United States in 2010. Total AFV use in California increased from 81,652 in 2004 to 136,409 in 2009.

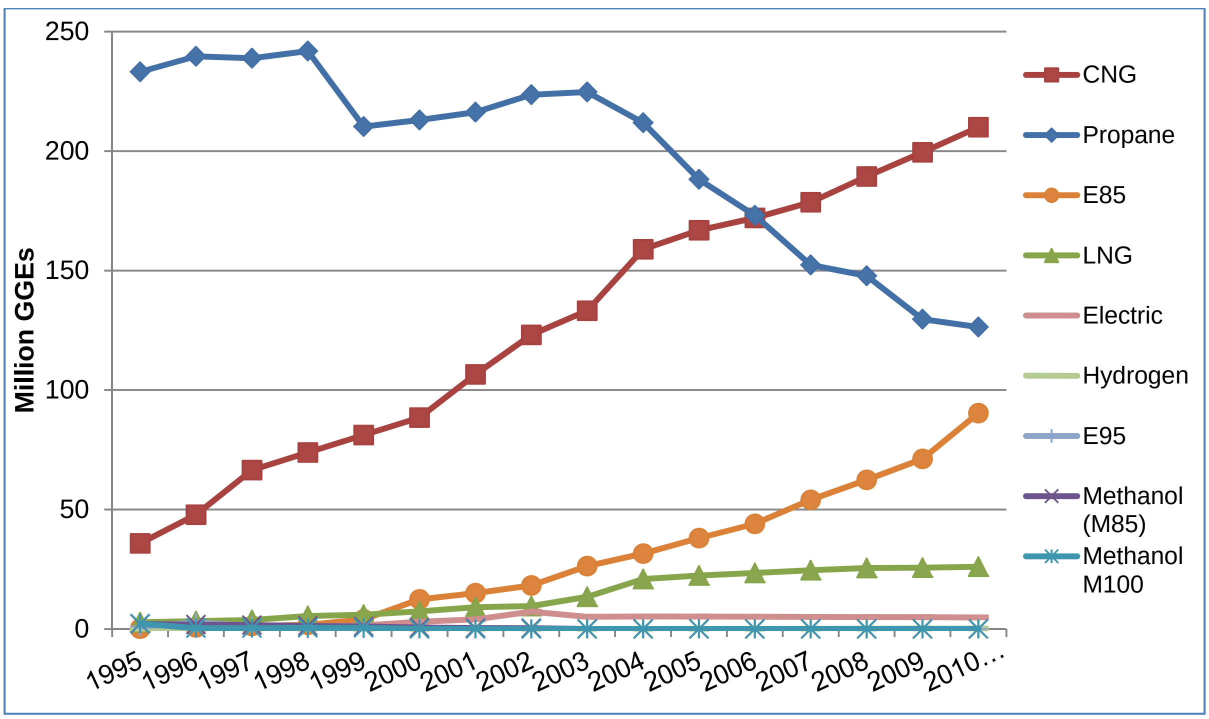
3.2.5.2 Alternative Fuel Consumption

Overall consumption of alternative transportation fuels in the United States increased almost 13 percent in 2011 to a total of 515,920 thousand gasoline gallon equivalents (GGEs), compared to 457,755 thousand GGEs in 2010. The estimated consumption of alternative fuels (in million GGEs) in the United States from 1995 through 2010 is shown on Figure 3-2.



Source: EIA Annual Energy Review. Downloaded from http://www.eia.gov/renewable/afv/index.cfm October 2013.

Figure 3-1: Alternative Fueled Vehicles in Use in the U.S., 1995–2010



Source: EIA Annual Energy Review. Downloaded from http://www.eia.gov/renewable/afv/index.cfm October 2013.

Figure 3-2: Estimated Consumption of Alternative Fuel by AFVs in the U.S., 1995–2010

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4. Environmental Consequences

The project alternatives were evaluated to determine if they would result in a demand for energy that would exceed the current supply, or cause a substantial increase in the rate of energy use.

4.1 Methodology

Implementation of the project would affect the use of energy resources in the Los Angeles County region. The analysis of these impacts is at the regional level and, therefore, by its nature, is an analysis of cumulative impacts. This energy analysis is based on the methodology described in detail in the California Department of Transportation (Caltrans) Standard Environmental Reference (SER), Volume 1, Chapter 13 – Energy (updated March 11, 2013). The energy analysis addresses three elements: indirect and direct energy consumption (each as temporary and permanent energy consumption) and service parameters. Indirect energy refers to energy associated with construction, maintenance, and operation of a transportation facility. Direct energy refers to the fuel consumed by vehicles using a transportation facility. Service parameters concern the actual transportation service versus the potential transportation service. Potential service of a vehicle would be the maximum rated capacity for passengers or cargo, and actual service is the real number it does carry. The ratio of actual service rendered versus potential service is called the “load factor.”

Direct transportation energy consumption impacts were estimated for the project alternatives using traffic forecasts described in the *Transportation Technical Report* (2014), the California Air Resources Board (ARB) EMFAC2011 air quality model, which provides estimated gasoline and diesel fuel consumption rates and information from the Alternative Fuels Data Center of the DOE. EMFAC2011 model assumptions include that the project location is in the South Coast Air Basin, ambient temperature is 50 degrees Fahrenheit (°F), and humidity is 50 percent. CNG buses are assumed to average 3.0 mi per diesel gallon equivalent (DGE), transit (electric) rail are assumed to average 64,585 British thermal units (BTUs) per vehicle-mile, and commuter (diesel) rail are assumed to average 92,474 BTUs per vehicle-mile.

