State Route 710 Study

Alternatives Analysis Report

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Acronyms and Abbreviations

AA	Alternatives Analysis
ACC	All Communities Convening
ADT	Average Daily Traffic
AM	Morning
ASTM	American Society for Testing and Materials
ATM	Active Traffic Management
BRT	Bus Rapid Transit
Caltech	California Institute of Technology
Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
CGS	California Geological Survey
CH_4	Methane
CLC	Community Liaison Council
CMP	Congestion Management Program
CMS	Changeable Message Sign
CO	Carbon Monoxide
CO_2	Carbon Dioxide
dBA	Decibels
DLL	Disturbance Limit Line
EB	Eastbound
EDR	Environmental Data Resources
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EMFAC	Emission Factor Model for Onroad Motor Vehicles
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
GHG	Greenhouse Gases
GIS	Geographical Information System
HICOMP	Highway Congestion Monitoring Program
HOV	High Occupancy Vehicle
I	Interstate
IEN	Information Exchange Network
ITS	Intelligent Transportation Systems
JPL	Jet Propulsion Laboratory
LA	Los Angeles
Leq	Average Hourly Equivalent Noise Level
LOS	Level of Service
LRT	Light Rail Transit
LRTP	Long Range Transportation Plan
LRV	Light Rail Vehicle
Metro	Los Angeles County Metropolitan Transportation Authority
MPH	Miles Per Hour
MSA	Metropolitan Statistical Area
MSAT	Mobile Source Air Toxics
NAAQS	National Ambient Air Quality Standards

NAC	Noise Abatement Criteria
National Register	National Register of Historic Places
NB	Northbound
NEPA	National Environmental Policy Act
NO_2	Nitrogen Dioxide
NOI	Notice of Intent
NOP	Notice of Preparation
NO_x	Oxides of Nitrogen
O-D	Origin-Destination
O_3	Ozone
OLEV	Online Electric Vehicle Technology
PA/ED	Project Approval and Environmental Documentation
PCC	Pasadena City College
PeMS	Performance Monitoring System
PM	Afternoon
PM_{10}	Particulate Matter 10 Microns or Smaller in Diameter
$PM_{2.5}$	Particulate Matter 2.5 Microns or Smaller in Diameter
ROD	Record of Decision
ROG	Reactive Organic Gases
ROW	Right-of-Way
RTP	Regional Transportation Plan
SB	Southbound
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison
SCS	Sustainable Community Strategies
SEA	Significant Ecological Areas
SO_2	Sulfur Dioxide
SOAC	Stakeholder Outreach Advisory Committee
SO_x	Sulfur Oxides
SR	State Route
TAC	Toxic Air Contaminant
TBM	Tunnel boring machine
TDM	Transportation Demand Management
TSM	Transportation System Management
TSP	Transit Signal Priority
TSSP	Traffic Signal Synchronization Program
U.S.	United States
UPRR	Union Pacific Railroad
v/c	Volume to capacity ratio
VHD	Vehicle Hours of Delay
VHT	Vehicles Hours of Travel
VMT	Vehicle Miles of Travel
WB	Westbound

ES.1.0 Need and Purpose

ES.1.1 Background and History

The SR 710 Study is the culmination of a long history of efforts to address north-south mobility in the western San Gabriel Valley and east and northeast Los Angeles. The history of the planning efforts dates back to 1933 when Legislative Route 167, later renamed SR 7, was defined to run from San Pedro east to Long Beach and north to the vicinity of Monterey Park. The majority of this route has been constructed and incorporated into the Interstate Highway System as Interstate 710 (I-710). In 1959, the proposed northern limits of SR 7 were extended to the planned Foothill Freeway (now I-210). Over the years, planning efforts continued to address community and agency concerns, eventually leading to the issuance of a Record of Decision (ROD) in 1998 by the Federal Highway Administration (FHWA) for a surface freeway. After litigation initiated by some of the affected communities, FHWA rescinded the ROD in 2003, citing changes in project circumstances such as funding uncertainty and the opening of the Metro Gold line to Pasadena, and requiring a more thorough evaluation of the feasibility of a bored tunnel.

In 2006, Metro and Caltrans conducted two tunnel feasibility assessments, the *Route 710 Tunnel Technical Feasibility Assessment Report* and the *SR-710 Tunnel Technical Study*, to evaluate the feasibility of constructing a tunnel to complete the planned SR 710 freeway route that would lessen the potential impacts associated with a surface route. The studies found that a tunnel would be a viable solution and would warrant more detailed evaluation. In November 2008, Measure R (a half-cent sales tax dedicated to transportation projects in Los Angeles County) was approved by a two-thirds majority of County voters. Included in the Measure R plan is the commitment of $780 million to improve the connection between the SR 710 and I-210 freeways.

In March 2011, Caltrans published a Notice of Intent (NOI) under the National Environmental Policy Act (NEPA) and a Notice of Preparation (NOP) under the California Environmental Quality Act (CEQA) to initiate the environmental review process for the “Interstate 710 North Gap Closure” project. The environmental review process began with the “SR-710 Conversations” outreach effort, led by Metro, including 21 pre-scoping and scoping meetings throughout the study area in March and April of 2011. Metro also initiated the “State Route 710 Gap Closure Transit Profile Study” to gather transit service and patronage data and to assess current and future transit travel markets within the study area.

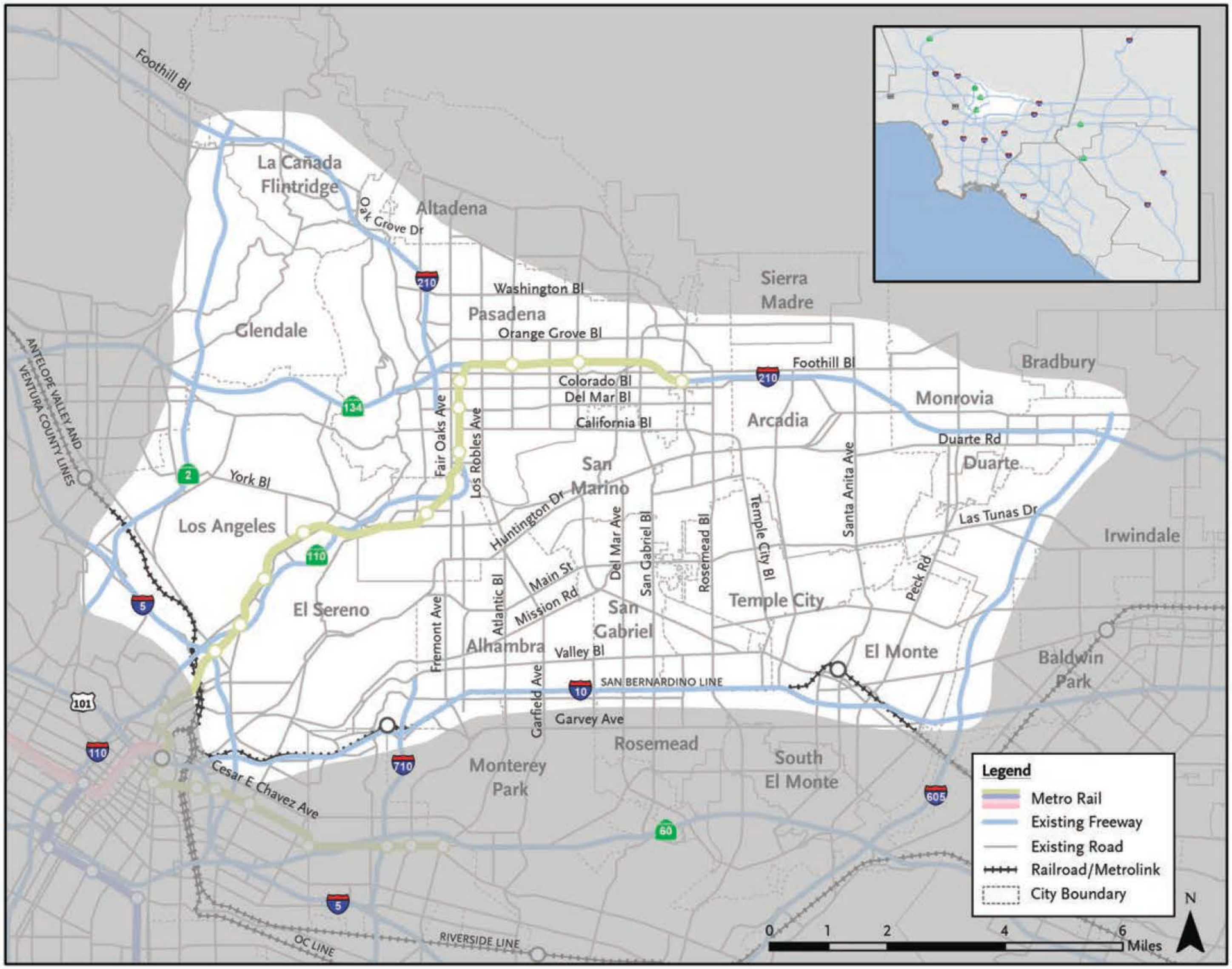
ES.1.2 Study Area

The study area is approximately 100 square miles and is generally bounded by the I-210 freeway on the north, the I-605 freeway on the east, the I-10 freeway on the south, and the I-5 and SR 2 freeways on the west. The study area is illustrated in Figure ES-1. According to data from the Southern California Association of Governments (SCAG), the study area had a population of 1.18 million people in 2008, and 450,000 jobs were located in the study area. By 2035, the study area is forecast to have a population of 1.33 million people and an employment base of 507,000 jobs.

ES.1.3 Need

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, 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

Figure ES-1. Study Area



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, 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 (SR 118, US-101/SR 134/I-210, I-10, SR 60, I-105, SR 91, SR 22) and seven major north-south freeway routes (I-405, US-101/US-170, I-5, I-110/SR 110, I-710, I-605, and SR 57) in the central portion of the Los Angeles-Long Beach-Santa Ana MSA. Of the seven north-south routes, four of them are located partially within the study area (I-5, I-110/SR 110, I-710, and I-605), and two of these (I-110/SR 110 and I-710) terminate within the study area without connecting to another freeway. As a result, a very large 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:

- It degrades the overall efficiency of the larger **regional transportation system.**
- It causes **congestion on freeways in the study area.**
- It contributes to **congestion on the local streets in the study area.**
- It results in **poor transit operations within the study area.**

ES.1.4 Purpose

Based on the needs discussed above related to the regional transportation system, congestion on freeways in the study area, cut-through traffic that affects local streets in the study area, and poor transit operations within the study area, 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.

ES.1.5 Objectives

To address the four elements of need for the project, five objectives related to the performance of the transportation system were developed as shown in Table ES-1.

Table ES-1. Transportation System Objectives

Element of Need	Objective
Regional transportation system	1. Minimize travel time
	2. Improve connectivity and mobility
Congestion on study area freeways	3. Reduce congestion on freeway system
Congestion on local streets	4. Reduce congestion on local street system
Transit operations in study area	5. Increase transit ridership

Three additional objectives were developed to address environmental impacts, planning considerations, and cost efficiency as shown in Table ES-2.

Table ES-2. Environmental and Other Project Objectives

Value or Concern	Objective
Environment and communities	6. Minimize environmental and community impacts related to transportation
Consistency with plans	7. Assure consistency with regional plans and strategies
Provide financially feasible transportation solutions	8. Maximize the cost-efficiency of public investments

ES.2.0 Alternatives Considered

A wide range of possible transportation alternatives was identified based on past studies and comments received during the "SR-710 Conversations" from stakeholders including elected officials, city and agency staff, and the community. The resulting options were evaluated and refined through a sequential screening process to identify the alternatives that best meet the Need and Purpose of the study. The following sections describe the screening process, selection criteria, and the alternatives selected for evaluation via conceptual engineering and initial environmental analysis in this Alternatives Analysis (AA).

ES.2.1 Screening Criteria and Selection Process

The screening of alternatives followed a sequential process summarized below and illustrated in Figure ES-2:

Figure ES-2: Screening Process

- **Preliminary Screening** – An unscreened set of alternatives was identified during project initiation through a process that included a review of prior studies and public input received during the "710 Conversations" scoping process conducted by Metro and Caltrans in 2011. From this large set of alternatives, the preliminary screening step led to the identification of the preliminary set of alternatives, consisting of 42 alternatives representing a reasonable range of modes and alignments. Criteria used for the preliminary screening included the potential to accommodate regional north-south travel, reduce local street congestion, minimize community impacts, minimize the potential to encounter contaminated soil and groundwater, and accommodate ridership potential (for relevant modes). Within each travel mode, alternatives were evaluated against each other, and the most promising alternatives from each mode were selected to be included in the preliminary set of alternatives.
- **Initial Screening** – The initial screening evaluated the preliminary set of alternatives based on the eight project objectives described in Section 1.5. In general, the initial screening relied on available data and schematic representations of each alternative. To find the best performing alternatives

within each mode in the initial screening, the performance of each alternative was compared only to that of other alternatives of the same mode. This evaluation step resulted in the identification of the initial set of alternatives, consisting of 12 alternatives and representing each mode from the preliminary set of alternatives.

- **Secondary Screening** – In the secondary screening step of the AA phase, the initial set of alternatives was studied and evaluated using detailed performance measures reflecting the eight project objectives. Additional engineering and environmental evaluation of each alternative was conducted, based on travel demand and ridership forecasting specific to each alternative and the conceptual-level engineering plans. The alternatives performing best on the secondary screening will be further developed and enhanced for evaluation during the Project Approval and Environmental Documentation (PA/ED) phase, along with possible hybrid or combination alternatives.

ES.2.2 Initial Set of Alternatives

The initial set of alternatives was screened from the preliminary set of alternatives and represents a range of modes and alignments. The No Build Alternative, the TSM/TDM Alternative, and the 10 "build" alternatives (as well as three design variations) are described below.

ES.2.2.1 No Build Alternative

The No Build Alternative includes all of the projects that are identified in the financially constrained project list of SCAG's *2008 Regional Transportation Plan (RTP): Making the Connections*. The No Build Alternative also includes currently planned projects in Los Angeles County that are identified in Measure R, as well as those in the "Constrained Plan" of Metro's 2009 Long Range Transportation Plan (through the year 2035). The No Build Alternative does not include any project in the SR 710 corridor in the study area.

ES.2.2.2 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 such as substantially increased bus service in the study area, active transportation (pedestrian and bicycle) facilities, intersection spot improvements, local street improvements, and Intelligent Transportation Systems (ITS) elements. The transit service improvements included in the TSM/TDM Alternative are illustrated in Figure ES-3. These transit improvements are also included in the BRT and LRT alternatives, but are not included in the freeway and highway alternatives.

ES.2.2.3 Bus Rapid Transit (BRT) Alternatives

The BRT alternatives would provide higher speed, high frequency bus service operating in a combination of new, dedicated bus lanes and existing, mixed-flow traffic lanes. Bus priority methods such as synchronized traffic signal timing and preferential treatment of bus arrivals at signalized intersections would also be incorporated into the BRT system. The BRT alternatives also include all of the additional transit service provided in the TSM/TDM alternative, except where those services overlap with the BRT service itself. The BRT alternatives are illustrated in Figure ES-4.

BRT-1. Alternative BRT-1 would provide BRT service between Los Angeles Union Station and the Jet Propulsion Laboratory (JPL) in La Cañada Flintridge.