Of the scenario years analyzed, estimated energy consumption in 2035 is expected to represent the most conservative (i.e., highest) energy consumption because population and employment are projected to be higher in that year than in any earlier year. In addition, this analysis does not reflect the benefit of energy efficiency and conservation measures that are likely to be adopted by 2035 and which would result in lower energy consumption than projected in these estimates (i.e., new California Environmental Protection Agency [Cal/EPA]/United States Environmental Protection Agency (EPA) fuel economy standards, bus rapid transit programs reducing personal vehicle use, and increased use of high-occupancy vehicles [HOVs]).

Project-related indirect energy impacts were estimated using standard Caltrans approximation factors, as described in the SER. Implementation of the project would affect the use of energy resources in the Los Angeles County region. The analysis of these impacts is at the regional level and, therefore, by its nature, an analysis of cumulative impacts. Three main areas of impact have been identified: (1) energy demands for construction; (2) energy demands for operation of the regional transportation system as of 2035; and (3) the cumulative impacts of the growing energy demand associated with implementation of the project.

4.2 Permanent Direct Impacts

4.2.1 Build Alternatives

Local energy demand for transportation projects typically is dominated by vehicle fuel usage. Operational energy consumption was estimated for the vehicles (autos, light-, medium-, and heavy-duty trucks, transit buses) and passenger rail traveling:

- Within the SR 710 North Study area, which is bounded by I-210 on the north, I-605 on the east, I-10 on the south, and I-5 and SR 2 on the west; and
- Within the six-county SCAG region.

Energy calculations are based on the vehicle miles traveled (VMT) (i.e., numbers of vehicles, distance traveled) annually (Tables 4.1 and 4.2) for the 2013 base year and each of the Year 2035 alternatives. In addition to VMT, travel conditions within the study area also influence fuel consumption rates. Without the capacity improvements proposed in the Build Alternatives, congested traffic conditions would be more prevalent throughout the study area and to a lesser extent, the region. These conditions contribute to a higher energy consumption rate because vehicles use extra fuel while idling in stop-and-go traffic or moving at slow speeds through congested roadways. Both VMT and travel speeds were used to estimate the vehicle fuel consumption for each of the scenarios reported in Table 4.3.

For the energy consumption calculations, the EMFAC2011 fuel use percentages for each vehicle category were used to determine total gasoline and diesel fuel usage rates. For the buses, it was assumed that the Transitway, Express Buses, and Local Buses would be 75 percent CNG fueled and 25 percent diesel, while the Rapid Buses are all CNG fueled. For the passenger rail, it was assumed that all high speed and light rail would be electric and that all commuter rail would be diesel. CNG is marketed in terms of DGE, created to allow comparing the cost and fuel economy of a natural gas vehicle to a comparable diesel vehicle.[1] Data from the DOE Office of Energy Efficiency and Renewable Energy lists the average energy use by commuter rail (diesel) engines as 92,474 BTUs per mile and by transit rail (electric) engines as 64,585 BTU per mile.[2] Tables 4.3 and 4.4 report annual energy use for cars and trucks (millions of gallons), buses (millions of DGE) and trains (millions of BTUs) for the study area and region, respectively. Tables 4.5 and 4.6 convert these measures of energy consumption into BTUs in order to provide a uniform metric to represent energy consumption for the Build Alternatives, which is then compared against existing year (2013) and 2035 baseline conditions (No Build) for the study area and region, respectively.

The Build Alternatives would tend to increase average travel speeds by removing bottlenecks and reducing delays. However, annual VMT in the SR 710 North Study area would also increase when comparing most of the Build Alternatives with the 2035 baseline condition (No Build).

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1 The Clean Vehicle Education Foundation, *Background and Justification for Handbooks 44 and 130 Definition of "Diesel Gallon Equivalent (DGE)" of Compressed Natural Gas (CNG) and Liquefied Natural Gas (LNG) as a Vehicular Fuel*, http://www.cleanvehicle.org/committee/technical/PDFs/DGEforCNGandLNGJustificationDocument.pdf (accessed December 11, 2013).

2 U.S. Department of Energy Office of Energy Efficiency and Renewable Energy *National Labs Transportation Energy Data Book*, 32 Edition, Table 2.12, July 2013.

TABLE 4.1:
Operational Annual Vehicle Miles Traveled – Study Area

Scenario	Study Area Annual VMT (millions)			
	Auto	Truck	Bus	Train
2013 Existing	8,332	488	14	3.5
2035 Baseline (No Build Alternative)	8,437	738	14	5.0
2035 TSM/TDM Alternative	8,464	736	16	5.0
2035 BRT Alternative	8,456	739	16	5.0
2035 LRT Alternative	8,456	735	16	6.3
2035 Freeway Tunnel Alternative – Single-Bore Operational Variations:				
2035 Single-Bore with Toll	8,494	747	15	5.0
2035 Single-Bore with Toll without Trucks	8,518	729	15	5.0
2035 Single-Bore with Toll (with and without Express Bus)	8,496	745	16	5.0
2035 Freeway Tunnel Alternative – Dual-Bore Operational Variations:				
2035 Dual-Bore without Toll	8,572	750	15	5.0
2035 Dual-Bore without Toll without Trucks	8,625	716	15	5.0
2035 Dual-Bore with Toll (with and without Express Bus)	8,585	740	15	5.0