Figure ES-3. TSM/TDM Alternative – Bus Service Improvements

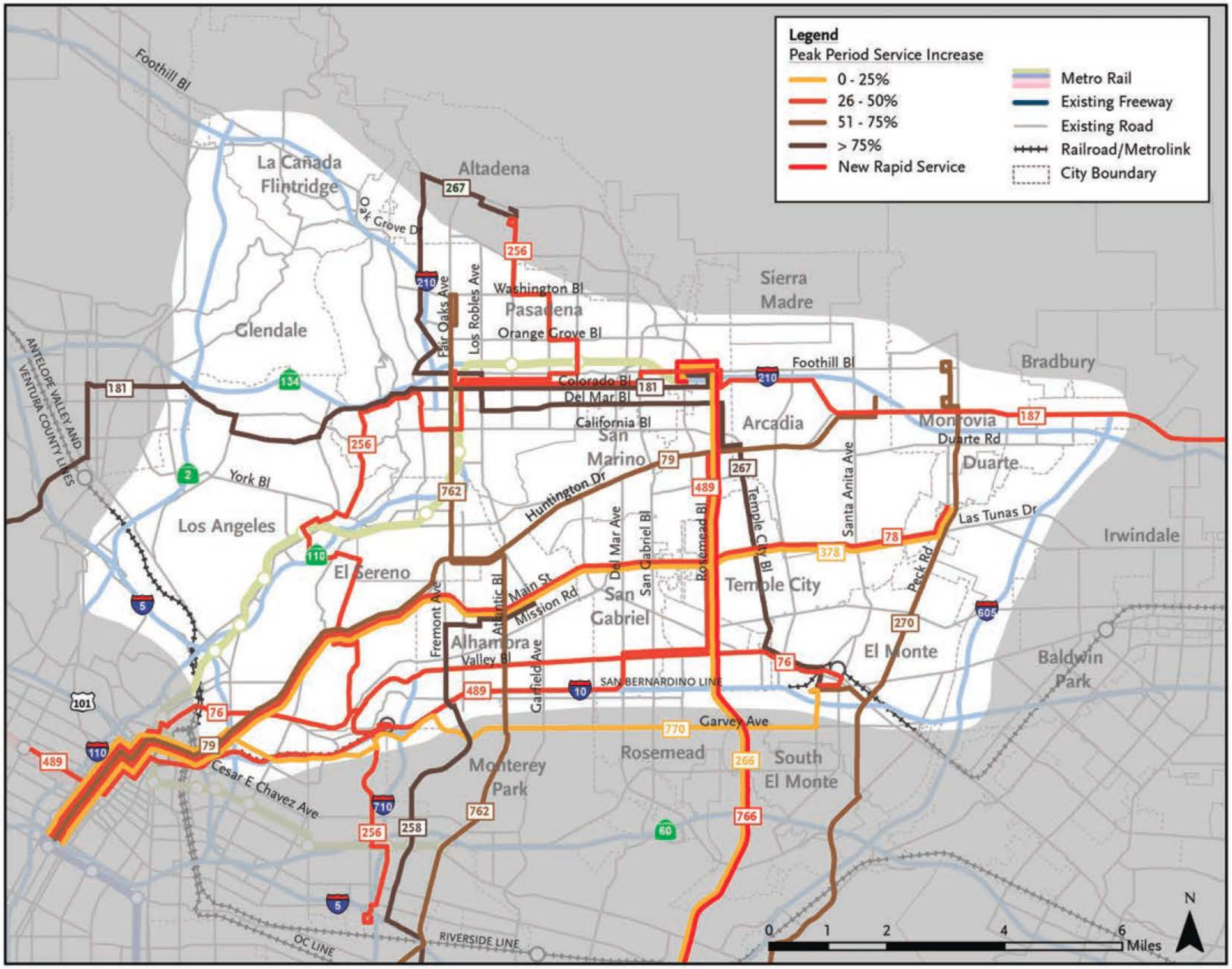
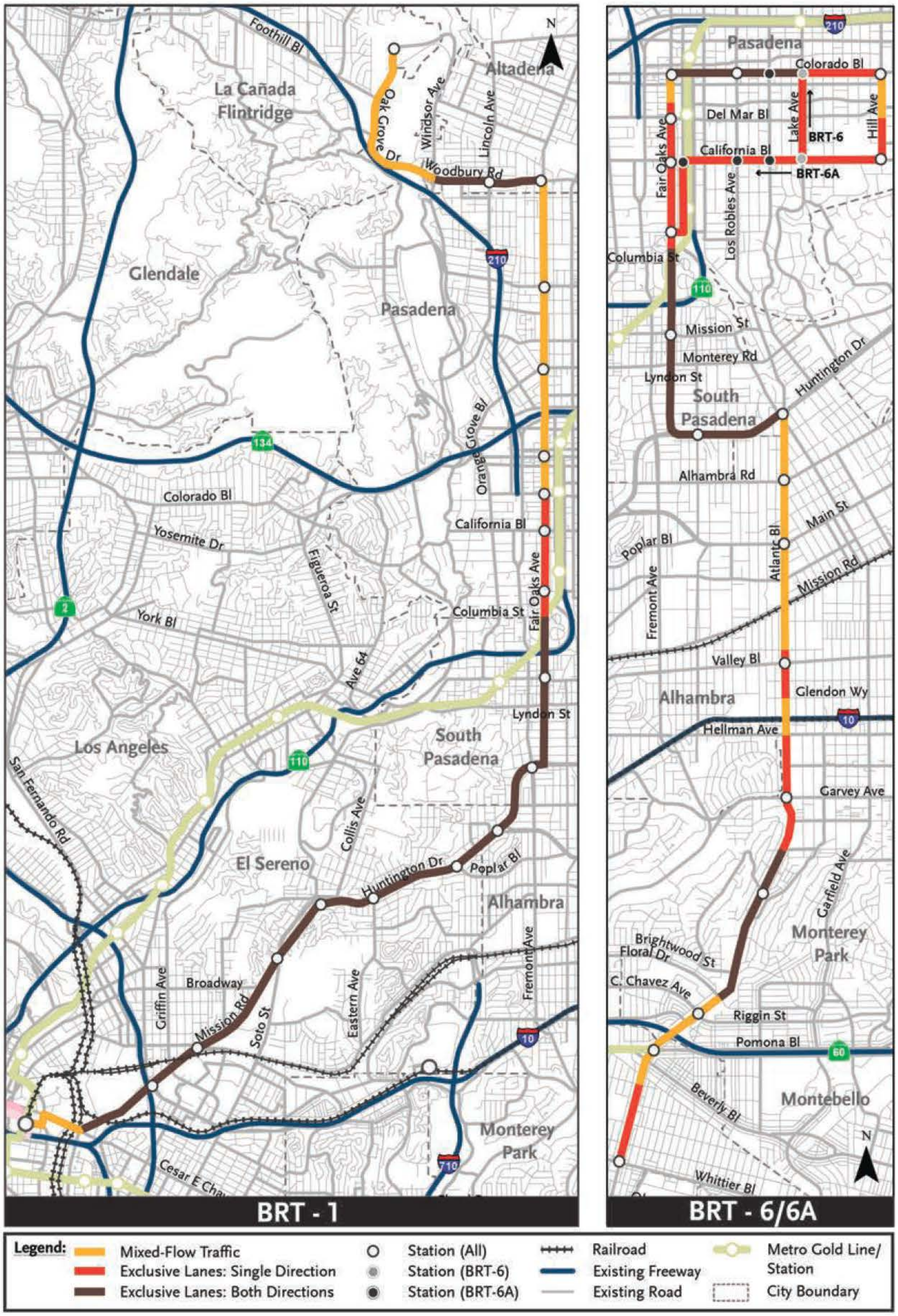


Figure ES-4: BRT Alternatives



BRT-6. Alternative BRT-6 would provide BRT service between Whittier Boulevard, just south of the Gold Line Atlantic Station, and Pasadena City College (PCC) and the California Institute of Technology (Caltech) in Pasadena.

BRT-6A. Alternative BRT-6A is a design variation of Alternative BRT-6 but with a different terminal loop than Alternative BRT-6. Instead of traveling both eastbound and westbound on Colorado Boulevard, Alternative BRT-6A would travel only eastbound on Colorado Boulevard and then return westbound on California Boulevard after stopping at PCC and Caltech.

ES.2.2.4 Light Rail Transit (LRT) Alternatives

The LRT alternatives would be similar to the Metro Gold Line and Metro Blue Line currently operated by Metro in Los Angeles County. LRT systems typically operate along dedicated rights-of-way at-grade, but can be built in aerial or underground configurations where necessary. They are electrically powered through an overhead catenary system. In dedicated right-of-way, Metro LRT vehicles can operate at speeds of up to 65 mph. The LRT alternatives include all of the additional transit service provided in the TSM/TDM alternative, except where those services overlap with the LRT service itself. The LRT alternatives are illustrated in Figure ES-5.

LRT-4A. Alternative LRT-4A would begin at an aerial station on Mednik Avenue adjacent to the existing East LA Civic Center Station on the Metro Gold Line. It would remain elevated as it travels north to a station adjacent to Cal State LA, then descend into a tunnel north of Valley Boulevard and end at an underground station beneath the existing Fillmore Station on the Metro Gold Line.

LRT-4B. Alternative LRT-4B was developed as a design variation of Alternative LRT-4A to reduce the length of tunneling required. Alternative LRT-4B would follow the same path as Alternative LRT-4A to the Cal State LA Station. Instead of immediately entering a tunnel, Alternative LRT-4B would continue on an elevated structure above Mission Road, turning north on Palm Avenue where it would descend to grade on Palm Avenue. Alternative LRT-4B would then enter a bored tunnel before Main Street and continue along an alignment similar to that of Alternative LRT-4A.

LRT-4D. Alternative LRT-4D was developed as a design variation of Alternative LRT-4A to eliminate the bored tunnel section and use only cut-and-cover tunnel techniques. Alternative LRT-4D would originate at an underground station beneath Beverly Boulevard, near the existing Atlantic Station on the Metro Gold Line and end at an underground station beneath the existing Fillmore Station on the Metro Gold Line.

LRT-6. Alternative LRT-6 would connect the existing Atlantic and Fillmore stations on the Metro Gold Line. Alternative LRT-6 would begin at an aerial station on Atlantic Boulevard near Pomona Boulevard and terminate with a new, elevated station above the existing Fillmore Station on the Metro Gold Line. The alternative would consist of at-grade and aerial segments.

ES.2.2.5 Freeway Alternatives

The four freeway alternatives would extend SR 710 as an access-controlled freeway with a total of four travel lanes in each direction. Three of the freeway alternatives (F-2, F-5, and F-7) would be constructed in tunnels, using primarily bored tunnels with short segments of cut-and-cover tunnels to access the bored tunnel. The fourth freeway alternative (F-6) consists primarily of a combination of surface and depressed segments, with one short cut-and-cover tunnel segment. The freeways would be open to all vehicles without restrictions, except for a prohibition on hazardous materials in tunnels. Figure ES-6 illustrates the alignment of the freeway alternatives.

Figure ES-5: LRT Alternatives

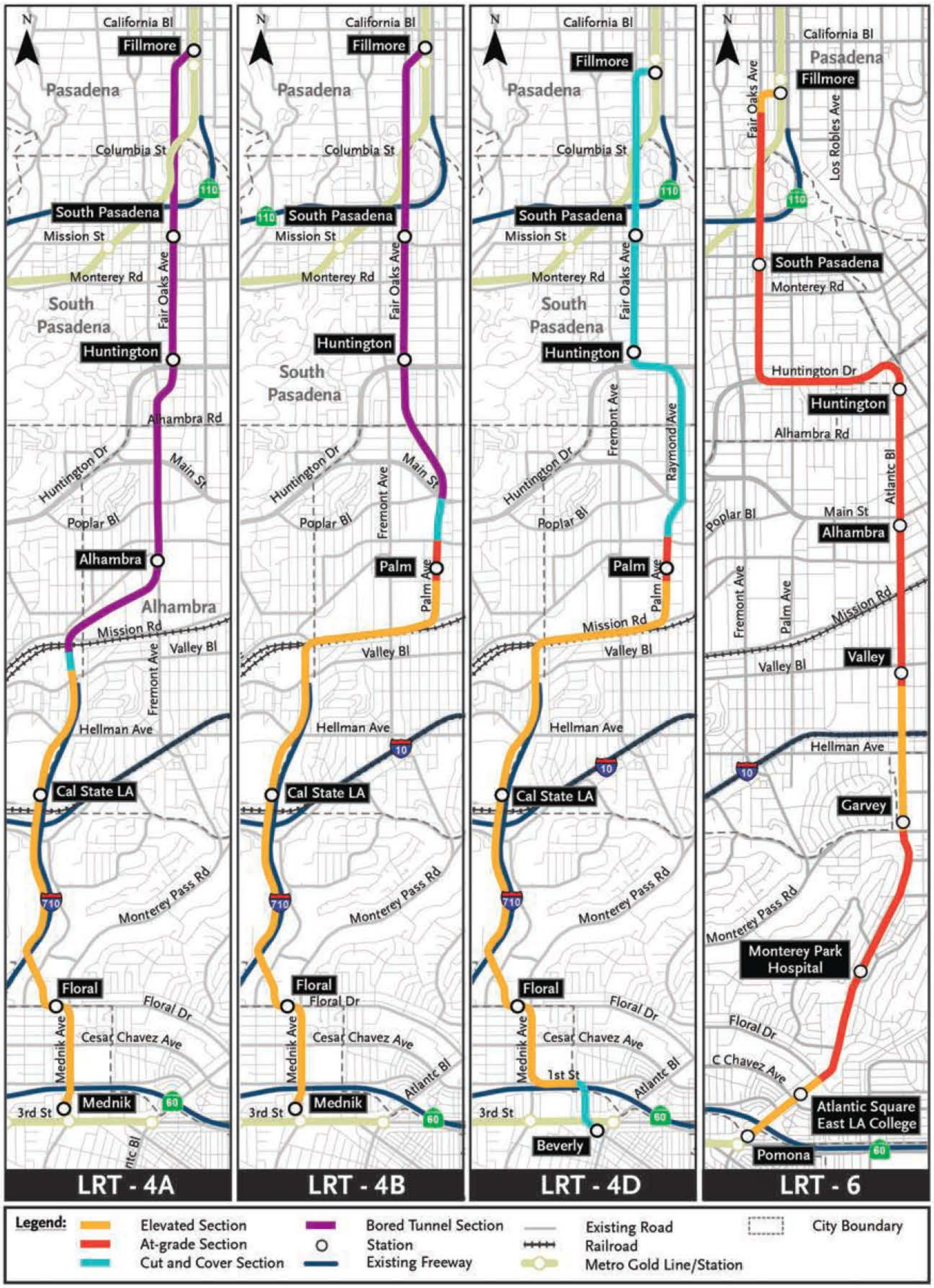
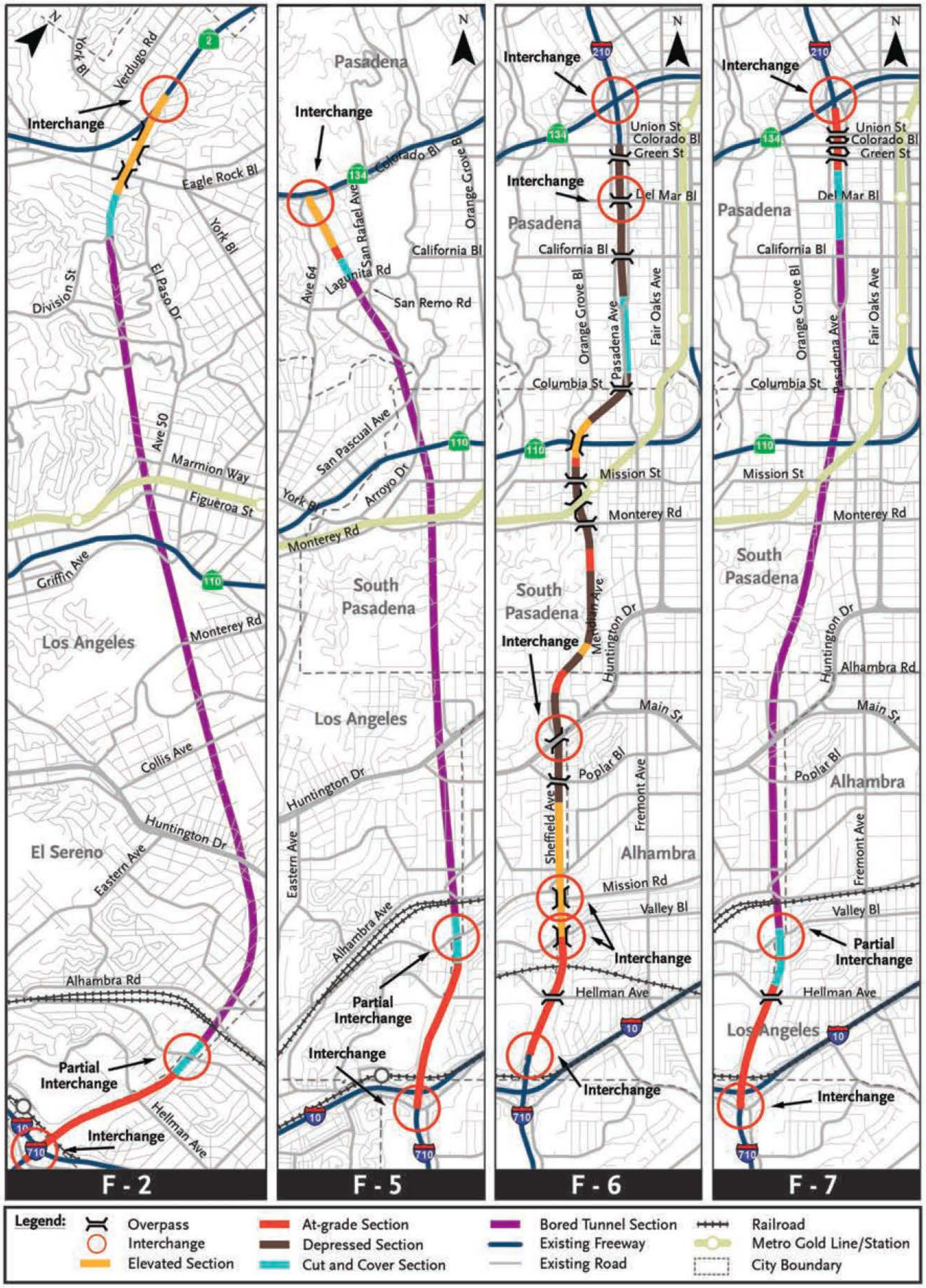


Figure ES-6: Freeway Alternatives



F-2. Alternative F-2 would originate at the existing SR 710 stub north of the I-10 freeway and connect to SR 2 between the Verdugo Road and SR 134 interchanges. The alternative would be an eight-lane freeway primarily constructed in two bored tunnels. Each tunnel would be dedicated to either northbound or southbound travel, with two lanes on each of two levels in each tunnel.

F-5. Alternative F-5 would also originate at the existing SR 710 stub north of I-10, similar to Alternative F-2, and connect to the SR 134 freeway near the Colorado Boulevard interchange. This alternative would also be an eight-lane freeway with two bored tunnels for directional travel similar to Alternative F-2. Alternative F-2 would provide interchange access to the SR 134/SR 710 interchange both to and from SR 134 for both eastbound and westbound travel and interchange access to Valley.

F-6. Alternative F-6 would also originate at the existing SR 710 stub north of I-10, but would consist of a combination of surface and depressed freeway segments, ultimately connecting to the existing SR 710 stub south of the I-210/SR 134 interchanges in Pasadena. Generally, Alternative F-6 would follow a very similar alignment to the "Meridian Variation" approved in the Record of Decision in 1998. Ramps would provide access to the freeway from Valley Boulevard, Mission Road/Alhambra Avenue, Huntington Drive, and Del Mar Boulevard.

F-7. Alternative F-7 would also originate at the existing SR 710 stub north of I-10. It would connect via a bored tunnel to the existing SR 710 stub south of the I-210/SR 134 interchanges in Pasadena. This alternative would also be an eight-lane freeway with two bored tunnels for directional travel similar to Alternative F-2.

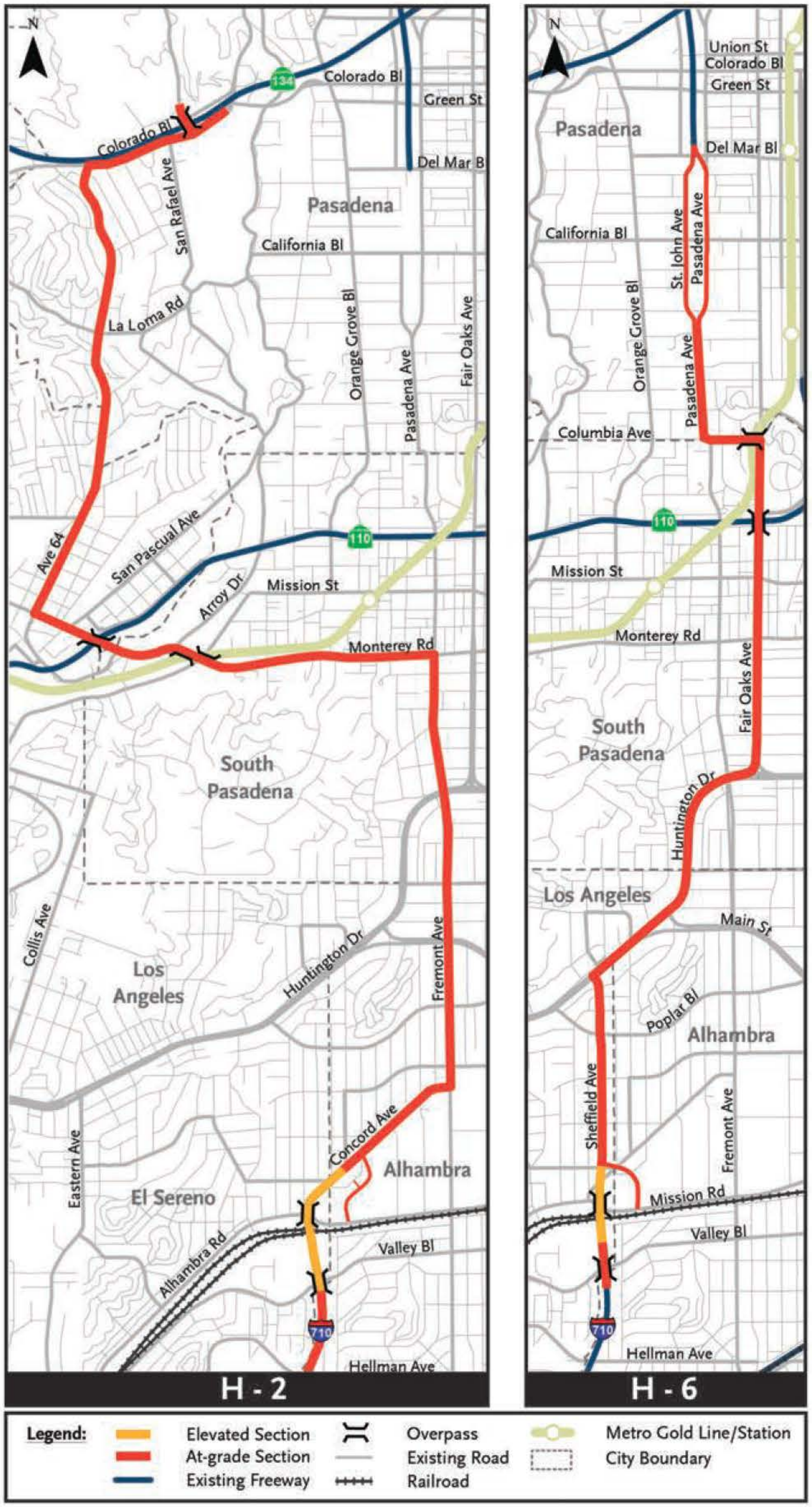
ES.2.2.6 Highway Alternatives

The highway/arterial alternatives would extend SR 710 by providing major roadway improvements to existing arterials in the study area. Each of these alternatives would provide three lanes in each direction along the length of the alignments. Where possible, the roadway widening associated with each alternative is limited to one side of the existing roadway to reduce the number of property acquisitions. Properties would be maintained on the other side of the roadway and in many areas have a frontage road for access. Figure ES-7 illustrates the alignment of the highway alternatives.