Source: *Transportation Technical Report* (CH2M HILL 2014).
BRT = Bus Rapid Transit
LRT = Light Rail Transit
SR 710 = State Route 710
TSM/TDM = Transportation System Management/Transportation Demand Management
VMT = vehicle miles traveled

TABLE 4.2:
Operational Annual Vehicle Miles Traveled – Regional

Scenario	Regional Annual VMT (millions)			
	Auto	Truck	Bus	Train
2013 Existing	133,520	9,618	184	29
2035 Baseline (No Build Alternative)	154,149	18,062	184	51
2035 TSM/TDM Alternative	154,148	18,061	187	51
2035 BRT Alternative	154,140	18,061	187	51
2035 LRT Alternative	154,093	18,057	188	53
2035 Freeway Tunnel Alternative – Single-Bore Operational Variations:				
2035 Single-Bore with Toll	154,177	18,061	187	51
2035 Single-Bore with Toll without Trucks	154,238	18,060	187	51
2035 Single-Bore with Toll (with and without Express Bus)	154,165	18,061	187	51
2035 Freeway Tunnel Alternative – Dual-Bore Operational Variations:				
2035 Dual-Bore without Toll	154,325	18,057	187	51
2035 Dual-Bore without Toll without Trucks	154,274	18,045	187	51
2035 Dual-Bore with Toll (with and without Express Bus)	154,276	18,058	187	51

Source: *Transportation Technical Report* (CH2M HILL 2014).
BRT = Bus Rapid Transit
LRT = Light Rail Transit
SR 710 = State Route 710
TSM/TDM = Transportation System Management/Transportation Demand Management
VMT = vehicle miles traveled

TABLE 4.3:
Study Area Energy Consumption – Annual

Scenario	Annual Study Area Energy Consumption				
	Gasoline (millions of gallons)	**Diesel (millions of gallons)**	**CNG (millions of DGE)**	**Train Energy (billions of BTUs)**	**Operational Energy (billions of BTUs)**
2013 Existing	292	27	2.9	255	-
2035 Baseline (No Build Alternative)	301	37	2.9	347	-
2035 TSM/TDM Alternative	302	36	3.2	347	-
2035 BRT Alternative	302	36	3.2	347	-[1]
2035 LRT Alternative	302	37	3.3	431	0.11
2035 Freeway Tunnel Alternative – Single-Bore Operational Variations:					
2035 Single-Bore with Toll	299	36	3.2	347	2.5
2035 Single-Bore with Toll without Trucks	299	35	3.2	347	2.5
2035 Single-Bore with Toll (with and without Express Bus)	299	36	3.3	347	2.5
2035 Freeway Tunnel Alternative – Dual-Bore Operational Variations:					
2035 Dual-Bore without Toll	301	37	3.2	347	2.5
2035 Dual-Bore without Toll without Trucks	303	35	3.2	347	2.5
2035 Dual-Bore with Toll (with and without Express Bus)	302	36	3.2	347	2.5

Source: California Air Resources Board EMFAC2011.
[1] While the BRT Alternative includes new bus stops, these will only use a few LED lights using a negligible amount of energy.
BRT = Bus Rapid Transit
BTUs = British thermal units
CNG = compressed natural gas
DGE = diesel gallon equivalent (140 standard cubic feet of natural gas)
LRT = Light Rail Transit
TSM/TDM = Transportation System Management/Transportation Demand Management

TABLE 4.4:
Regional Energy Consumption – Annual

Scenario	Annual Regional Energy Consumption				
	Gasoline (millions of gallons)	**Diesel (millions of gallons)**	**CNG (millions of DGE)**	**Train Energy (billions of BTUs)**	**Operational Energy (billions of BTUs)**
2013 Existing	4,521	447	38.1	2,200	-
2035 Baseline (No Build Alternative)	5,297	739	38.3	3,831	-
2035 TSM/TDM Alternative	5,297	739	38.9	3,831	-
2035 BRT Alternative	5,297	740	38.9	3,831	-[1]
2035 LRT Alternative	5,295	739	39.0	3,915	0.11
2035 Freeway Tunnel Alternative – Single-Bore Operational Variations:					
2035 Single-Bore with Toll	5,298	739	38.9	3,831	2.5
2035 Single-Bore with Toll without Trucks	5,300	740	38.9	3,831	2.5
2035 Single-Bore with Toll (with and without Express Bus)	5,298	740	39.0	3,831	2.5
2035 Freeway Tunnel Alternative – Dual-Bore Operational Variations:					
2035 Dual-Bore without Toll	5,303	739	38.9	3,831	2.5
2035 Dual-Bore without Toll without Trucks	5,302	738	38.9	3,831	2.5
2035 Dual-Bore with Toll (with and without Express Bus)	5,302	739	38.9	3,831	2.5

Source: California Air Resources Board EMFAC2011.
[1] While the BRT Alternative includes new bus stops, these will only use a few LED lights using a negligible amount of energy.
BRT = Bus Rapid Transit
BTUs = British thermal units
CNG = compressed natural gas
DGE = diesel gallon equivalent (140 standard cubic feet of natural gas)
LRT = Light Rail Transit
TSM/TDM = Transportation System Management/Transportation Demand Management