H-2. Alternative H-2 would begin at the existing SR 710 stub north of I-10 and connect the SR 710 freeway directly to Concord Avenue. The SR 710 freeway would come to an end at Valley Boulevard and transition to a major arterial that would travel over Valley Boulevard, the Union Pacific Railroad (UPRR) tracks, and Mission Road/Alhambra Avenue to Concord Avenue. The alignment would ultimately end near the intersection of San Rafael Avenue and Linda Vista Avenue.

H-6. Alternative H-6 would also begin at the existing SR 710 stub north of I-10 and connect the SR 710 freeway directly to Sheffield Avenue. The SR 710 freeway would come to an end at Valley Boulevard and transition to a major arterial that would travel over Valley Boulevard, the UPRR tracks, and Mission Road/Alhambra Avenue to Sheffield Avenue. The alignment would then continue to Huntington Drive, to Fair Oaks Avenue, to Columbia Street, and then to Pasadena Avenue. Just north of the intersection of Pasadena Avenue and Bellefontaine Street, the roadway would split into a northbound segment along Pasadena Avenue and a southbound segment along Saint John Avenue. The improvements in both directions would end near Del Mar Boulevard.

Figure ES-7: Highway Alternatives



ES.3.0 Transportation System Performance

The initial set of alternatives was evaluated against the five project objectives that were developed to address the project need. For each of these objectives, 20 detailed performance measures were developed as shown in Table ES-3.

Table ES-3: Transportation System Performance Measures

Objective	Performance Measures
1. Minimize travel time	Point-to-point travel time - vehicular Point-to-point travel time - transit Reduction in vehicle hours traveled (VHT) Percentage of travel on managed facilities
2. Improve connectivity and mobility	New interchanges/transit connections Jobs reachable within fixed time Transit boardings Arterial volumes Freeway throughput
3. Reduce congestion on freeway system	Facility miles operating at LOS F1 or worse Facility miles operating at LOS E or F0 Vehicle miles traveled (VMT) on congested freeway segments
4. Reduce congestion on local street system	Percent of intersections with congested approaches Average v/c on arterials VMT on arterials Arterial cut-through percentage North-south travel on arterials
5. Increase transit ridership	Increase in transit ridership Percent of population within 1/4 mile of transit Transit mode share

Based on each alternative's performance on the component performance measures that contribute to the evaluation of each objective, a score from 1 to 7 was calculated for each objective, with 1 indicating least favorable performance on that objective and 7 indicating the most favorable performance. Table ES-4 summarizes the performance of each of the alternatives. The detailed evaluation of each of the alternatives on each of the performance measures is presented in Chapter 3, and the calculation of the 1 to 7 score on each objective is described in Chapter 7.

Table ES-4: Summary of Transportation System Performance Measures

Element of Need	Objective	No Build	TSM/TDM	BRT-1	BRT-6	BRT-6A	LRT-4A	LRT-4B	LRT-4D	LRT-6	F-2	F-5	F-6	F-7	H-2	H-6
Regional Transportation System	1: Minimize travel time	1	2	3	2	2	3	3	3	3	4	3	4	5	1	2
	2: Improve connectivity and mobility	1	1	1	2	2	2	2	2	2	3	4	5	4	2	2
Freeway system in study area	3: Reduce congestion on freeway system	1	2	1	1	1	1	1	1	1	6	5	7	5	4	3
Local Street system in study area	4: Reduce congestion on local street system	1	1	1	1	1	1	1	1	1	4	5	6	6	1	2
Transit system in study area	5: Increase transit ridership	1	4	6	6	6	7	7	7	7	1	1	1	1	1	1

ES.3.1 Minimizing Travel Time

The project objective of minimizing travel times in the Southern California region was evaluated using several different measures including average point-to-point travel times for trips made by private vehicles, average point-to-point travel times for trips made by transit, total vehicle hours traveled (VHT), and others discussed in more detail in Chapter 3.

Figure ES-8: Regional Vehicular Travel Time Performance

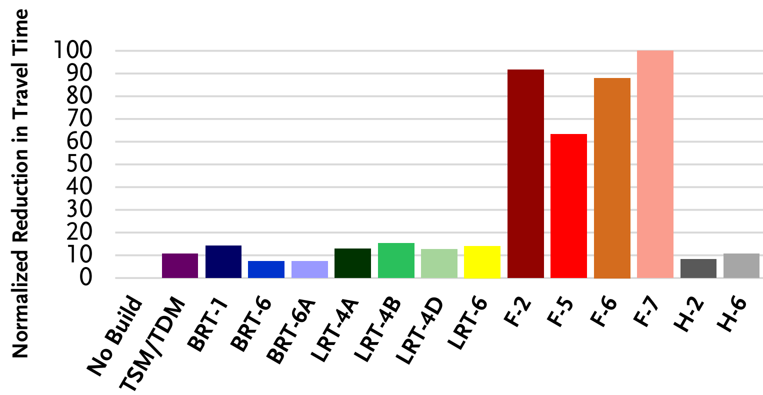
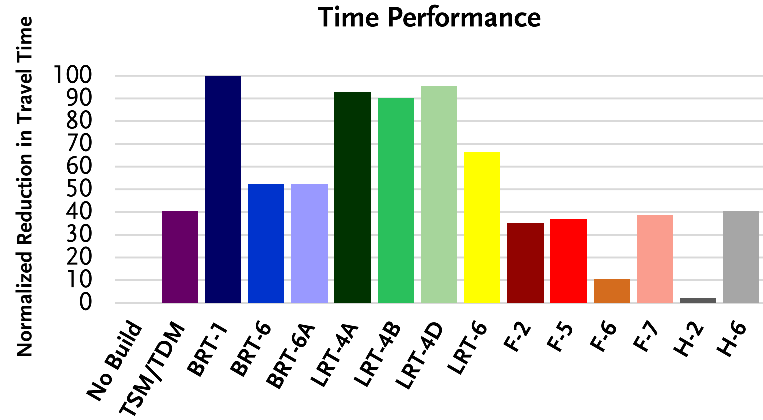


Figure ES-9: Regional Transit Travel Time Performance



For travel time savings for automobile trips, Alternatives F-2, F-6, and F-7 provide the greatest savings, as shown in Figure ES-8. Alternative F-5 provides somewhat less travel time savings. None of the transit or highway alternatives provides substantial travel times savings for automobile trips.

For reducing point-to-point travel times for transit trips in the study area, Alternatives BRT-1, LRT-4A, LRT-4B, LRT-4D, and LRT-6 are most effective, and Alternatives BRT-6 and BRT-6A are about half as effective, as shown in Figure ES-9. None of the freeway or highway alternatives are effective at reducing point-to-point travel times for transit trips.

The reduction in VHT includes all vehicular (automobile and truck) trips made during the a.m. and p.m. peak periods in the six-county SCAG region. The TSM/TDM Alternative and the transit alternatives are more effective at this measure than the freeway and highway alternatives, primarily because they remove some vehicular trips. The TSM/TDM Alternative, BRT alternatives, and LRT alternatives reduce total VHT during the a.m. and p.m. peak periods by 89,000 to 102,000 hours. Alternatives F-2, F-5, F-6, F-7, H-2, and H-6 each reduce total VHT by a total of 7,000 to 14,000 miles, since they do not include the transit improvements from the TSM/TDM Alternative.

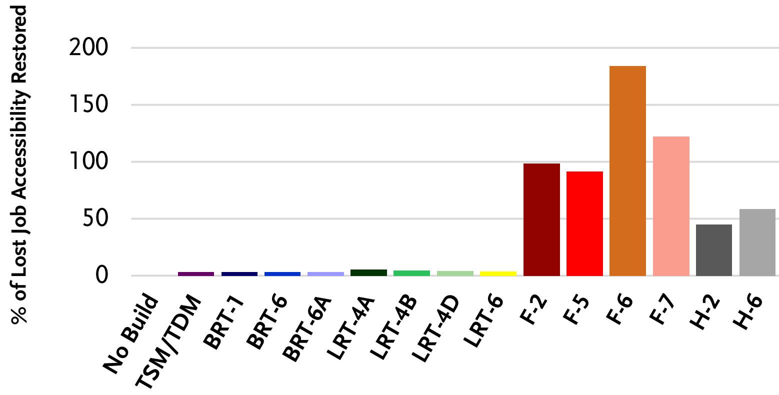
ES.3.2 Improving Connectivity and Mobility

The project objective of improving connectivity and mobility in the region was evaluated using several different measures including: jobs reachable within a fixed time, increase in transit boardings, reduction in arterial volumes, increase in north-south freeway throughput, and others discussed in more detail in Chapter 3.

The No Build Alternative would not enhance connectivity or mobility in the region and travel conditions would worsen due to growth in population and employment in the area.

Because of increasing congestion and delay on the regional transportation network, the number of jobs accessible to residents of the study area within 25.3 minutes (the average commute time in the United States) will decrease by 2035. Each of the alternatives was evaluated based on the percentage of this decrease in job accessibility that the alternative would restore. As shown in Figure ES-10, Alternative F-6 performs best on this measure, compensating for the entire decrease in job accessibility due to freeway congestion and making additional jobs accessible. The highway alternatives only restore about half of the decrease in job accessibility. The TSM/TDM Alternative, the BRT alternatives, and the LRT alternatives only minimally compensate for the lost job accessibility.

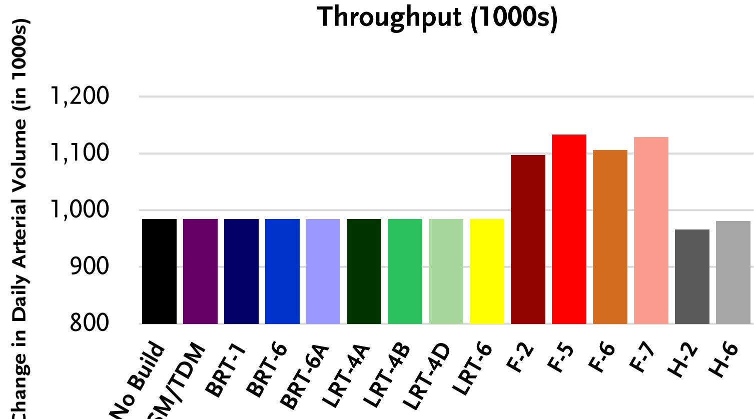
Figure ES-10: Recovery of Lost Job Accessibility



Regional travel on transit routes through the study area is depressed because transit speeds in the study area are slow. The increase in the number of transit boardings on north-south routes through the study area reflects the performance of each alternative in attracting regional trips to transit. The TSM/TDM Alternative and Alternative BRT-1 would result in an increase of approximately 25,000 total daily boardings on north-south transit routes through the study area compared to the No Build Alternative. Alternatives BRT-6, BRT-6A, LRT-4A, LRT-4B, LRT-4D perform slightly better, generating an increase of approximately 30,000 total daily boardings. None of the freeway or highway alternatives increase transit boardings.

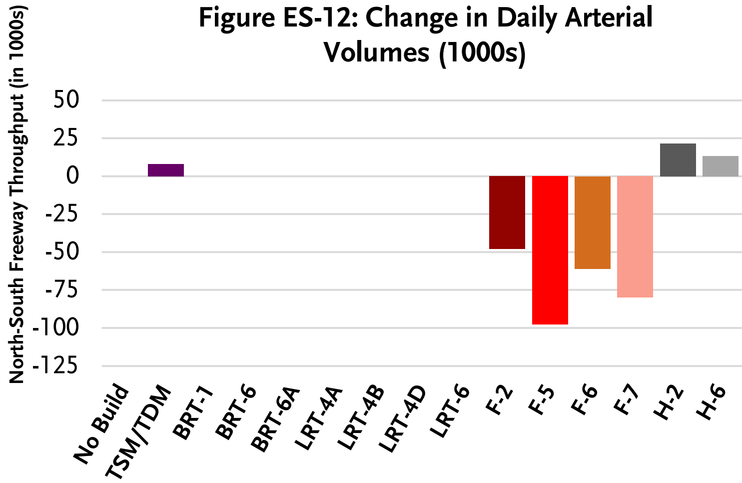
As shown in Figures ES-11 and ES-12, Alternatives F-5 and F-7 perform the best at increasing north-south throughput on the freeways in the study area and reducing traffic volumes on local north-south streets. These two alternatives increase north-south freeway throughput by 140,000 vehicles per day, while removing 80,000 or more daily vehicle trips from local north-south streets. Alternatives F-2 and F-6 perform slightly less well on these measures. None of the BRT or LRT alternatives increase freeway throughput or reduce traffic volumes on local streets. The TSM/TDM

Figure ES-11: North-South Freeway Throughput (1000s)



Alternative, Alternative H-2 and Alternative H-6 increase traffic volumes on local streets and decrease volumes on freeways.

Figure ES-12: Change in Daily Arterial Volumes (1000s)



ES.3.3 Congestion on Freeway System

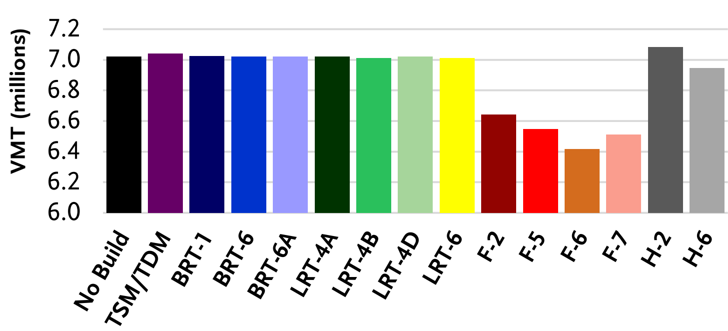
One of the performance measures used to evaluate the project objective of reducing congestion on the freeway system in the study area was the total vehicle miles traveled (VMT) on congested freeway segments in the study area and total directional miles of roadway facilities projected to operate at different levels of service (LOS). Severely congested facilities were identified by calculating the total directional miles operating at LOS F1 (more than 10 percent over capacity) or worse in 2035 during the a.m. or p.m. peak periods. Under the No Build Alternative, the number of roadway facility miles operating at LOS F1 during the a.m. or p.m. peak periods is projected to increase from 64 in 2008 to 100 in 2035. All transit-related alternatives provide only a small benefit on the number of miles of freeway operating at LOS F1, reducing it by less than five percent. The freeway alternatives all provide reductions of at least 17 percent, with Alternative F-6 providing a reduction of more than 25 percent. The highway alternatives provide reductions of up to 12 percent.

ES.3.4 Congestion on Local Street System

Two of the performance measures used to evaluate the project objective of reducing congestion on the local street system (arterial and collector roadways) in the study area was the total daily VMT on local streets and the number of vehicle trips traveling on local streets that have neither an origin nor a destination within the study area ("cut-through traffic").

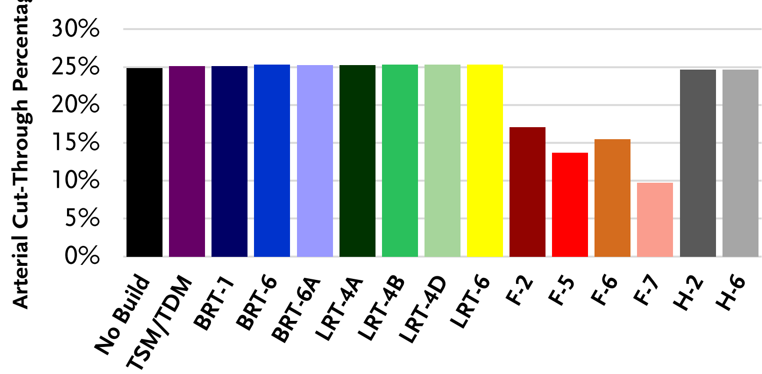
Figure ES-13 shows total daily VMT on the local street system in the study area for each of the alternatives. Under the No Build Alternative, the daily arterial VMT in the study area will increase from 6 million miles to 7 million miles. The TSM/TDM Alternative, the LRT alternatives, and the BRT alternatives have a minimal effect on arterial VMT. The freeway alternatives reduce daily arterial VMT by 400,000 to 600,000 miles, with Alternative F-6 providing the greatest reduction, followed by Alternative F-7. The highway alternatives add more arterial capacity along certain routes, which draws vehicle trips onto the arterial street network. Alternative H-2 increases daily arterial VMT in the study area by 62,000 miles, while Alternative H-6 decreases daily arterial VMT by 75,000 miles.

Figure ES-13: Arterial VMT (in millions)



Under the No Build Alternative by 2035, the percentage of cut-through traffic will increase from 19 percent to 25 percent. As shown in Figure ES-14, the TSM/TDM Alternative, the LRT alternatives, and the BRT alternatives result in no change in the percentage of cut-through traffic. All of the freeway alternatives reduce cut-through traffic by 30 to 60 percent, with Alternative F-7 being the most effective on this measure. The highway alternatives also result in no change in the percentage of cut-through traffic.

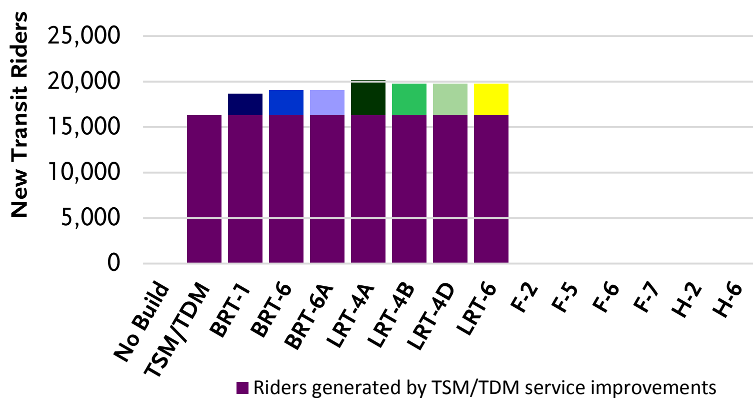
Figure ES-14: Arterial Cut-Through Percentage



ES.3.5 Transit Ridership

One of the performance measures used to evaluate the project objective of increasing transit ridership was the ability to attract new transit riders. As shown in Figure ES-15, the TSM/TDM Alternative is forecast to attract over 16,000 new transit riders daily by 2035. The BRT and LRT alternatives are forecast to attract approximately 19,000 to 20,000 new riders. None of the freeway or highway alternatives attract new transit riders.

Figure ES-15: New Transit Riders



ES.4.0 Environmental and Other Performance Measures

This section describes the performance of each alternative in the initial set of alternatives on the performance measures related to the three project objectives pertaining to environmental impacts, planning considerations, and cost efficiency. For each of these objectives, 22 detailed performance measures were developed as shown in Table ES-5. This section describes the performance of the initial set of alternatives on select performance measures related to these three project objectives shown in Table ES-5.

Table ES-6 summarizes the performance of each of the alternatives on the three project objectives pertaining to environmental and other concerns, with each alternative's performance on the component performance measures assigned a score from 1 to 7 as was done for the transportation system. The detailed evaluation of each of the alternatives on each of the performance measures is presented in Chapter 4, and the calculation of the 1 to 7 score on each objective is described in Chapter 7.

Table ES-5: Environmental and Other Performance Measures

Objective	Performance Measures
6. Minimize environmental and community impacts related to transportation	<u>Right-of-Way</u> Full or partial residential or business acquisitions <u>Human Environment</u> Recreational/community sites impacted Archeological sites impacted Properties over 45 years old impacted Significant historic resources impacted Increase in noise exposure Increase in mobile-source air toxics (MSATs) Increase in regional criteria pollutants Increase in greenhouse gas (GHG) emissions Hazardous waste sites impacted Visual intrusion in communities Scenic corridors impacts <u>Natural Environment</u> Areas of high paleontological sensitivity impacted Exposure to adverse geotechnical conditions Sensitive habitats impacted Drainages impacted
7. Assure consistency with regional plans and strategies	Consistency with RTP/SCS goals Consistency with Measure R goals Consistency with Metro LRTP goals
8. Maximize the cost-efficiency of public investments	Construction and right-of-way costs Available funding Technical feasibility

The environmental and community impacts discussed below have been identified based on conceptual engineering of each of the alternatives. For alternatives that are evaluated further in the Project Approval/Environmental Document (PA/ED) phase, designs will be refined to avoid or minimize impacts to the extent possible. In addition, where feasible, mitigation measures will be identified to reduce impacts that cannot be avoided.

Table ES-6: Summary of Environmental and Other Performance Measures

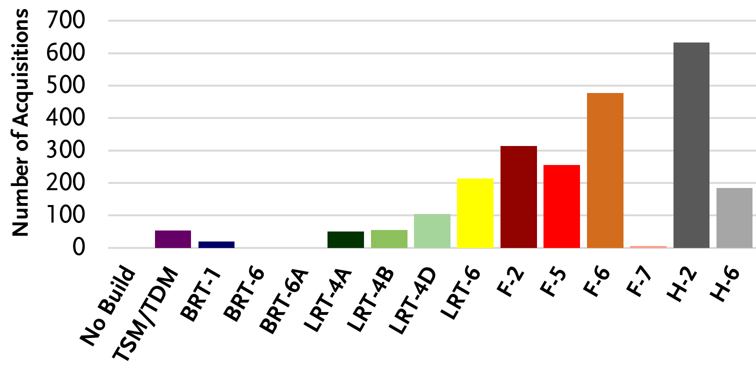
Value or Concern	Objective	No Build	TSM/TDM	BRT-1	BRT-6	BRT-6A	LRT-4A	LRT-4B	LRT-4D	LRT-6	F-2	F-5	F-6	F-7	H-2	H-6
Environmental & Communities	6A: Right of way	7	7	7	7	7	7	7	6	5	3	4	1	7	1	5
	6B: Human environment	6	6	7	6	6	6	6	6	5	4	4	3	5	4	5
	6C: Natural environment	7	7	6	7	7	5	5	5	7	5	4	5	5	6	7
Consistency with Plans	7: Consistency with regional plans and strategies	1	6	6	6	6	6	6	6	6	6	6	6	6	3	3
Provide Financially Feasible Transportation Solutions	8: Maximize cost-efficiency of public investments	7	7	7	7	7	4	4	4	5	5	5	6	6	7	7

ES.4.1 Environmental and Community Impacts

Property Acquisition. Potential property acquisitions were evaluated based on the total number of residential or business acquisitions required for each alternative. The No Build Alternative and Alternatives BRT-6 and BRT-6A would not require any property acquisitions. However, Alternatives BRT-6 and BRT-6A would have a considerable impact to on-street parking and loading areas that would affect businesses.

Of the remaining alternatives, Alternative F-7 would require the fewest property acquisitions (5), as shown in Figure ES-16. Alternative BRT-1 would require the second least (19), but it would have a considerable impact to on-street parking and loading areas that would affect businesses, although this number would be smaller than under Alternatives BRT-6 and BRT-6A. The TSM/TDM Alternative and Alternatives LRT-4A and LRT-4B would require between 50 and 55 property acquisitions. Alternatives LRT-4D and H-6 would require 103 and 184 acquisitions, respectively. Alternatives F-2 and F-5 would require 313 and 255 acquisitions, respectively, which would be concentrated around the north portal of the tunnels in these alternatives. Alternatives LRT-6 and F-6 would require 214 and 476 acquisitions, respectively, which would be spread along the alignments of each of these alternatives. Alternative H-2 would require 632 acquisitions, which would also be spread along the alignment of this alternative.

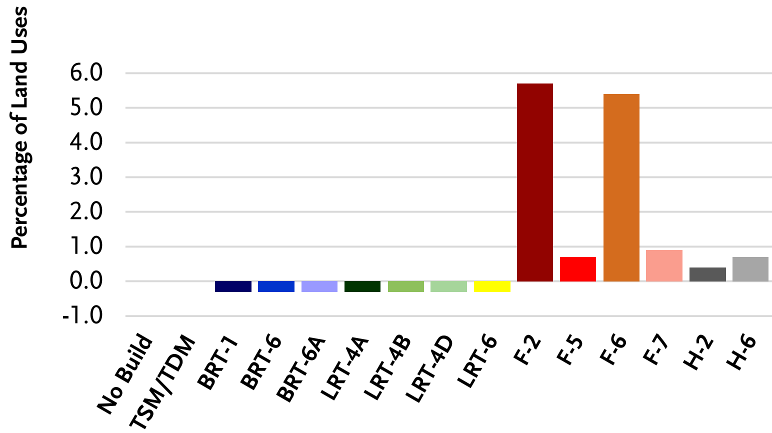
Figure ES-16: Full Property Acquisitions



Cultural Resources. Potential impacts to cultural resources were evaluated based on the number of known archaeological sites, historic (45 years or older) resources, and designated historic districts/buildings potentially affected. None of the alternatives would impact any known archaeological sites. The No Build Alternative would not result in any impacts to historic properties. Alternative H-2 would have the greatest potential impact to historic resources and designated historic districts/buildings with the potential to impact 1,055 historic-period buildings, 4 historic districts, 12 National Register eligible/listed properties, and 7 locally eligible/designated properties. The BRT alternatives, TSM/TDM Alternative, Alternatives F-7,LRT-4A, LRT-4B, and LRT-4D, would have the least impacts to cultural resources impacting between 9 and 115 historic-period buildings and eight or less historic districts, National Register eligible/listed properties, and/or locally eligible/designated properties.

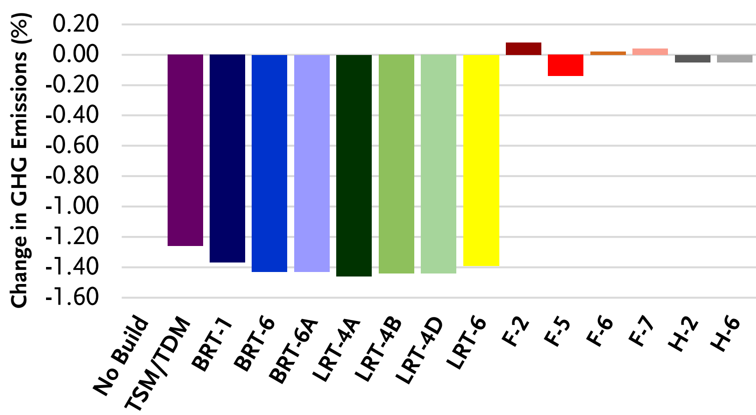
Noise. Noise impacts were evaluated by using the Federal Highway Administration (FHWA) Highway Traffic Noise Prediction Model (FHWA RD-77-108) to calculate the change in traffic noise levels adjacent to 15 different freeway segments along I-210, SR 134, SR 710, I-110, I-10, I-710, I-605, SR 2, and I-5, as well as for the non-tunnel sections of the alignments of the freeway and highway alternatives.

Figure ES-17: Percentage Increase in Sensitive Land Uses to Unacceptable Noise Level



The change in noise levels exposure under each alternative results from the change in traffic patterns and volume associated with each alternative. Compared to the No Build Alternative, the BRT and LRT alternatives would result in a small reduction in the acreage of sensitive land uses that would be exposed to noise levels exceeding 65 dBA Leq, as shown in Figure ES-17. Alternatives F-2, F-5, F-6, F-7, H-2, and H-6 would result in an increase in the number of sensitive land uses that would be exposed to noise levels exceeding 65 dBA Leq, with Alternatives F-2 and F-6 resulting in the greatest increase of all alternatives. The No Build Alternative would not result in any change to noise exposure within the study area.

Figure ES-18: Change in GHG Emissions Based on Regional VMT/VHT



Air Quality. Air quality impacts were evaluated by calculating the regional vehicle emissions associated with each alternative compared to the No Build Alternative for 2035 conditions. Emissions were calculated using the EMFAC 2007 emissions model with data on VMT, VHT, and vehicle hours of delay (VHD) from the traffic model. Emission types evaluated included Mobile Source Air Toxics (MSAT), criteria pollutants, and greenhouse gases. All alternatives, with the exception of Alternatives F-2, F-5, F-6, F-7, H-2 and H-6 would result in minor reductions of regional vehicle emissions primarily due to reductions in VMT, VHT, and VHD, as shown in Figure ES-18. The other alternatives would result in minor increases in the various emissions types; however, it should be noted that the regional-level methodology used in this analysis does not take into account any reductions from the air scrubbers proposed for the tunnel alternatives. The increases of regional vehicle emissions are primarily due to increases in VMT associated with the freeway and highway alternatives. The No Build Alternative would not result in any change to regional vehicle emissions beyond those estimated for this analysis.

Visual Resources. Visual impacts were assessed by evaluating the alternative's visual intrusion into the surrounding communities and designated scenic corridors or vistas. Caltrans' Visual Impact Analysis screening checklist was used for this analysis. The No Build Alternative would not result in visual intrusion in the communities within the study area. The TSM/TDM Alternatives and the BRT alternatives would result in low visual intrusion into communities. The freeway, highway, and LRT alternatives would all result in high visual intrusion into communities, especially at areas of cut-and-cover construction, tunnel openings, aerial structures, and roadway widenings within communities. In addition, Alternatives F-2, F-5, and H-2 would impact a portion of the Arroyo Parkway, a designated scenic parkway.

Geological Conditions. Geological conditions were evaluated based on the percentage of the alignment of each alternative within potentially liquefiable zones, subsurface material variability, or formational materials known to contain natural gas that could be impacted by an alternative. In addition, the number of active and potentially active faults crossing the alignment of an alternative were considered. The No Build Alternative would not result in any changes to geological conditions in the study area; however, the existing conditions do pose some risk to existing facilities within the study area. Alternatives LRT-4A, LRT-4B, LRT-4D, F-2, F-5, and F-7 would have the greatest potential to encounter adverse geotechnical conditions of concern, while the TSM/TDM Alternative would have the least potential.

ES.4.2 Consistency with Regional Plans and Strategies

The alternatives were evaluated for consistency with the goals and objectives of the Southern California Associated Government's (SCAG) 2012-2035 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), Measure R, and Metro's Long Range Transportation Plan (LRTP). The No Build Alternatives is not consistent with any of the goals/objectives in these three planning documents. The goals and objectives of SCAG's RTP/SCS focus on maximizing mobility and accessibility and ensuring safety, reliability, sustainability, and productivity of the regional transportation system; therefore, the BRT, LRT, and freeway alternatives have the greatest consistency with goals/objectives in SCAG's RTP/SCS, while the highway alternatives have the least consistency. The goals/objectives of Measure R focus on reducing congestion, improving traffic flow, improving mobility, and increasing public transportation; therefore, the BRT and freeway alternatives have consistency with the most goals/objectives of Measure R, followed by the LRT alternatives, while the TSM/TDM and highway alternatives are the least consistent. Of all alternatives, the TSM/TDM Alternative is consistent with the most goals/objectives in Metro's LRTP through implementation of signal synchronizations, ITS technologies, bicycle and pedestrian improvements, and bus signal prioritization.

ES.4.3 Maximizing Cost-Efficiency

The project objective of maximizing the cost-efficiency of public investments was evaluated using three measures: estimated construction and right-of-way costs, the availability of funding, and technical feasibility. The TSM/TDM Alternative and the BRT alternatives have the lowest capital and right-of-way costs, other than the No Build Alternative. Alternative LRT-6 is expected to have the lowest total capital and right-of-way cost of the LRT alternatives. Among the freeway alternatives, Alternative F-6 is expected to have the lowest capital cost, because it has no bored tunnel segments and only a short cut-and-cover tunnel segment. In addition, it makes use of existing infrastructure at the SR 710/SR 134/I-210 interchange and existing Caltrans right-of-way along the alignment. Among the freeway tunnel alternatives, Alternative F-7 is expected to have the lowest capital and right-of-way costs because it has the most direct tunnel and it also makes use of existing infrastructure at the SR 710/SR 134/I-210 interchange and existing Caltrans right-of-way at either end of the alignment.

The No Build Alternative, the TSM/TDM Alternative, the BRT alternatives, and the highway alternatives were rated the highest among the alternatives on the measure of the availability of funding because they could all be constructed within the Measure R budget for the project. The freeway alternatives were rated slightly lower on the measure of the availability of funding because, while they would exceed the Measure R budget, it is expected that potential toll revenues could be used to fund construction of these alternatives based on an independent study conducted by Metro that concludes that freeway tunnel alternatives could be funded by future toll revenues. The LRT alternatives were rated lower than the freeway alternatives on the measure of the availability of funding because they exceed the Measure R budget, and transit fares would not be sufficient to fund their construction.

All of the alternatives were determined to be technically feasible, as similar facilities have been or are being constructed in North America.

ES.5.0 Outreach Activities

ES.5.1 Project Scoping

The SR 710 project public outreach began in February 2011 with the "SR 710 Conversations," a series of scoping meetings that began with 21 pre-scoping and scoping meetings throughout the study area. The formal scoping period extended from March 3, 2011, through April 14, 2011, during which time Caltrans and Metro accepted comments on the proposed project. All scoping comments were documented in the *710 North Gap Closure, Scoping Summary Report*, Volumes I and II, dated September 2011. The scoping comments were reviewed and analyzed to develop the project's updated purpose and need, evaluation criteria, performance measures, and preliminary alternatives. This set the foundation for the start of the Alternatives Analysis.

ES.5.2 Community/Stakeholder Outreach

Building on the SR 710 Conversations, after the start of the SR 710 Study, community outreach efforts began with two All Communities Convening (ACC) meetings held in March 2012 with the purpose of gathering communities together in an open house format to discuss the project, share information about the process, and gather comments. At these meetings, the Community Liaison Councils (CLCs) were introduced as an option for community members to participate in the councils to generate interest and participation within the various communities of the study area and to invite the public to the next series of informational meetings. CLC meetings were held throughout the month of April to notify the community of the upcoming Open House meetings scheduled for the fall.

The Technical Advisory Committee (TAC) was created with the purpose of providing technical input to Metro, Caltrans, and the project team. Representatives of each jurisdiction in the study area, as well as representatives of other stakeholder agencies, were invited to participate in the TAC. The TAC reviewed technical analyses and methodologies and provided feedback on technical materials and project information. TAC members were also responsible for sharing information with their agencies. The TAC met eight times during the AA process, in January, February, March, April, May, July, August, and November, 2012.

The Stakeholder Outreach Advisory Committee (SOAC) was created at the direction of the Metro Board and consisted of members of planning commissions, transportation commissions, and elected officials. The SOAC met in May, July, August, and November, 2012, to be briefed on the progress of the SR 710 Study. SOAC members were responsible for providing updates to their respective jurisdictions on the progress of the study and in turn recommend items to the project team to place on the agenda for subsequent SOAC meetings.

Open House Meetings. A series of seven Open House meetings was held in May 2012 at locations throughout the study area to share the project progress and to gather input from community members and other stakeholders on the Initial Set of Alternatives and on the screening process. At the Open Houses, seven stations were set up covering the following topics: welcome and introduction, study overview, environmental study review process, scoping process review, alternative concepts overview, feedback, and next steps in the study.

Each station presented information in English and Spanish on large presentation boards, allowing members of the community to proceed at their own pace. Each station was also staffed by members of the project team, who were available to answer questions and provide clarifications. Attendees were encouraged to provide their feedback on "Post-It®" notes that could be affixed to the boards. All feedback was documented and shared with the project team.

ES.6.0 Evaluation Process and Summary

In the secondary screening, the performance of the 12 alternatives in the initial set of alternatives on the eight project objectives was evaluated using 42 performance measures. Table ES-4 presented earlier summarizes the performance of each of the alternatives on the five objectives related to the project need. Table ES-6 presented earlier summarizes the performance of each of the alternatives on the three objectives related to environmental, planning, and cost concerns.