TABLE 4.5:
Study Area Operational Energy Consumption – Percent Change

Scenario	Annual		
	Billion BTUs[1]	% Change from 2013 Existing	% Change from 2035 Baseline
2013 Existing	37,800	--	--
2035 Baseline (No Build Alternative)	40,200	6%	--
2035 TSM/TDM Alternative	40,200	6%	0.0%
2035 BRT Alternative	40,200	6%	0.0%
2035 LRT Alternative	40,500	7%	0.7%
2035 Freeway Tunnel Alternative – Single-Bore Operational Variations:			
2035 Single-Bore with Toll	39,900	6%	-0.7%
2035 Single-Bore with Toll without Trucks	39,800	5%	-1.0%
2035 Single-Bore with Toll (with and without Express Bus)	39,900	6%	-0.7%
2035 Freeway Tunnel Alternative – Dual-Bore Operational Variations:			
2035 Dual-Bore without Toll	40,200	6%	0.0%
2035 Dual-Bore without Toll without Trucks	40,200	6%	0.0%
2035 Dual-Bore with Toll (with and without Express Bus)	40,200	6%	0.0%

Source: LSA Associates, Inc. (2014).
[1] Assumes an energy content of 130,500 BTUs per gallon of diesel fuel, 115,000 BTUs per gallon of gasoline, and 1,020 BTUs per cubic foot of natural gas.
BRT = Bus Rapid Transit
BTUs = British thermal units
LRT = Light Rail Transit
TSM/TDM = Transportation System Management/Transportation Demand Management

TABLE 4.6:
Regional Operational Energy Consumption – Percent Change

Scenario	Annual		
	Billion BTUs[1]	% Change from 2013 Existing	% Change from 2035 Baseline
2013 Existing	586,000	--	--
2035 Baseline (No Build Alternative)	715,000	22%	--
2035 TSM/TDM Alternative	715,000	22%	0%
2035 BRT Alternative	715,000	22%	0%
2035 LRT Alternative	715,000	22%	0%
2035 Freeway Tunnel Alternative – Single-Bore Operational Variations:			
2035 Single-Bore with Toll	715,000	22%	0%
2035 Single-Bore with Toll without Trucks	715,000	22%	0%
2035 Single-Bore with Toll (with and without Express Bus)	715,000	22%	0%
2035 Freeway Tunnel Alternative – Dual-Bore Operational Variations:			
2035 Dual-Bore without Toll	716,000	22%	0%
2035 Dual-Bore without Toll without Trucks	715,000	22%	0%
2035 Dual-Bore with Toll (with and without Express Bus)	716,000	22%	0%

Source: LSA Associates, Inc. (2014)
[1] Assumes an energy content of 130,500 BTUs per gallon of diesel fuel, 115,000 BTUs per gallon of gasoline, and 1,020 BTUs per cubic foot of natural gas.
BRT = Bus Rapid Transit
BTUs = British thermal units
LRT = Light Rail Transit
TSM/TDM = Transportation System Management/Transportation Demand Management

As for annual gasoline consumption in the SR 710 North Study area, when compared to the 2035 baseline condition (No Build), Table 4.3 shows that the Build Alternatives would result in changes that range from less than a 1 percent increase to a 0.7 percent reduction. Table 4.4 shows that the annual gasoline consumption in the region would be approximately equal for all Build Alternatives and about the same as the 2035 baseline condition (No Build).

As for annual diesel consumption in the SR 710 North Study area, when compared to the 2035 baseline condition (No Build), Table 4.3 shows that the Build Alternatives would result in changes that range from no change for the LRT Alternative to a 5 percent reduction for the single- and dual-bore tunnel without trucks operational variations. Table 4.4 shows the annual diesel consumption in the region would be approximately equal for all Build Alternatives and about the same as the 2035 baseline condition (No Build).

As for annual CNG consumption in the SR 710 North Study area, when compared to the 2035 baseline condition (No Build), Table 4.3 shows that all of the Build Alternatives would result in an increase in annual CNG consumption ranging from 10 to 14 percent. Table 4.4 shows the annual CNG consumption for the region would be approximately equal for all Build Alternatives at about 39 million DGE (about a 1.8 percent increase over the 38.3 million DGE baseline).

Combining these three fuel consumptions (i.e., gasoline, diesel, and CNG) as energy (BTUs) and adding the rail energy use, Table 4.5 shows that in the SR 710 North Study area, all the Build Alternatives would result in a 5 to 7 percent increase in operational energy consumption from the 2013 existing condition. Table 4.6 shows that for operational energy consumption in the region, all project alternatives would result in the same 22 percent increase in operational energy consumption from the 2013 existing condition.

Similarly, Table 4.5 shows that in the SR 710 North Study area, the LRT Alternative would result in an approximately 0.7 percent increase in operational energy consumption from the 2035 baseline condition (No Build), with the other Build Alternatives resulting in changes ranging from no change to a 1 percent decrease for the single-bore tunnel with toll without trucks operational variation. Table 4.6 shows that for operational energy consumption in the region, none of the project alternatives would result in a measurable change in operational energy consumption.

The difference between actual and potential transportation has been given careful consideration. Potential service of a vehicle would be the maximum rated capacity for passengers or cargo, and actual service is the real number it does carry. The implications of this concept are vital in comparisons between different transportation modes. For example, a commuter bus may be filled to capacity in one direction while taking people to work or shopping, but may return nearly empty to complete the loop of its route. It has the potential to carry a full passenger load on the return trip, but this is, practically speaking, impossible. Thus, although it consumes fuel for the complete loop, it actually provides transportation for fewer than the maximum rates of passenger-miles. The same holds true for a delivery truck that leaves a warehouse full and returns empty. The ratio of actual service rendered versus potential service is called the “load factor” and must be used in connection with an energy analysis.

Load factors also apply to private vehicles. For example, a passenger car rated for six seats and carrying only the driver has a load factor of 1/6th, whereas motorcycles, which are usually considered to be single-seaters in spite of their extra-long seat and foot pegs for a passenger, may actually be given a load factor of 2 when a passenger is carried.

The purpose of the proposed project is to effectively and efficiently accommodate regional and local north-south travel demands in the study area. Making this accommodation would not alter the ratio of the actual transportation service versus the potential transportation service within the project region; thus, the proposed project would have no effect on service parameters.

Thus, of the three analysis elements (i.e., direct and indirect energy consumption and service parameters), direct energy consumption and service parameters would not be substantially impacted by any of the project alternatives.

Additionally, two of the Build Alternatives, the LRT and Freeway Tunnel Alternatives will have large operational energy demands. While the BRT Alternative includes new bus stops, these will only use LED lighting using a negligible amount of energy. The LRT Alternative would require seven new stations, estimated to have a daily electrical demand of approximately 200 to 400 kVA each for elevated and underground stations, respectively, for a total additional daily electrical demand of 2,200 kVA. Operation of the Freeway Tunnel Alternative would use approximately 48 MW daily. These translate to approximately 0.11 billion BTU/yr for operating the LRT stations and 2.5 billion BTU/yr for the operation of the tunnel(s) in the Freeway Tunnel Alternative. As shown in Tables 4.3 through 4.6, these operational energy use amounts are very small relative to the total direct energy use in the study area and region.

4.2.2 No Build Alternative

Under the No Build Alternative, the permanent effects on energy consumption discussed above for the Build Alternatives would not occur for the project itself, but these permanent energy consumption effects would occur for the other transportation improvement projects included in the No Build Alternative.

4.3 Permanent Indirect Impacts

4.3.1 Build Alternatives

Permanent indirect energy impacts consist principally of the ongoing, nonrecoverable energy costs associated with the maintenance of vehicles. This analysis was conducted using the Caltrans Input-Output Method. This method converts VMT based on existing data from other road improvement projects in the United States using conversions listed in the Caltrans *Energy and Transportation Systems* handbook (July 1983). It was assumed that the energy requirements for maintaining vehicles have not changed from those listed in the handbook. Thus, the per-vehicle indirect energy impacts for the Build Alternatives and the existing condition would all be the same.

Using the annual VMT data for autos, trucks, and transit shown in Tables 4.1 and 4.2, and recalling that the VMT increases in the study area and the region would be due to a combination of factors, including increases in population in the region as well as project improvements, Table 4.7 shows that the Build Alternatives would result in maintenance-related energy consumption changes in the SR 710 North Study area. The LRT Alternative would require a maintenance yard for cleaning,

TABLE 4.7:
Study Area Permanent Indirect Energy Impacts

Scenario	Maintenance-Related Energy		
	Auto (billion BTUs)	**Truck (billion BTUs)**	**% Change from No Build**
2013 Existing	9,410	1,450	–
2035 Baseline (No Build Alternative)	9,530	2,170	–
2035 TSM/TDM Alternative	9,560	2,170	0.3%
2035 BRT Alternative	9,550	2,180	0.3%
2035 LRT Alternative	9,550	2,170	0.2%
2035 Freeway Tunnel Alternative – Single-Bore Operational Variations:			
2035 Single-Bore with Toll	9,590	2,200	0.8%
2035 Single-Bore with Toll without Trucks	9,620	2,150	0.6%
2035 Single-Bore with Toll (with and without Express Bus)	9,590	2,200	0.8%
2035 Freeway Tunnel Alternative – Dual-Bore Operational Variations:			
2035 Dual-Bore without Toll	9,680	2,210	1.6%
2035 Dual-Bore without Toll without Trucks	9,740	2,120	1.4%
2035 Dual-Bore with Toll (with and without Express Bus)	9,690	2,180	1.5%

Source 1: *Transportation Technical Report* (CH2M HILL 2014).
Source 2: California Department of Transportation, *Energy and Transportation Systems* handbook (July 1983).
BRT = Bus Rapid Transit
BTUs = British thermal units
LRT = Light Rail Transit
TSM/TDM = Transportation System Management/Transportation Demand Management

maintaining, and storing light rail vehicles (LRVs). The maintenance yard would include a car wash, a paint shop, and other support facilities, and would also have enough storage tracks to accommodate all of the LRVs required to operate the light rail line. The Caltrans handbook maintenance factors used in this analysis include maintenance activities such as these.

When compared to the 2035 baseline condition (No Build), the Build Alternatives would result in a 0.2 to 1.6 percent increase in maintenance-related energy consumption. Table 4.8 shows that for the region, none of the Build Alternatives would result in a measurable change in maintenance-related energy consumption from the 2035 baseline condition (No Build).

4.3.2 No Build Alternative

Under the No Build Alternative, the permanent indirect effects on energy consumption discussed above for the Build Alternatives would not occur for the project itself, but these permanent energy consumption effects would occur for the other transportation improvement projects included in the No Build Alternative.