The **No Build Alternative** and the **TSM/TDM Alternative** are required to be evaluated in the PA/ED phase. Therefore, they should be evaluated further.

Among the **BRT alternatives**, the measures for the objectives related to transportation system performance were similar to one another, with Alternative BRT-1 performing slightly better at reducing transit travel times, but Alternatives BRT-6 and BRT-6A performing slightly better at increasing access to high-frequency transit service and increasing north-south transit patronage. Therefore, performance on the transportation objectives does not clearly favor one alternative over the others. However, Alternatives BRT-6 and BRT-6A could be implemented with no right-of-way acquisition and would also have a smaller potential impact on sensitive habitat. Therefore, Alternatives BRT-6, along with the design variation Alternative BRT-6A, should be evaluated further in the PA/ED phase.

Among the **LRT alternatives**, the measures for the objectives related to transportation system performance were similar to one another. However, on the measures for the objectives related to environmental and other concerns, Alternative LRT-6 was clearly inferior to Alternatives LRT-4A, LRT-4B, and LRT-4D. Alternative LRT-6 would require the acquisition of hundreds of properties, impact more historic period properties, and impact more community facilities. Similarly, compared to Alternatives LRT-4A and LRT-4B, Alternative LRT-4D would have greater property impacts. Therefore, Alternatives LRT-4A and LRT-4B should be evaluated further in the PA/ED phase.

Among the **freeway alternatives**, Alternatives F-6 and F-7 are superior to Alternatives F-2 and F-5 on the measures for the objectives related to the transportation system performance. Alternatives F-6 and F-7 each performed best on either minimizing travel times or improving connectivity and mobility, and they both performed best on the objective of reducing congestion on local streets. The performance on the objectives related to environmental and other concerns distinguished Alternatives F-6 and F-7 from one another. Alternative F-7 would require only a small number of property acquisitions (fewer than 10), compared to the over 400 required for Alternative F-6 in addition to properties that Caltrans already owns. Alternative F-7 would also impact fewer historic period properties and community facilities. Therefore, Alternative F-7 should be evaluated further in the PA/ED phase.

None of the **highway alternatives** perform well on the measures for objectives related to transportation system performance. They also performed poorly on the measures for objectives related to environmental and other concerns, especially Alternative H-2. Therefore, neither of the highway alternatives should be evaluated further in the PA/ED phase.

Thus, the alternatives recommended for further evaluation in the PA/ED phase are as follows:

- The No Build Alternative
- The TSM/TDM Alternative
- Alternative BRT-6, with possible refinements as described below
- Alternative LRT-4A/B, with possible refinements as described below
- Alternative F-7, with possible refinements, as described below

Recommended Refinements of Alternatives

No single alternative performs most favorably on all eight project objectives. Therefore, as the alternatives are further evaluated in the PA/ED phase, refinements of these alternatives that improve their performance and reduce their impacts should be developed and considered, as well as alternatives that combine elements of alternatives whose performance complements each other.

Recommended Refinements of Alternatives

In the PA/ED phase, alternatives will be refined first to avoid and then to minimize potential impacts to the extent possible. Where impacts cannot be avoided or minimized, feasible mitigation measures will be identified to reduce impacts. Additional refinements of alternatives that should be investigated in the PA/ED phase include the following:

- The **No Build Alternative** should be updated to reflect the financially constrained project list in the 2012 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS). This plan was adopted by SCAG after the initiation of the AA, but it would be appropriate to update the No Build Alternative in the PA/ED phase to be consistent with the newly adopted plan. The ridership and travel demand forecasting in the PA/ED phase will be based on the 2012 RTP/SCS.
- The **TSM/TDM Alternative** was found to have potential right-of-way impacts, primarily resulting from the spot intersection and roadway segment improvements included in the alternative. These spot improvements should be refined in coordination with the local jurisdictions to maximize the alternative's benefits and to minimize its impacts. In addition, these improvements should be refined to identify opportunities to create "complete streets" that enhance the pedestrian and bicycle environment and to ensure that they do not detract from it. The other components of the TSM/TDM Alternative should also be reviewed and refined to look for additional opportunities to improve the performance of the alternative.
- **Alternative BRT-6**, like all of the BRT alternatives, would displace a large amount of on-street parking. Therefore, refinements should be considered to its design, alignment, and/or operational characteristics to minimize their impact to on-street parking. Refinements should also be considered to maximize ridership and productivity (passengers per bus).
- **Alternative LRT-4A/B** station locations should be refined to maximize ridership, minimize property impacts, and to facilitate transfers to the Metro Gold line at its northern and southern termini.

  Alternative LRT-4A/B could be combined with **enhanced bus service**, including feeder routes to its stations. By making Alternative LRT-4A/B the spine of a transit network that serves destinations to its east and west, and not solely along its alignment, it may be possible to attract additional transit ridership and improve the performance of this alternative.

- **Alternative F-7** should incorporate refinements to its design and alignment to minimize its impact. Potential tolled operations to improve its financial feasibility should also be evaluated. Restriction on use by trucks should be evaluated to determine if they are effective at reducing impacts.

  Alternative F-7 could be combined with a **BRT or other enhanced bus service** to improve the performance of this alternative on the performance measures related to the transit system. Alternative F-7 was found to not increase transit ridership or transit mode share. By introducing a well-designed BRT or other enhanced bus service into Alternative F-7, it may be possible to diminish north-south transit travel times through the study area and attract additional transit ridership.

1.0 Need and Purpose

1.1 Background and History

The State Route (SR) 710 Study is the culmination of a long history of efforts to address north-south mobility in the western San Gabriel Valley and east and northeast Los Angeles (LA). The history of the planning efforts dates back to 1933 when Legislative Route 167, later renamed SR 7, was defined to run from San Pedro east to Long Beach and north to the vicinity of Monterey Park. Over the following twenty years, the planned route was amended several times but maintained a northerly limit at Huntington Drive until 1959 when it was extended further from its northern boundary of Huntington Drive to the planned Foothill Freeway, which is now Interstate 210 (I-210). Five years later in 1964, the California Highway Commission adopted the "Meridian Route" as the preferred alignment for SR 7 between Huntington Drive and the Foothill Freeway. This route would create a freeway link through the city of South Pasadena, primarily following Meridian Avenue. In 1967, the Federal Highway Administration (FHWA) approved this alignment; however, some of the affected cities opposed this route and took action to change it.

In 1969, the city of South Pasadena proposed a new "Westerly Route" that would run farther west to circumnavigate that city instead of running through it. This route was studied over the following three years by the Division of Highways (later renamed Caltrans in 1972) and the California Highway Commission, which ultimately determined it to be infeasible. In 1973, within a few months of this determination, South Pasadena filed a lawsuit against the FHWA for failing to prepare an Environmental Impact Statement (EIS), which was required following the passage of the National Environmental Policy Act (NEPA) of 1969.

From 1973 to 1992, Caltrans prepared a series of Draft Environmental Impact Statements and Supplemental Draft Environmental Impact Statements to address additional agency and community concerns. In 1983, the existing segments of the freeway between SR 1 and Interstate (I-) 10 were incorporated into the Interstate Highway System as I-710. In 1992, the FHWA provisionally approved a Final EIS, with conditions requiring study of all practical methods to minimize the facility's footprint and lessen the project's impacts on the affected communities and historic resources. The Record of Decision (ROD) was signed on April 13, 1998. Immediately following the signing of the ROD, the city of South Pasadena filed a federal lawsuit asserting that the information provided in the EIS failed to protect clean air, the environment, and historic properties. In 1999, a Federal U.S. District Court issued a preliminary injunction that prohibited Caltrans from construction and right-of-way acquisition within the corridor. However, the injunction did not prohibit continued planning work on SR 710.

Planning efforts continued to address the issues raised by FHWA and the affected communities until 2003, when FHWA rescinded the 1998 ROD, citing changes in project circumstances such as funding uncertainty and the opening of the Metro Gold line to Pasadena, and requiring a more thorough evaluation of the feasibility of a bored tunnel. At that time, FHWA determined that a new Supplemental EIS was necessary to satisfy the requirements of NEPA.

In 2006, Metro and Caltrans conducted two feasibility assessments, the *Route 710 Tunnel Technical Feasibility Assessment Report* and the *SR-710 Tunnel Technical Study*, to evaluate the feasibility of constructing a tunnel to complete the planned SR 710 freeway route that would lessen the potential impacts associated with a surface route. The study found that a tunnel would be a viable solution and would warrant more detailed evaluation.

In November 2008, Measure R (a half-cent sales tax dedicated to transportation projects in Los Angeles County) was approved by a two-thirds majority of County voters. Included in the Measure R plan is the commitment of $780 million to improve the connection between the SR 710 and I-210 freeways.

In March 2011, Caltrans published a Notice of Intent (NOI) under NEPA and Notice of Preparation (NOP) under the California Environmental Quality Act (CEQA) to initiate the environmental review process for the "Interstate 710 North Gap Closure" project. The environmental review process began with the "SR-710 Conversations" outreach effort, led by Metro, including 21 pre-scoping and scoping meetings throughout the project study area in March and April of 2011. Metro also initiated the *State Route 710 Gap Closure Transit Profile Study* to gather transit service and patronage data and to assess current and future transit travel markets within the study area.

1.2 Study Area

The study area is approximately 100 square miles and is generally bounded by the I-210 freeway on the north, the I-605 freeway on the east, the I-10 freeway on the south, and the I-5 and SR 2 freeways on the west. The study area includes all or portions of the cities of Alhambra, Arcadia, Duarte, El Monte, Glendale, La Cañada Flintridge, Los Angeles, Monrovia, Monterey Park, Pasadena, Rosemead, San Gabriel, San Marino, Sierra Madre, South Pasadena, and Temple City. It also includes several distinct neighborhoods, including El Sereno and Highland Park, within the City of Los Angeles and parts of several unincorporated communities, such as La Crescenta-Montrose and Altadena, in the western San Gabriel Valley and foothills.

The study area is illustrated in Figure 1-1. According to data from the Southern California Association of Governments (SCAG), the study area had a population of 1.18 million people in 2008, and 450,000 jobs were located in the study area. By 2035, the study area is forecast to have a population of 1.33 million people and an employment base of 507,000 jobs.

1.3 Need

The study area is centrally located within the extended urbanized area of Southern California, as illustrated in Figure 1-2. With few exceptions, the area from Santa Clarita in the north to San Clemente in the south, a distance of approximately 90 miles, is continuously urbanized. Physical features such as the San Gabriel Mountains and the 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, identified by the Census Bureau as the Los Angeles-Long Beach-Santa Ana metropolitan statistical area (MSA).

Within this urbanized area, social and economic activity creates a great demand for travel between and among residential and employment centers. Greater Los Angeles is notable for its decentralized pattern of development, with 47 employment centers concentrating 10,000 jobs or more within 10 acres in Los Angeles and Orange Counties (Giuliano et al. 2007). As a result, travel patterns are complex, with people living in each part of the region traveling to other parts of the region to go to work and to carry out other activities in their daily lives.

Figure 1-1: Study Area

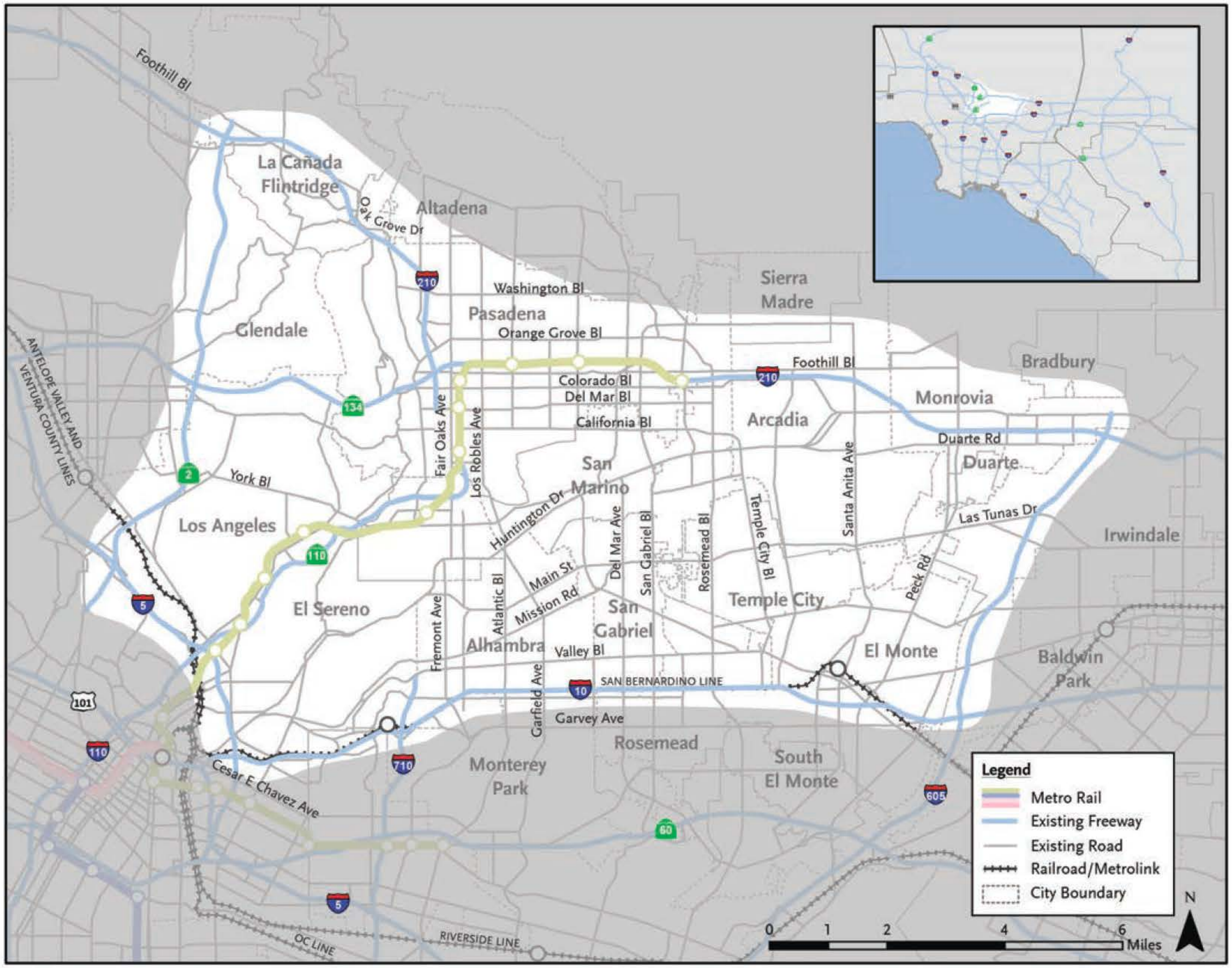


Figure 1-2: Southern California Region

There are seven major east-west freeway routes (SR 118, US-101/SR 134/I-210, I-10, SR 60, I-105, SR 91, SR 22) and seven major north-south freeway routes (I-405, US-101/SR 170, I-5, I-110/SR 110, I-710, I-605, and SR 57) in the central portion of the Los Angeles-Long Beach-Santa Ana metropolitan statistical area. Of the seven north-south routes, four of them are located partially within the study area (I-5, I-110/SR 110, I-710, and I-605), and two of these (I-110/SR 110 andI-710) terminate within the study area without connecting to another freeway. As a result, a very large 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 affects the overall efficiency of the larger regional transportation system, causes congestion on freeways in the study area, contributes to cut-through traffic that affects the local streets in the study area, and results in poor transit operations within the study area. The following sections discuss each of these issues in detail.

1.3.1 Regional Transportation System

The movement of people within the study area and the region is inhibited by inefficiencies in the regional transportation system. According to the 2011 *Annual Urban Mobility Report* (Texas Transportation Institute 2011), the Los Angeles-Long Beach-Santa Ana MSA ranks first (worst) in the United States for total travel delay, total congestion cost, and travel time index (the ratio of travel time during congested conditions to free flow) for automobile travel. The urban area ranks third in yearly delay for commuters, excess fuel used per commuter, and overall congestion cost.

Transit users in the region also experience travel delay. Most transit use in the region occurs on buses, which generally operate on the same streets as automobiles and suffer from the same congestion. According to June 2012 Metro ridership statistics, 76 percent of daily system-wide transit ridership occurs on buses. The average speed of these buses has decreased over the past two decades, eroding the benefits achieved through the introduction of Metro Rapid Bus routes in 2000. The average speed of Metro buses increased from 16 mph in 1992 to 18.5 mph in 2005 after the introduction of Metro Rapid Bus service, but it has since decreased to 17.1 mph due to increasing arterial congestion (Metro Congestion Management Program).

Travelers in the region are projected to experience continuing and worsening freeway and arterial congestion through 2035. According to the SCAG 2012 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), the total vehicular delay in Los Angeles County is projected to increase by 28 percent between 2008 and 2035. Table 1-1 shows that the total vehicle miles of travel (VMT), total vehicle hours of travel (VHT), and total delay in Los Angeles County will increase significantly in the future.

Table 1-1: Los Angeles County VMT, VHT, and Delay

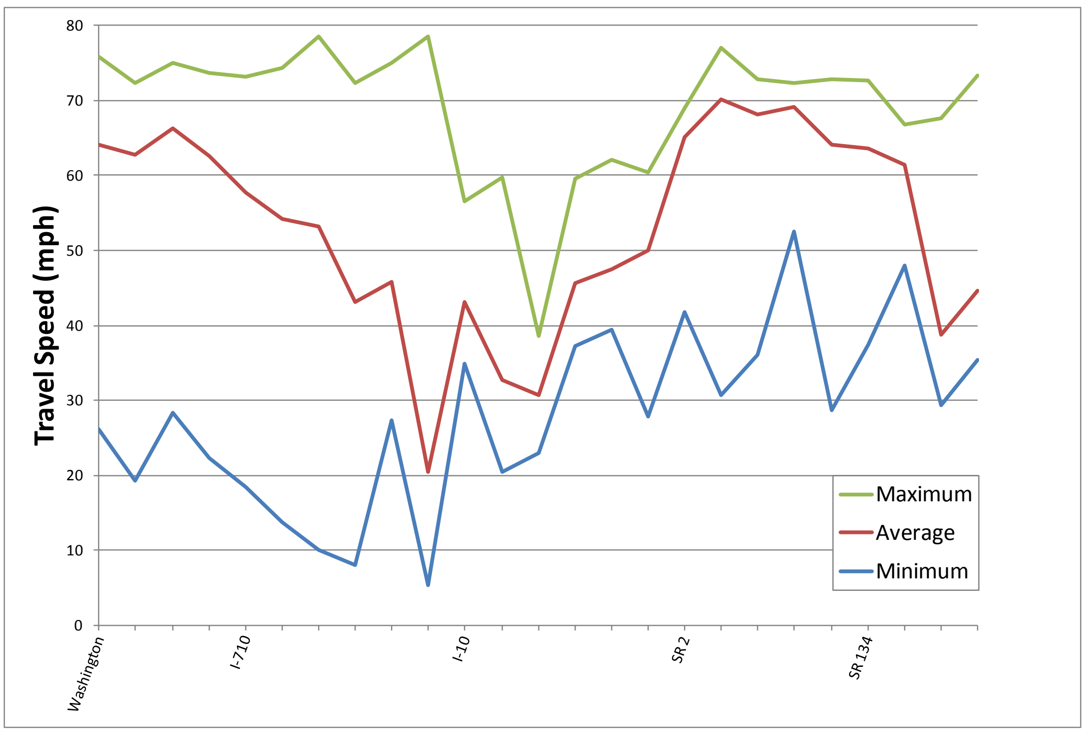
Travel Measure	2008	2035
VMT (thousands)	225,636	252,939
VHT (thousands)	7,624	8,887
Delay	2,379	3,041

Note: VMT is vehicle miles of travel; VHT is vehicle hours of travel; delay is in vehicle hours
Source: SCAG 2012 RTP/SCS, "Highways and Arterials"

Of the four north-south regional freeways that enter the study area (I-5, I-110/SR 110, I-710, and I-605), only I-5 is continuous through the study area and oriented in a direction that serves the northern portion of the Los Angeles-Long Beach-Santa Ana MSA. As a result, I-5 carries a disproportionate share of regional trips. Analysis using the SCAG RTP travel demand model shows that over one quarter of the traffic on I-5 between I-10 and SR 110 does not have an origin or destination between SR 710 and SR 134. In other words, a great deal of regional and inter-regional traffic on I-5 is using one of the most congested areas of the regional freeway network. This traffic that does not need to be on I-5 to reach its destination contributes to recurring delay on the freeway.

In addition to recurring delay during peak hours, speeds and delays on the freeways at the same time of day are often highly variable from day to day. Figure 1-3 displays an example of the speed variation on I-5, a major regional freeway at the edge of the study area. The figure shows that peak-hour (5:00 to 6:00 p.m. on Tuesdays, Wednesdays and Thursdays) speeds on I-5 between Washington Boulevard and SR 134 are highly variable and unpredictable within a single month (October 2011). For example, the speed approaching the SR 2 interchange varied from over 65 mph to below 30 mph at the same time of day.

Figure 1-3: PM Peak Hour Speed Variation on I-5



As a result of the unreliable and unpredictable travel conditions, travelers must build "buffer time" into their travel plans to allow for the possibility of longer-than-usual delays. Based on data from Caltrans' Performance Monitoring System (PeMS) the time to travel on I-5 from I-710 to SR 134 during the weekday peak varies from less than 15 minutes to more than 25 minutes. Even the average travel time is 53 percent higher than the free-flow speed of 60 mph, but due to the speed variation travelers need to allow a buffer of 97 percent of the free-flow travel time to assure arrival at their destination by a particular time.

The time required to make many north-south trips is exacerbated by the spacing between north-south freeways in the study area. Because of the approximate 12-mile spacing between north-south freeways on either side of the study area, many north-south trips must first travel east-west on the freeway system to reach a north-south freeway. The additional out-of-direction travel increases the required travel time in two ways. First, the actual distance traveled is longer than it might otherwise be, so travel time would be increased even under free-flow conditions. Second, the additional travel on the east-west freeways degrades operations of those freeways, so travel speeds are reduced beyond what they would otherwise be on those freeways.

Figure 1-4 illustrates these effects. The graphic highlights the length of a trip from two residential areas (East Los Angeles and El Monte) to an employment center in the study area (downtown Pasadena). The freeway travel distance from each residential area to the employment center is at least twice the direct, straight line distance. The result is that travelers are spending unnecessary time, traveling unnecessary distances, and increasing congestion on the regional freeway network.

One result of the inefficiency of the regional transportation is a decrease in the accessibility of employment opportunities to residents in and near the study area. As congestion and travel time increase, the number of jobs that the average resident can reach in a reasonable amount of time decreases, limiting employment options. Although the number of jobs in the study area is forecast to increase by more than 10 percent by 2035, and those within the SCAG region by more than 25 percent, Figure 1-5 shows that the number of jobs accessible within 25.3 minutes (the average travel time to work reported in the 2010 American Community Survey by the Census Bureau) for many residents in and near the study area will decline.

1.3.2 Freeway System in Study Area

The freeways within the study are often highly congested, resulting in travel delays. Many segments of the freeway network operate at or over capacity during peak periods. Table 1-2 presents data from Caltrans' 2008 State Highway Congestion Monitoring Program (HICOMP) report showing the hours that key freeway segments in the study area are congested on a typical weekday. As Table 1-2 indicates, the 2008 peak hours of congestion span several hours each day, and the periods of congestion are expected to increase with the growth of the region. Even with the implementation of other planned transportation improvements, increasing travel demands will overtake freeway system capacity, and traffic operations on the already congested freeway network in the study area will continue to decline.

Table 1-2: Periods of Recurring Freeway Congestion, 2008

Freeway	Segment (Direction)	AM Peak Congestion Time	PM Peak Congestion Time
I-5	SR 134 to I-110 (Southbound)	7:00 – 11:30	
I-5	I-10 to SR 2 (Northbound)	9:00 - noon	3:45 – 7:15
I-10	I-605 to I-710 (Westbound)	6:00 – 10:45	
I-10	I-5 to I-605 (Eastbound)		1:45 – 7:00
I-605	I-210 to I-10 (Southbound)	7:30 – 9:30	
I-210	I-210 to SR 2 (Westbound)	8:15 to 9:30	
I-210	SR 134 to I-605 (Eastbound)		3:15 – 6:15
SR 2	SR 134 to I-5 (Southbound)	6:45 – 9:00	

Note: HICOMP defines congestion as speeds less than 35 mph.
Source: 2008 State Highway Congestion Monitoring Program

Figure 1-4: Out-of-Direction Travel

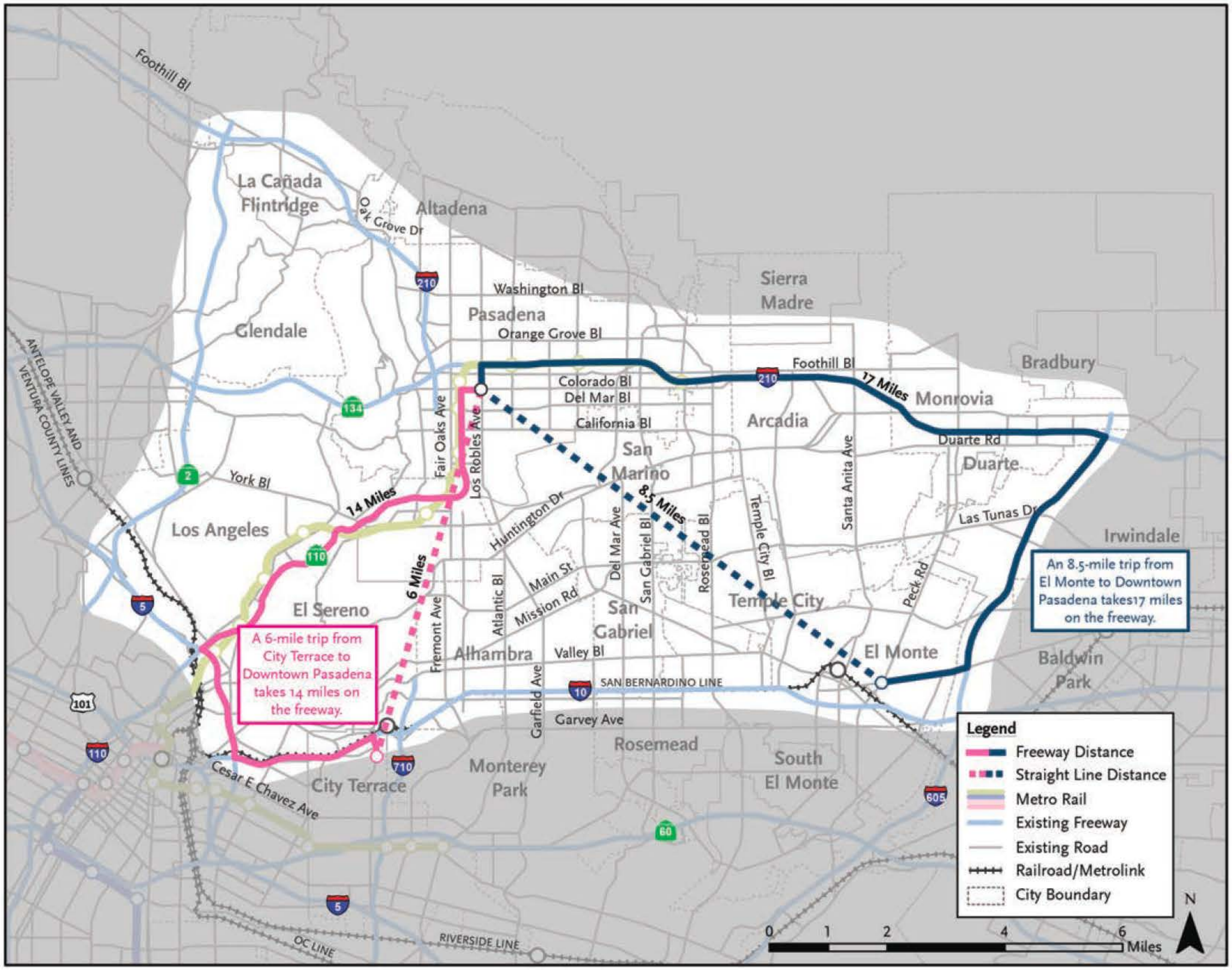
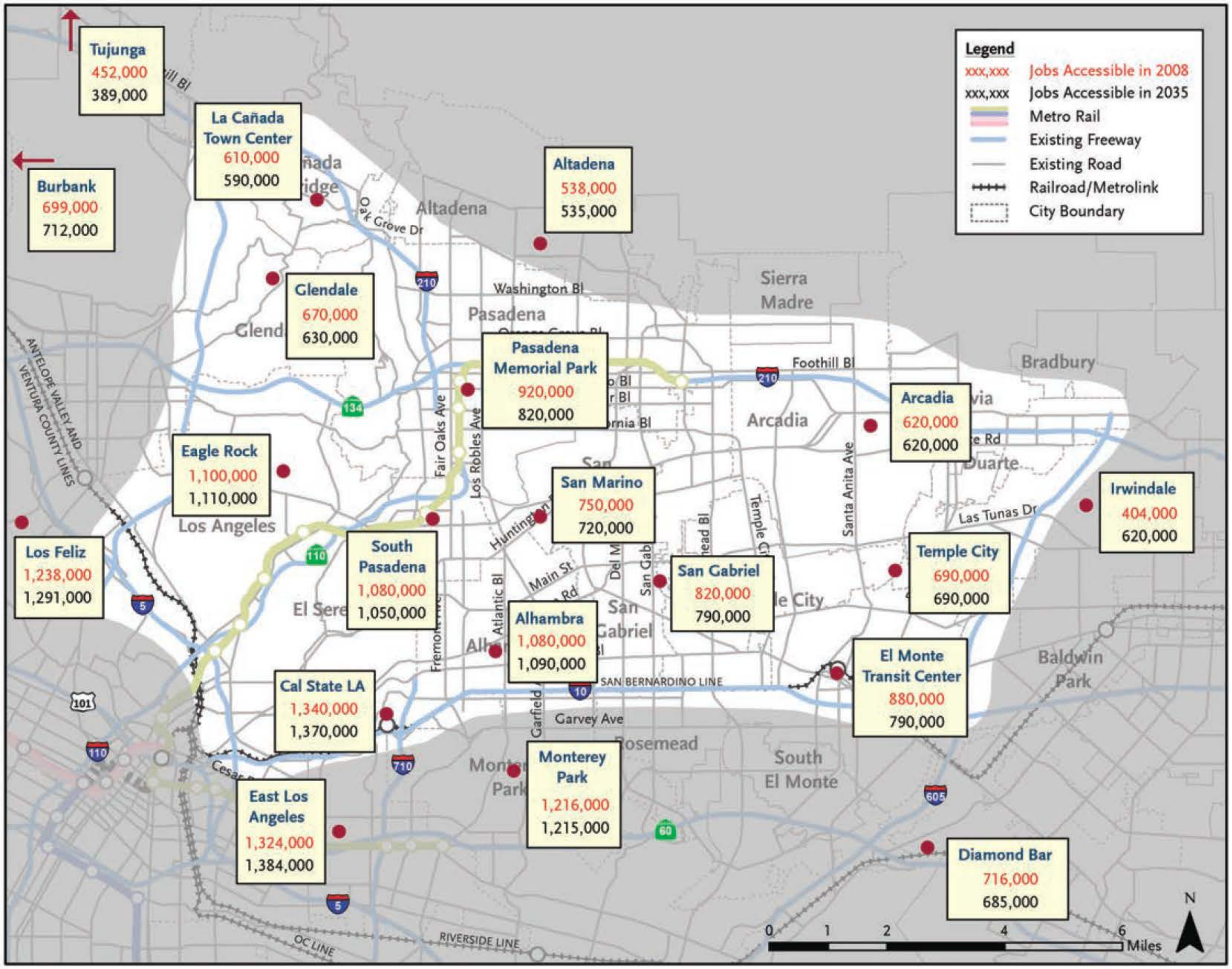


Figure 1-5: Job Accessibility, 2008 and 2035



The north-south freeways in the study area are among the region's most congested. As shown in Figure 1-6, analysis conducted by SCAG for the 2012 Regional Transportation Plan (RTP) found that current p.m. peak period travel speeds on north/south freeways between I-10 and US-101/SR 134/I-210 are below 15 mph in many locations. Speeds on I-5 between I-10 and SR 2 are among the slowest in the region. As shown in Figure 1-7, by 2035 speeds will be noticeably lower.

One way to quantify the degree to which mobility is constrained in the north-south direction compared to the east-west direction is to compare the volume/capacity (v/c) ratios of freeways in each of those directions. The total volume of traffic on the freeways at select locations compared to the total capacity of the freeways at those locations represents the v/c ratio for traffic in that direction. According to analysis with the SCAG RTP travel demand model, the v/c ratio for traffic on north-south freeways is more than ten percent greater than that for east-west freeways during the p.m. peak period.

1.3.3 Local Street System

One result of the distances between freeways and the congestion on the freeway system is that travelers use local streets in the study area to complete their regional trips. Figure 1-8 illustrates four street segments in the heart of the study area that are currently heavily used by trips that have both their origins and their destinations outside the study area. These four street segments are each at least two miles from the edge of the study area (which is bounded on all sides by a freeway), meaning that these "cut-through" trips are traveling at least four miles and crossing at least two freeways. Nonetheless, according to analysis with the SCAG RTP travel demand model, 19 percent of the trips on these roadways have both origins and destinations outside the study area. This percentage will increase to approximately 25 percent by 2035. The large amount of cut-through traffic in the study area plays a major role in contributing to arterial congestion.

Within the study area, higher roadway volumes are observed in the north-south direction than in the east-west direction. Figure 1-9 presents the 2008 average daily traffic (ADT) volumes on the study area's major arterials, based on data from SCAG's RTP travel demand model. Throughout the study area, four-lane north-south arterials such as Fremont Avenue, Atlantic Boulevard, Garfield Avenue, San Gabriel Boulevard, and Rosemead Boulevard (SR 19) all have segments that carry over 35,000 vehicles per day. In contrast, only Huntington Drive, a six-lane arterial, carries that volume of traffic in the east-west direction.

As with the study area freeways, it is possible to compare v/c ratios on north-south roadways in the local roadway network to those on east-west roadways. According to analysis with the SCAG RTP travel demand model, the v/c ratio for traffic on north-south roadways is more than ten percent greater than that for east-west roadways during the p.m. peak period. By 2035, the v/c ratio for traffic on north-south roadways will be more than 15 percent greater than that for east-west roadways.

1.3.4 Transit System in Study Area

In general, transit travel in the study area is affected by the same congestion on the roadway network that affects automobile travel. This is because most transit trips within the study area are made via bus, which operate on the roadway network. According to the Metro transit model, approximately 79 percent of transit trips in the study area were made via bus in 2006, 20 percent were made via light rail (the Metro Gold Line), and less than one percent were made via commuter rail (Metrolink).