TABLE 4.8:
Regional Permanent Indirect Energy Impacts

Scenario	Maintenance-Related Energy		
	Auto (trillion BTUs)	Truck (trillion BTUs)	% Change from No Build
2013 Existing	151	28	–
2035 Baseline (No Build Alternative)	174	53	–
2035 TSM/TDM Alternative	174	53	0%
2035 BRT Alternative	174	53	0%
2035 LRT Alternative	174	53	0%
2035 Freeway Tunnel Alternative – Single-Bore Operational Variations:			
2035 Single-Bore with Toll	174	53	0%
2035 Single-Bore with Toll without Trucks	174	53	0%
2035 Single-Bore with Toll (with and without Express Bus)	174	53	0%
2035 Freeway Tunnel Alternative – Dual-Bore Operational Variations:			
2035 Dual-Bore without Toll	174	53	0%
2035 Dual-Bore without Toll without Trucks	174	53	0%
2035 Dual-Bore with Toll (with and without Express Bus)	174	53	0%

Source 1: *Transportation Technical Report* (CH2M HILL 2014).
Source 2: California Department of Transportation, *Energy and Transportation Systems* handbook (July 1983).
BRT = Bus Rapid Transit LRT = Light Rail Transit
BTUs = British thermal units TSM/TDM = Transportation System Management/Transportation Demand Management

4.4 Temporary Indirect Impacts

4.4.1 Build Alternatives

Temporary indirect energy impacts result from the manufacture of vehicles that operate on the project and project construction. Indirect manufacturing energy effects involve the one-time, nonrecoverable energy costs associated with the manufacture of vehicles. Construction energy effects involve the one-time, nonrecoverable energy costs associated with construction of roads and structures. The indirect energy analysis for the project was also conducted using the Caltrans Input-Output Method as described in the Caltrans *Energy and Transportation Systems* handbook (July 1983). It was assumed that the energy requirements for manufacturing vehicles have not changed from those listed in the handbook. Thus, the per-vehicle indirect energy impacts for the baseline (No Build), the Build Alternatives and the existing condition would all be the same.

For the tunneling equipment demand, the LADWP and the Pasadena Water and Power Utility have committed to build electrical substations at the southern tunnel portal and the northern tunnel portal, respectively, for the Freeway Tunnel Alternative and its design variations. The LADPW has committed to build a substation at the southern tunnel portal for the LRT Alternative. It is estimated that the construction power demand at each freeway tunnel boring machine (TBM) portal would be approximately 55.5 MW and at each LRT TBM portal would be approximately 12 MW. Thus, it is anticipated that the large construction energy demands from any of the Freeway and LRT tunnel alternatives would be accommodated by these utility providers.

Table 4.9 shows that all the Build Alternatives would have a substantial increase to total indirect energy consumption in the study area, ranging from 40 percent for the TSM/TDM Alternative and 93 percent for the BRT Alternative (with relatively minor construction costs) to 980 percent for the LRT Alternative (with the greater construction costs for LRT tunnels, stations, and maintenance facilities) to over 1,000 percent for the single-bore tunnel alternatives and over 2,000 percent for the dual-bore tunnel alternatives. Table 4.10 shows that when including the construction costs for all transportation projects for the region, as described in the 2012 SCAG RTP, at $525 billion

TABLE 4.9:
Study Area Temporary Indirect Energy Impacts

Scenario	Construction-Related Energy				Total Indirect Energy (billion BTUs)	% Change from No Build
	Manufacturing		Energy to Build (billion BTUs)	Build Cost[1] (billions)		
	Auto (billion BTUs)	Truck & Bus (billion BTUs)				
2013 Existing	11,700	775	–	–	23,300	–
2035 Baseline (No Build Alternative)	11,800	1,160	16,700	$0.10	41,400	–
2035 TSM/TDM Alternative	11,800	1,160	33,600	$0.21	58,300	40%
2035 BRT Alternative	11,800	1,170	55,300	$0.34	80,000	93%
2035 LRT Alternative	11,800	1,160	422,000	$2.62	447,000	980%
2035 Freeway Tunnel Alternative – Single-Bore Operational Variations:						
2035 Single-Bore with Toll	11,900	1,180	523,000	$3.25	548,000	1,220%
2035 Single-Bore with Toll without Trucks	11,800	1,180	523,000	$3.25	548,000	1,220%
2035 Single-Bore with Toll (with and without Express Bus)	11,800	1,180	523,000	$3.25	548,000	1,220%
2035 Freeway Tunnel Alternative – Dual-Bore Operational Variations:						
2035 Dual-Bore without Toll	12,400	1,230	926,000	$5.75	951,000	2,200%
2035 Dual-Bore without Toll without Trucks	12,500	1,170	926,000	$5.75	951,000	2,200%
2035 Dual-Bore with Toll (with and without Express Bus)	12,000	1,170	926,000	$5.75	951,000	2,200%

Source 1: *Transportation Technical Report* (CH2M HILL 2014).
Source 2: California Department of Transportation, *Energy and Transportation Systems* handbook (July 1983).
[1] Build cost in 2020 dollars , the earliest planned opening year.
BRT = Bus Rapid Transit LRT = Light Rail Transit
BTUs = British thermal units TSM/TDM = Transportation System Management/Transportation Demand Management