Figure 1-6: Year 2008 Average PM Peak Period Speeds

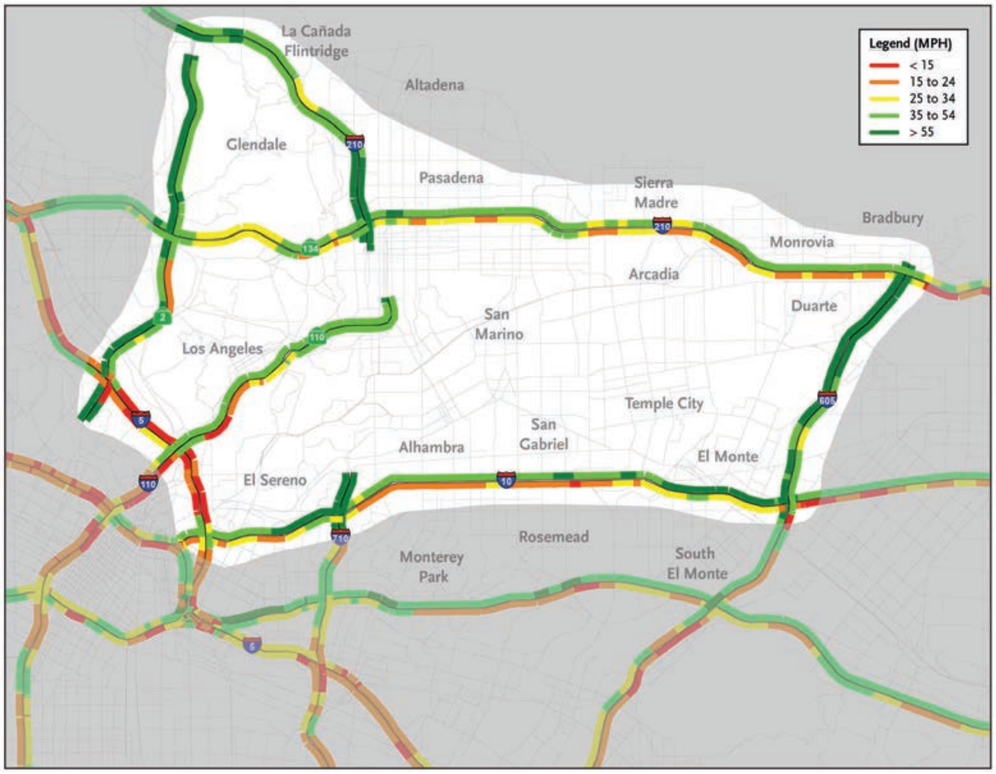


Figure 1-7: Year 2035 Average PM Peak Period Speeds

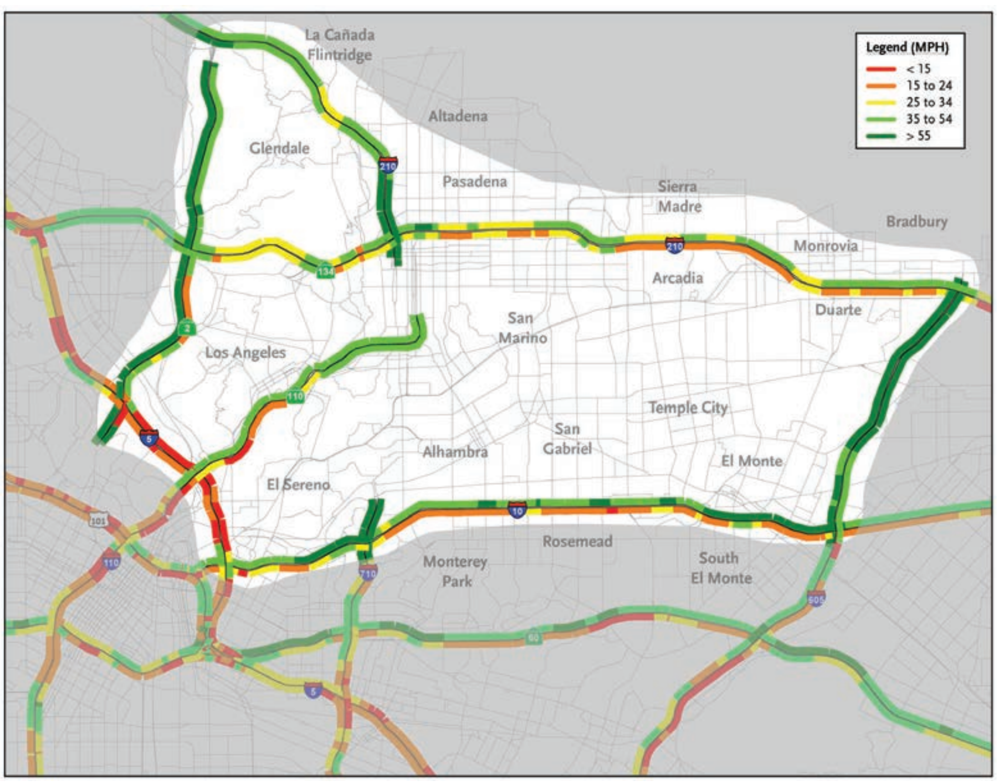


Figure 1-8: Study Area Street Segments Analyzed for Cut-Through Traffic

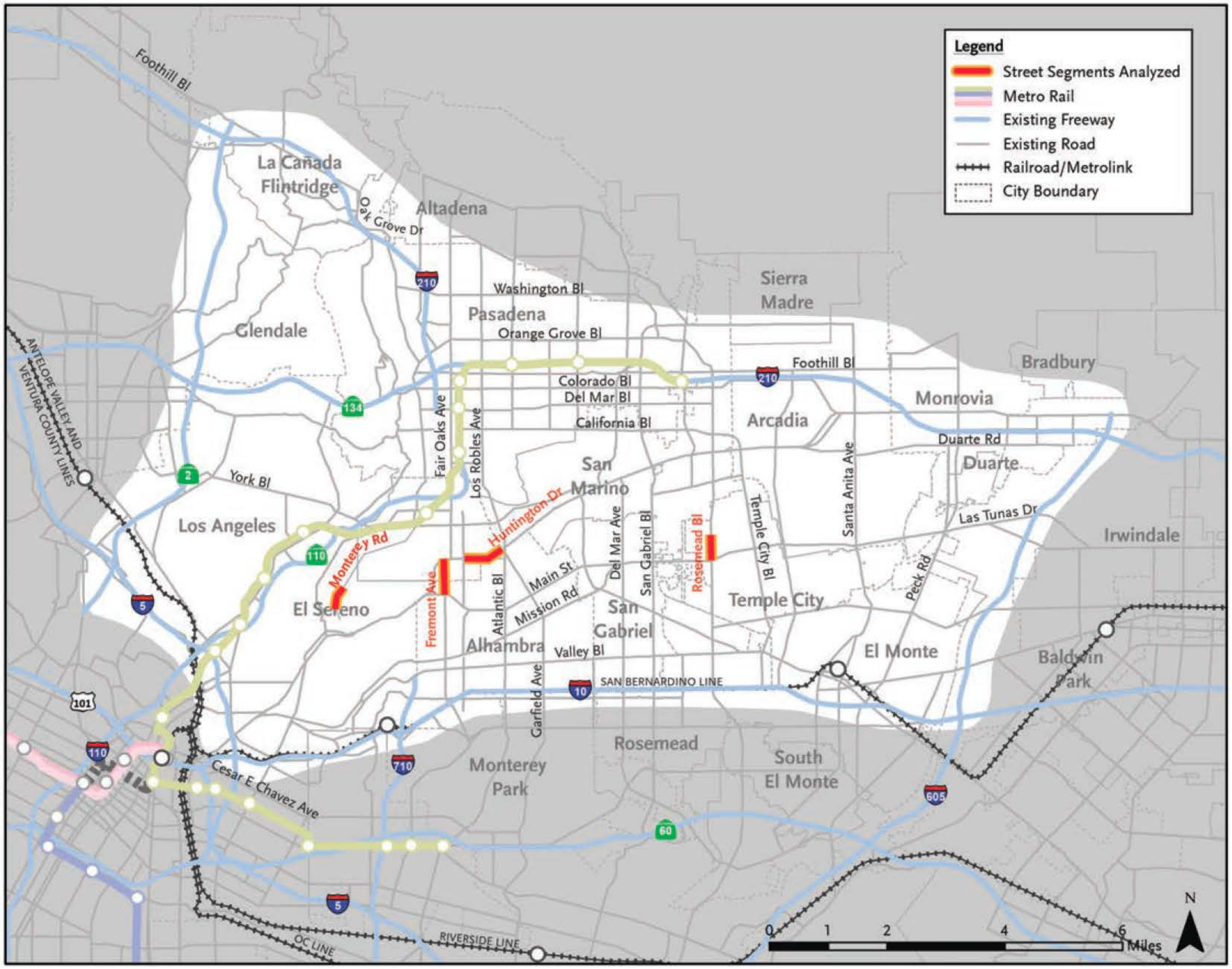
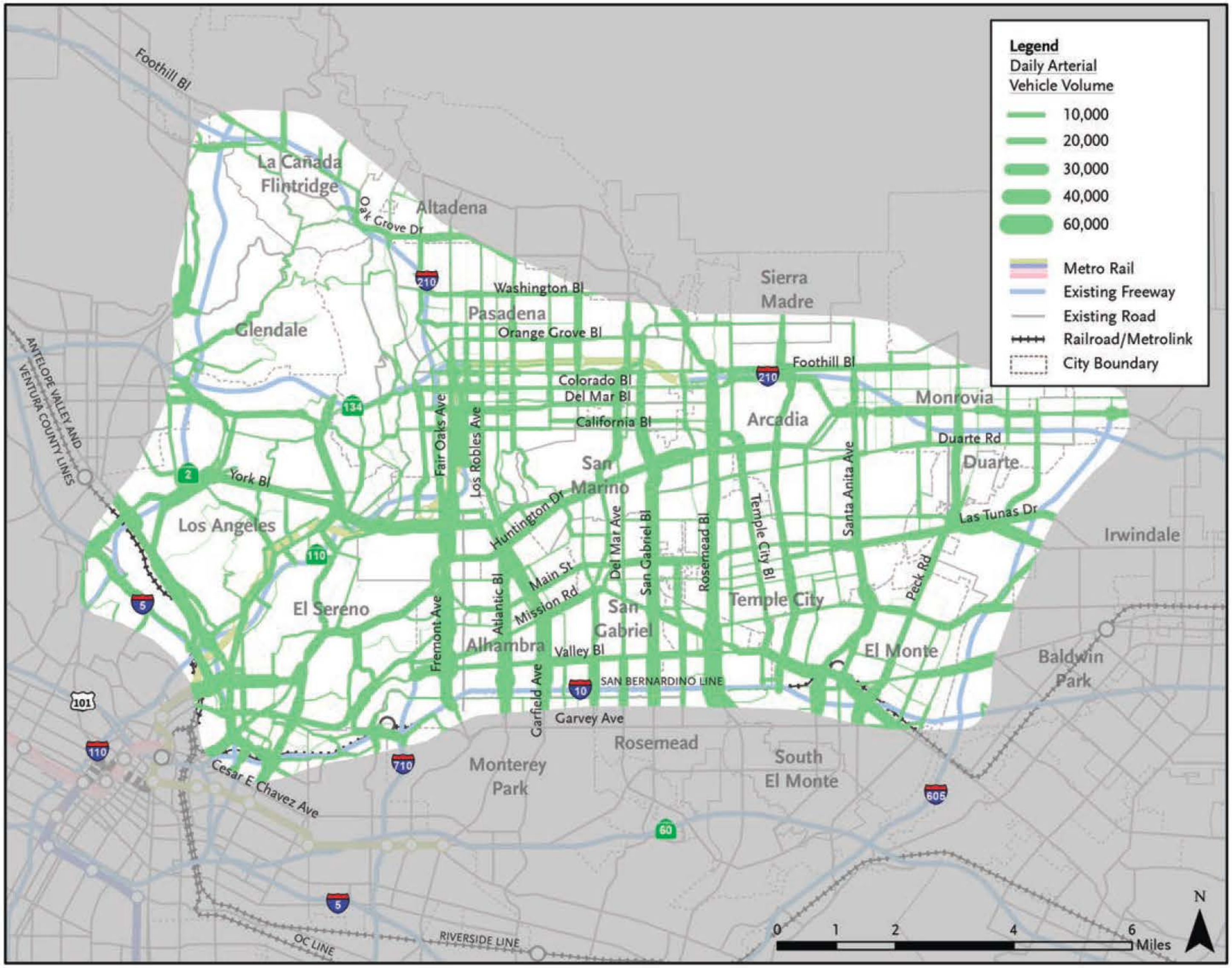
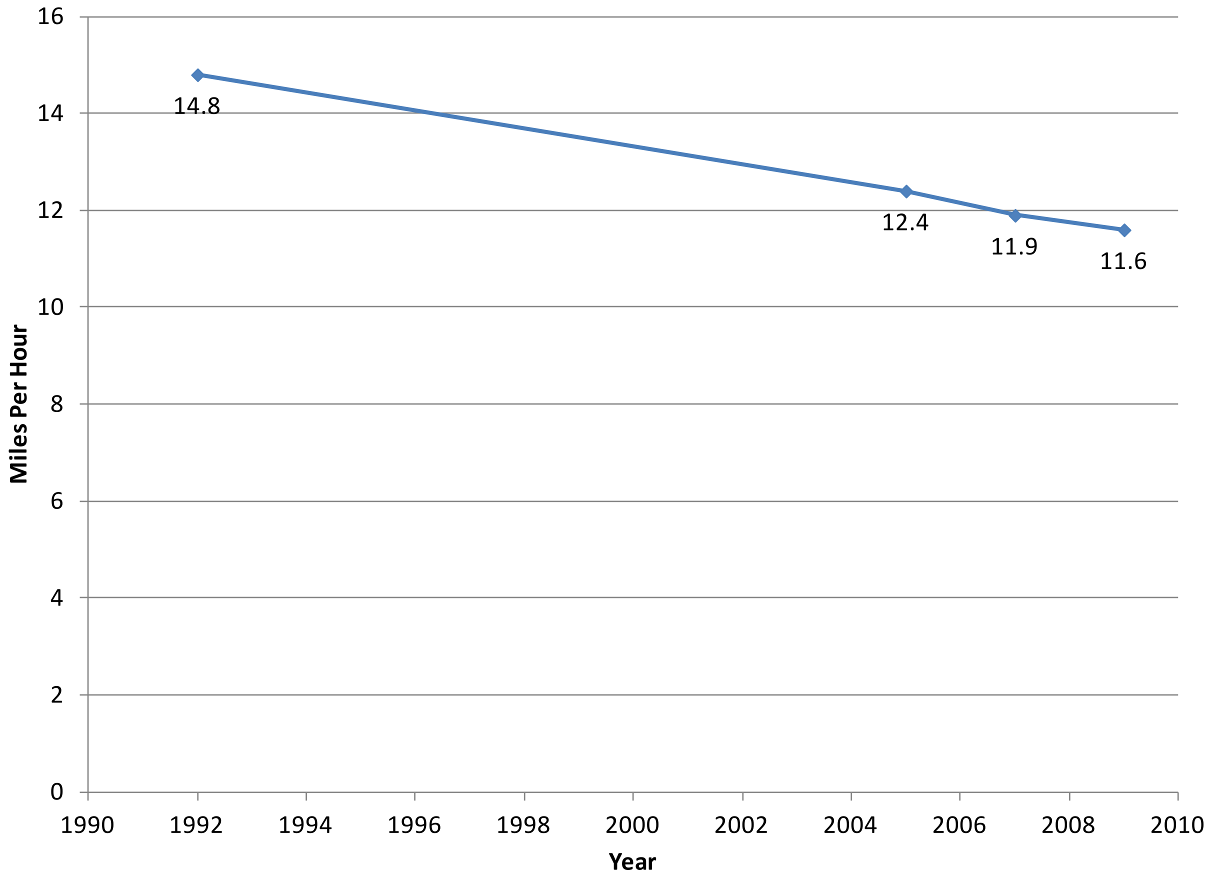


Figure 1-9: Year 2008 Arterial Traffic Volumes



As part of the Los Angeles County Congestion Management Program (CMP), transit speeds on a select number of bus routes have been monitored for two decades. As illustrated in Figure 1-10, since 1992, the average speed of Metro Route 260, which travels through the study area on Fair Oaks Avenue and Atlantic Boulevard, has decreased from 14.8 mph to 11.6 mph (Metro 2010).

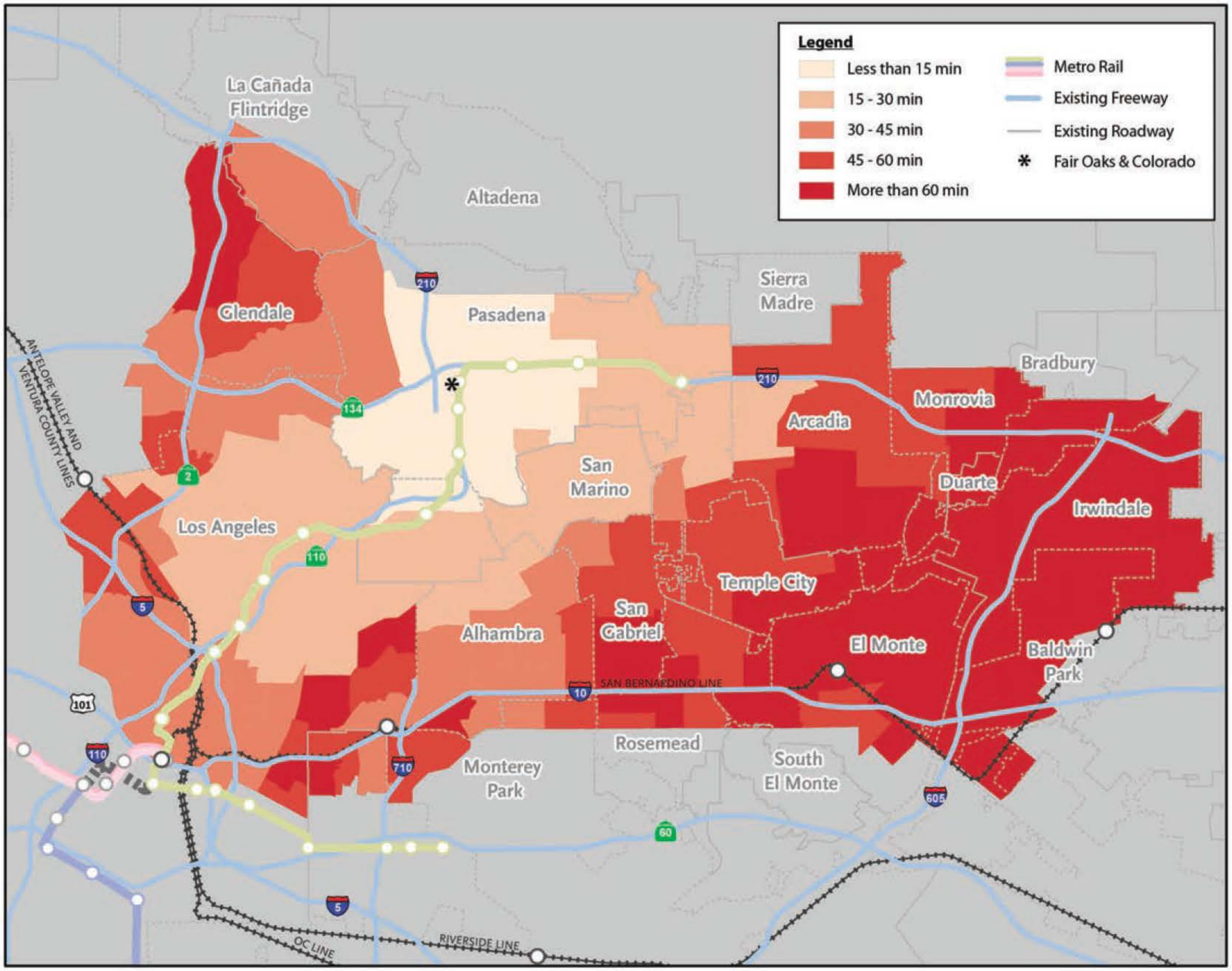
Figure 1-10: Average Speed of Metro Route 260



Transit service in the study area experiences the same variability in travel time that automobile travel experiences. A bus trip from the Metro Gold Line Atlantic Station to the Fair Oaks Avenue/Colorado Boulevard intersection, a distance of 9.3 miles, takes up to 48 minutes in the peak period (60 percent longer than during uncongested periods) (LA Metro Route 260 Schedule 2011).

As a result of slow transit speeds, relatively short distances can take a long time to traverse by transit. Figure 1-11 illustrates the amount of time to travel by transit from various parts of the study area to the employment center in downtown Pasadena. Based on peak hour transit headways and travel times, it can take residents of the communities of El Sereno, Alhambra, San Gabriel, and Rosemead 60 minutes or more to get to downtown Pasadena by transit, even though all these communities are within 7.5 miles of Pasadena. (These times do not include the time to walk from home to the transit stop, but they do include time waiting for the transit vehicle to arrive. Wait times for transit trips in the study area are typically 20 to 30 percent of the total trip time.)