TABLE 4.10:
Regional Temporary Indirect Energy Impacts

Scenario	Construction-Related Energy				Total Indirect Energy (trillion BTUs)	% Change from No Build
	Manufacturing		Energy to Build (trillion BTUs)	Build Cost[1] (billions)		
	Auto (trillion BTUs)	Truck & Bus (trillion BTUs)				
2013 Existing	187	15	–	–	381	–
2035 Baseline (No Build Alternative)	216	28	84,400	$524.70	84,900	–
2035 TSM/TDM Alternative	216	28	84,400	$524.81	84,900	0%
2035 BRT Alternative	216	28	84,500	$524.94	85,000	0%
2035 LRT Alternative	216	28	84,800	$527.22	85,300	0.5%
2035 Freeway Tunnel Alternative – Single-Bore Operational Variations:						
2035 Single-Bore with Toll	216	28	84,900	$527.85	85,400	0.6%
2035 Single-Bore with Toll without Trucks	216	28	84,900	$527.85	85,400	0.6%
2035 Single-Bore with Toll (with and without Express Bus)	216	28	84,900	$527.85	85,400	0.6%
2035 Freeway Tunnel Alternative – Dual-Bore Operational Variations:						
2035 Dual-Bore without Toll	216	28	85,300	$530.35	85,800	1.1%
2035 Dual-Bore without Toll without Trucks	216	28	85,300	$530.35	85,800	1.1%
2035 Dual-Bore with Toll (with and without Express Bus)	216	28	85,300	$530.35	85,800	1.1%

Source 1: *Transportation Technical Report* (CH2M HILL 2014).
Source 2: California Department of Transportation, *Energy and Transportation Systems* handbook (July 1983).
[1] Build cost in 2020 dollars , the earliest planned opening year.
BRT = Bus Rapid Transit LRT = Light Rail Transit
BTUs = British thermal units TSM/TDM = Transportation System Management/Transportation Demand Management

(not including this project), the project-related construction cost increases of between $0.21 to $5.75 billion result in changes to total indirect energy consumption in the region of approximately 1 percent or less for all Build Alternatives compared to the No Build Alternative.

4.4.2 No Build Alternative

Under the No Build Alternative, the temporary energy consumption discussed above for the Build Alternatives would not occur, but temporary energy consumption would occur for the other transportation improvement projects included in the No Build Alternative. Generally, construction energy can be compared to increased roadway maintenance energy if a project is not built. However, there is insufficient information to quantify this roadway maintenance energy.

4.5 Total Energy Impacts

The combination of the direct and indirect energy impacts are summarized in Tables 4.11 and 4.12. An important criterion in any energy impact analysis is if or when the energy savings a project would achieve would offset the energy cost to construct the project. If the energy savings would offset the energy costs, the project would have a payback period defined as the period of time taken to do so. As shown in Table 4.11, the estimated costs to construct the various Build Alternatives would range from approximately 17 trillion to 926 trillion BTUs. As is also shown in Table 4.11, there are very small or no direct or indirect energy savings associated with any of the Build Alternatives compared to the baseline (No Build) alternative, so the payback period for the any of the Build Alternatives is not quantifiable.

As shown in Table 4.11 for the study area, the temporary indirect energy impacts of constructing the Build Alternatives would be substantial. However, as shown in Table 4.12 for the region, none of the Build Alternatives would consume substantially more energy than the No Build Alternative. Thus, while none of the Build Alternatives would have a quantifiable payback period from energy savings, the project impact to regional energy supplies would be minor. As the regional energy impacts from any of the Build Alternatives is small, the three energy utilities (LADWP, Pasadena Water and Power Utility, and Southern California Edison) would not be adversely impacted by the maintenance or operation energy demands of any of the proposed Build Alternatives. Thus, for the region, none of the three analysis elements (direct and indirect energy consumption and service parameters) would be substantially impacted by any of the project alternatives. Therefore, no avoidance, minimization, or mitigation measures would be required.

Additionally, while the vehicle mix operating on the project study area roadways is showing increasing numbers of passenger car electric vehicle and alternative fuel use vehicles, these vehicles use similar amounts of energy as gasoline powered per mile, thus this transition won’t result in a large change to the energy use results shown in Tables 4.11 and 4.12.

Note that the Caltrans Input-Output Analysis Method is outdated and might be producing higher construction energy results than a more refined analysis method. However, there are no acceptable alternative analysis methods. Thus, the energy impact results in this report should be used only as a comparison between project alternatives, and not as an accurate estimate of actual energy use.

TABLE 4.11:
Study Area Energy Consumption Summary

Scenario	Non-Construction Energy		Construction Energy (BBTUs/yr)	Total Energy (BBTUs/yr)	% Change from Existing	% Change from No Build
	Direct Energy (BBTUs/yr)	Indirect Energy (BBTUs/yr)				
2013 Existing	37,800	12,500	--	50,300	--	--
2035 Baseline (No Build Alternative)	40,200	13,000	16,700	69,900	40%	--
2035 TSM/TDM Alternative	40,200	13,000	33,600	86,800	70%	20%
2035 BRT Alternative	40,200	13,000	55,300	108,500	120%	55%
2035 LRT Alternative	40,500	13,000	422,000	475,500	850%	580%
2035 Freeway Tunnel Alternative – Single-Bore Operational Variations:						
2035 Single-Bore with Toll	39,900	13,100	523,000	576,000	1,050%	720%
2035 Single-Bore with Toll without Trucks	39,800	13,100	523,000	575,900	1,040%	720%
2035 Single-Bore with Toll (with and without Express Bus)	39,900	13,100	523,000	576,000	1,050%	720%
2035 Freeway Tunnel Alternative – Dual-Bore Operational Variations:						
2035 Dual-Bore without Toll	40,200	13,200	926,000	979,400	1,850%	1,300%
2035 Dual-Bore without Toll without Trucks	40,200	13,200	926,000	979,400	1,850%	1,300%
2035 Dual-Bore with Toll (with and without Express Bus)	40,200	13,200	926,000	979,400	1,850%	1,300%

Source 1: *Transportation Technical Report* (CH2M HILL 2014).
Source 2: The California Department of Transportation, *Energy and Transportation Systems* handbook (July 1983).
[1] A payback period of fewer than 5 years is considered an excellent investment, while a payback period of greater than 20 years will generally be beyond the foreseeable future of the project (Caltrans 1983).
BRT = Bus Rapid Transit
BBTUs/yr = billion British thermal units per year
Caltrans = California Department of Transportation
LRT = Light Rail Transit
TSM/TDM = Transportation System Management/Transportation Demand Management

TABLE 4.12:
Regional Energy Consumption Summary

Scenario	Non-Construction Energy		Construction Energy (TBTUs/yr)	Total Energy (TBTUs/yr)	% Change from Existing	% Change from No Build
	Direct Energy (TBTUs/yr)	Indirect Energy (TBTUs/yr)				
2013 Existing	586	202	--	788	--	--
2035 Baseline (No Build Alternative)	715	244	84,400	85,400	10,740%	--
2035 TSM/TDM Alternative	715	244	84,400	85,400	10,740%	0.00%
2035 BRT Alternative	715	244	84,500	85,500	10,750%	0.12%
2035 LRT Alternative	715	244	84,800	85,800	10,790%	0.47%
2035 Freeway Tunnel Alternative – Single-Bore Operational Variations:						
2035 Single-Bore with Toll	715	244	84,900	85,900	10,800%	0.59%
2035 Single-Bore with Toll without Trucks	715	244	84,900	85,900	10,800%	0.59%
2035 Single-Bore with Toll (with and without Express Bus)	715	244	84,900	85,900	10,800%	0.59%
2035 Freeway Tunnel Alternative – Dual-Bore Operational Variations:						
2035 Dual-Bore without Toll	716	244	85,300	86,300	10,850%	1.1%
2035 Dual-Bore without Toll without Trucks	715	244	85,300	86,300	10,850%	1.1%
2035 Dual-Bore with Toll (with and without Express Bus)	716	244	85,300	86,300	10,850%	1.1%

Source 1: *Transportation Technical Report* (CH2M Hill 2014).
Source 2: The California Department of Transportation, *Energy and Transportation Systems* handbook (July 1983).
[1] A payback period of fewer than 5 years is considered an excellent investment, while a payback period of greater than 20 years will generally be beyond the foreseeable future of the project (Caltrans 1983).
BRT = Bus Rapid Transit
Caltrans = California Department of Transportation
LRT = Light Rail Transit
TBTUs/yr = Trillion British thermal units per year
TSM/TDM = Transportation System Management/Transportation Demand Management

4.6 Consistency with Energy Conservation Plans

The CEC, the CPUC, and the CPA approved the final State of California Energy Action Plan in 2003, which was proposed by a subcommittee of these three agencies. The Plan established shared goals and specific actions to ensure that adequate, reliable, and reasonably priced electrical power and natural gas supplies are achieved and provided through policies, strategies, and actions that are cost effective and environmentally sound for California's consumers and taxpayers. In 2005, an updated Energy Action Plan was adopted by the CEC and the CPUC to reflect policy changes and actions after 2003.

The State's energy policies have been substantially influenced by the passage of AB 32, the California Global Warming Solutions Act of 2006. The CEC's IEPR advances policies that would enable the State to meet its energy needs in a carbon-constrained world. That report also provides a comprehensive set of recommended actions to achieve these policies.

Rather than produce a new Energy Action Plan, the CEC and the CPUC have prepared instead the Energy Action Plan – 2008 Update, which examines the State's ongoing actions in the context of global climate change. The update was prepared using the information and analysis prepared for the 2007 IEPR as well as recent CPUC decisions.

As described in Sections 4.3 and 4.4, while the temporary indirect energy impacts of constructing the Build Alternatives are substantial at a local level, the total indirect energy impacts would be negligible at the regional level. Because the California energy conservation planning actions are conducted at a regional level and, as described in Section 4.5, the total project impact to regional energy supplies would be minor, none of the Build Alternatives would conflict with these California energy conservation plans.

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5. Energy Minimization Measures

5.1 Construction Minimization Measure

The following measure would minimize energy use during construction of any of the Build Alternatives.

E-1 As part of the Plans, Specifications, and Estimates (PS&E), a construction efficiency plan will be prepared, which may include the following:

- Reuse of existing rail, steel, and lumber wherever possible, such as for falsework, shoring, and other applications during the construction process.
- Recycling of asphalt taken up from roadways, if practicable and cost-effective.
- Use of newer, more energy-efficient equipment where feasible and maintenance of older construction equipment to keep in good working order.
- Promoting of scheduling of construction operations to efficiently use construction equipment, i.e., only haul waste when haul trucks are full and combine smaller dozer operations into a single comprehensive operation, where possible.
- Promotion of construction employee carpooling.

5.2 Operational and Maintenance Minimization Measures

As discussed in Section 4, neither maintenance nor operation of any of the Build Alternatives would result in adverse impacts related to energy consumption in both the LADWP and the Pasadena Water and Power Utility areas compared to the No Build Alternative; therefore, no avoidance, minimization, or mitigation measures are required.

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