Figure 1-11: Transit Travel Time (in Minutes) to Downtown Pasadena



1.4 Purpose

To address the needs discussed above related to the regional transportation system, congestion on freeways in the study area, cut-through traffic that affects local streets in the study area, and poor transit operations within the study area, 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

1.5 Objectives

Based on the project Need and Purpose, eight objectives were established for the project. These objectives reflect the changes and improvements desired as a result of the project. Formulation of specific objectives is an important step in the development of performance measures by which potential alternatives can then be evaluated. For this reason, the objectives established for the project were required to satisfy the following guidelines:

- Be relevant to the project Need and Purpose
- Be responsive to agency, stakeholder, and public concerns.
- Be independent of one another to avoid duplication or double counting of performance measures
- Be measurable using quantitative performance measures or clearly established qualitative performance measures.
- Be well defined and easily understood by all study participants.

Five of the project objectives address the four elements of need related to the performance of the transportation system, as shown in Table 1-3.

Table 1-3: Transportation System Objectives

Element of Need	Objective
Regional transportation system	1. Minimize travel time
	2. Improve connectivity and mobility
Congestion on study area freeways	3. Reduce congestion on freeway system
Congestion on local streets	4. Reduce congestion on local street system
Transit operations in study area	5. Increase transit ridership

Three additional objectives address environmental impacts, planning considerations, and cost efficiency as shown in Table 1-4.

Table 1-4: Environmental and Other Project Objectives

Value or Concern	Objective
Environment and communities	6. Minimize environmental and community impacts related to transportation
Consistency with plans	7. Assure consistency with regional plans and strategies
Provide financially feasible transportation solutions	8. Maximize the cost-efficiency of public investments

2.0 Alternatives Considered

A wide range of possible transportation alternatives was identified based on past studies and comments received during the "SR-710 Conversations" from stakeholders including elected officials, city and agency staff, and the community. The resulting options were evaluated and refined through a sequential screening process to identify the alternatives that best meet the Need and Purpose of the study. The following sections describe the screening process, selection criteria, and the alternatives selected for evaluation via conceptual engineering and initial environmental analysis in this Alternatives Analysis (AA).

2.1 Screening Criteria and Selection Process

This section provides an overview of the multi-step screening process from scoping to the identification of the alternatives recommended to move forward into the environmental phase. Each evaluation step refined the results of the previous efforts using more detailed engineering, operational, and environmental analysis. Each of the screening steps and resulting sets of alternatives is described in more detail in the subsequent sections.

Throughout the development and execution of the screening process, the SR 710 Study team engaged a Technical Advisory Committee (TAC). Representatives of each jurisdiction in the Study Area, as well as representatives of other stakeholder agencies, were invited to participate in the TAC. The TAC reviewed technical analyses and methodologies and provided feedback on technical materials and project information. TAC members were also responsible for sharing information with their agencies. The TAC met eight times during the AA process, in January, February, March, April, May, July, August, and November, 2012. In addition, input from the TAC was supplemented by public outreach efforts that are described in Chapter 6.

The screening followed a sequential process, including preliminary, initial, and secondary screenings. The screening process is summarized below and illustrated in Figure 2-1,

Figure 2-1: Screening Process

- **Preliminary Screening** – An unscreened set of alternatives was identified during project initiation through a process that included a review of prior studies and public input received during the "SR-710 Conversations" scoping process conducted by Metro and Caltrans in 2011. From this large set of alternatives, the preliminary screening step led to the identification of the preliminary set of alternatives, consisting of 42 alternatives representing a reasonable range of modes and alignments. Criteria used for the preliminary screening included the potential to accommodate regional north-south travel, reduce local street congestion, minimize community impacts, minimize the potential to encounter contaminated soil and groundwater, and accommodate ridership potential (for relevant modes). Within each travel mode, alternatives were evaluated against each other, and the most promising alternatives from each mode were selected to be included in the preliminary set of alternatives.

- **Initial Screening –** The initial screening evaluated the preliminary set of alternatives based on the eight project objectives described in Chapter 1. In general, the initial screening relied on available data and schematic representations of each alternative. To find the best performing alternatives within each mode in the initial screening, the performance of each alternative was compared only to that of other alternatives of the same mode. This evaluation step resulted in the identification of the initial set of alternatives, consisting of 12 alternatives and representing each mode from the preliminary set of alternatives.
- **Secondary Screening –** In the secondary screening step of the AA phase, the initial set of alternatives was studied and evaluated using detailed performance measures reflecting the eight project objectives. Additional engineering and environmental evaluation of each alternative was conducted, based on travel demand and ridership forecasting specific to each alternative and the conceptual-level engineering plans. The alternatives performing best on the secondary screening will be further developed and enhanced for evaluation during the Project Approval and Environmental Documentation (PA/ED) phase, along with possible hybrid or combination alternatives.

2.2 Unscreened Set of Alternatives

An unscreened set of alternatives was identified through the "SR-710 Conversations" scoping process, through a review of prior studies, and through an assessment of mobility needs and potential travel corridors in the study area. Over 200 alternative concepts were identified throughout the study area in a wide range of transportation modes including freeway, highway, bus rapid transit (BRT), light rail transit (LRT), commuter rail, transportation system management/transportation demand management (TSM/TDM), and advanced technologies. Appendix A includes a table with descriptions of each alternative.

2.3 Preliminary Screening

The preliminary screening evaluated the unscreened set of alternatives based on the project need and input from the TAC. The preliminary screening used five criteria developed from the project need:

- Accommodate regional north-south travel
- Reduce local street congestion
- Minimize community impacts
- Minimize potential to encounter contaminated soil and groundwater
- Accommodate ridership potential (for relevant modes)

The table in Appendix A summarizes the results of the preliminary screening. A review of the alternatives that showed the greatest potential to address the five criteria revealed several major categories of alternatives, with variations in each category. The most viable alternatives of each category that best met the criteria listed above were selected to be included in the preliminary set of alternatives. The preliminary screening methodology and resulting preliminary set of 42 alternatives was presented to the TAC on March 8, 2012 for input and feedback.

No freight rail alternatives were included in the preliminary set of 42 alternatives because the primary need identified for the project is to accommodate regional north-south travel demands, and the primary demand for mobility in the study area is that of people, not freight. There are very few large warehouses in the study area compared to other parts of the SCAG region (SCAG 2012, Metro 200811), and the vast majority of truck traffic from the San Pedro ports is destined for intermodal yards and other facilities south and east of the study area (SCAG 2012). SCAG's RTP/SCS includes an east-west freight corridor to move goods from the ports to these facilities. The distribution of truck trips in the County is not expected to change substantially in the future because available and undeveloped warehouse space is primarily located in the same geographic areas as existing warehouse space, outside the study area (SCAG 2010). In addition, expansion of intermodal capacity serving truck traffic from the San Pedro ports is expected to take place at the existing facilities south and east of the study area, or potentially in the Victor Valley, far to the east of the study area (Metro 2009).

2.4 Preliminary Set of Alternatives

The preliminary set of alternatives included 42 alternatives representing a wide array of strategies and travel modes: TSM/TDM, BRT, LRT, freeway, highway/arterial, commuter rail, and advanced technologies. Figures 2-2 through 2-5 illustrate the alignments for the BRT, LRT and commuter rail, freeway, and highway alternatives in the preliminary set of alternatives. Each travel mode considered is defined below.

Transportation System Management/Transportation Demand Management (TSM/TDM). TSM includes techniques for making the transportation system operate more efficiently. Examples of TSM include coordinated traffic signal timing in a congested area, ramp meters to time the entry of vehicles onto a freeway, and minor street widening and intersection improvements. TDM includes techniques to reduce the use of motor vehicles, shift the use of motor vehicles to uncongested times of the day, and/or improve transport options.

Bus. Traditional bus service operates in mixed flow traffic on freeways and arterial streets. Bus service is flexible, easily changed, and has the ability to detour around road obstacles. Service reliability depends heavily on traffic conditions.

Bus Rapid Transit (BRT). BRT uses buses in exclusive right-of-way or bus-only lanes with transit signal priority. Exclusive right-of-way could be configured at-grade, underground, or on aerial structures. Buses have the flexibility to leave their right-of-way and detour around road obstacles. Because of the limited use of mixed flow, BRT service quality is affected less by traffic conditions than traditional bus service.

Light Rail Transit (LRT). LRT uses electric trains on conventional rails, powered by overhead wires. Because the power delivery system is overhead, tracks can be installed in mixed flow lanes, exclusive right-of-way with grade crossings, or roadway medians. Automobiles can drive across or along the tracks at grade crossings and on street-running segments. Right-of-way can be at-grade, aerial, or underground. Trains do not have the flexibility to detour around obstacles, and such incidents typically require single tracking and service interruptions. Because of the limited use of mixed flow lanes, LRT service is typically affected little by traffic conditions.

Freeway. A freeway is a controlled-access roadway designed exclusively for high-speed vehicular traffic and high traffic volumes. Freeways are divided with separated traffic streams. They have full control of access, with interchanges at major cross-streets. There are no traffic signals.

Highway/Arterial. Highways are multi-lane roadways with limited access locations, generally at signalized intersections; Caltrans typically refers to as a “conventional highway.” Signalized intersections are typically spaced one-quarter mile or more apart. Some cross streets may be grade-separated, as are rail crossings. There is no direct access from properties adjacent to the highway.

Commuter Rail. Commuter Rail is a form of public transportation that primarily operates between a city center to outer suburbs and commuter towns. Commuter rail train cars are typically larger than LRT cars and provide more seating and less standing room, for the longer distance trips.

Advanced Technology. Advanced technologies include several types of transportation improvement concepts that could be utilized on freeway, highway, or arterial systems. Such technologies include online electric vehicle technology (OLEV), low emission vehicles, dual mode systems, and automated vehicle systems/vehicle platooning. More information about the advanced technologies considered can be found in Appendix B.

2.5 Initial Screening

In the initial screening, readily available information and data were used to evaluate each alternative against appropriate performance measures to identify the alternatives best suited to address the project objectives. The performance measures associated with each project objective are shown in Table 2-1.

Table 2-1: Initial Screening Performance Measures

Objective	Performance Measures
1. Minimize travel time	• Assessment of changes in multimodal travel times for a range of local and regional trips • Assessment of total travel time regionwide. • Percentage of facilities with dedicated or managed operations
2. Improve connectivity and mobility	• Number of new connections to existing highway, bus, and rail facilities • Assessment of changes in travel time to employment bases, using both transit and highway modes • North/south travel served
3. Reduce congestion on freeway system	• Ability to attract trips from congested freeway segments in study area
4. Reduce congestion on local street system	• Assessment of the shift in trips from congested arterials
5. Increase transit ridership	• Increase in transit riders • Percent of population within 1/4 mile of transit
6. Minimize environmental and community impacts related to transportation	• Acres of right-of-way • Recreational sites within proximate distance • Concentration of known cultural sites/historical districts or buildings within proximate distance • Length through sensitive receptors • Visual intrusion into communities • Environmental justice populations within proximate distance
7. Assure consistency with regional plans and strategies	• Consistency with RTP/SCS goals • Consistency with Measure R goals • Consistency with Metro LRTP goals
8. Maximize cost-efficiency of public investments	• Relative construction costs • Potential for funding • Technology demonstrated to be feasible

Figure 2-2: BRT Alternatives in the Preliminary Set of Alternatives

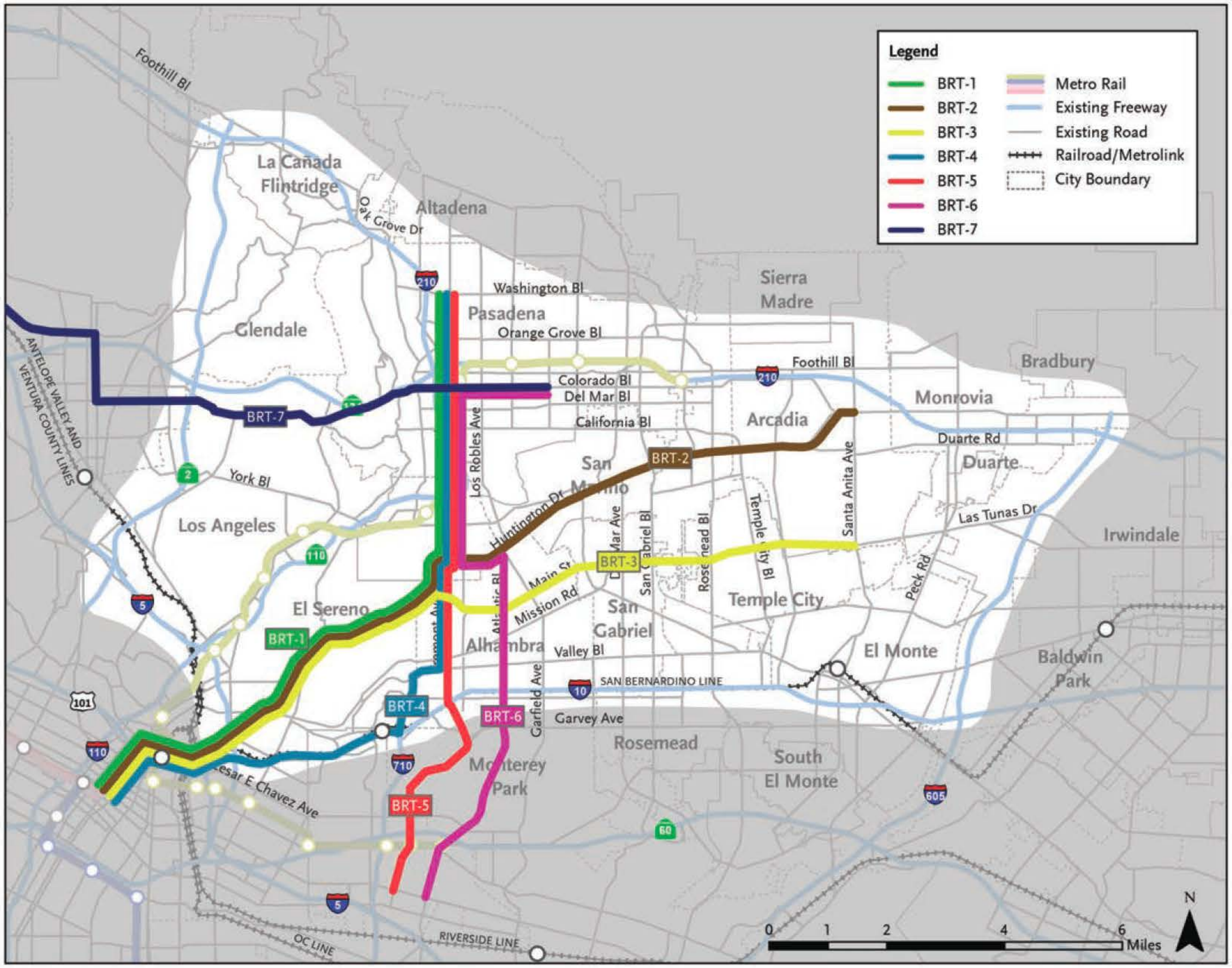


Figure 2-3: LRT and Commuter Rail Alternatives in the Preliminary Set of Alternatives

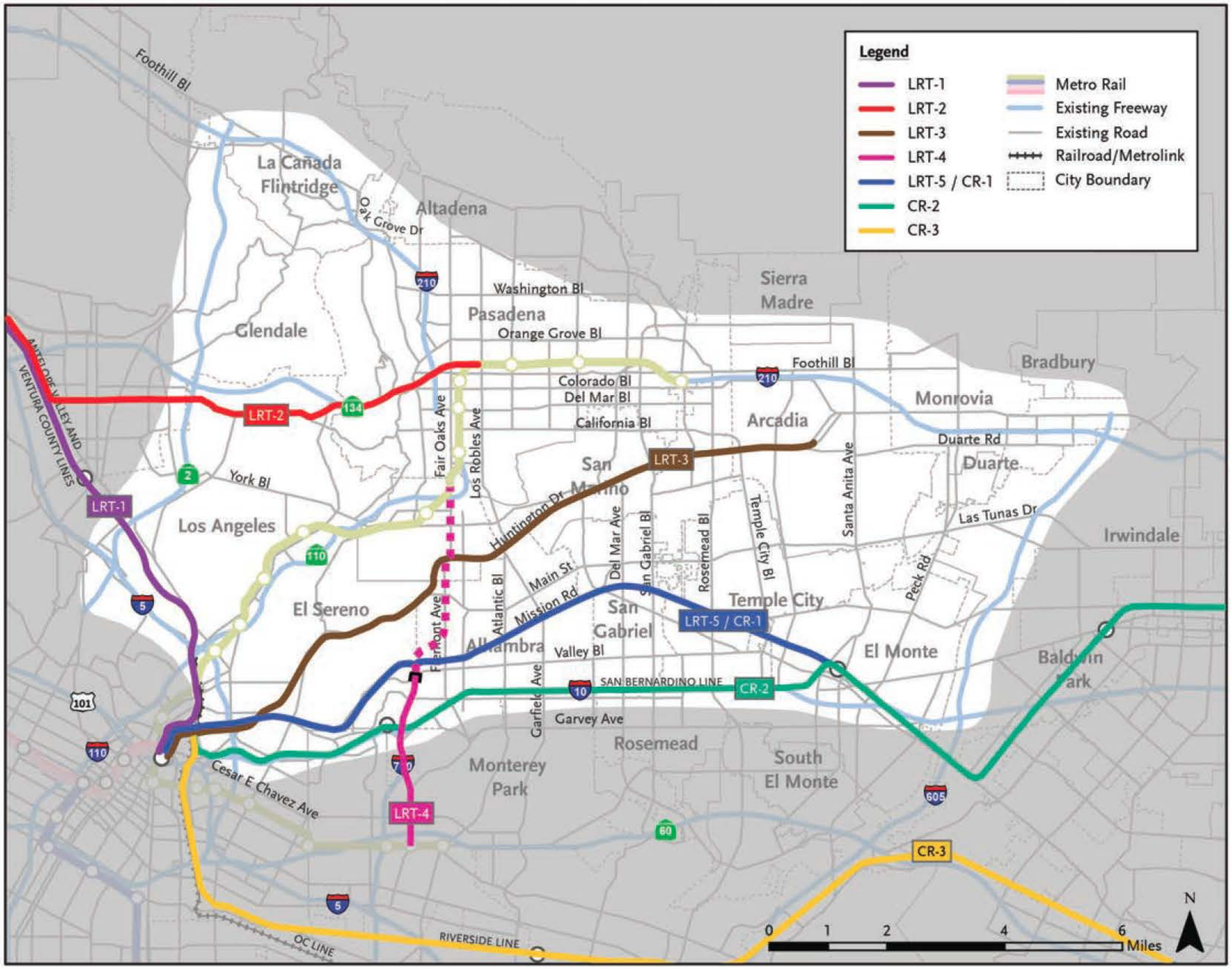


Figure 2-4: Freeway Alternatives in the Preliminary Set of Alternatives

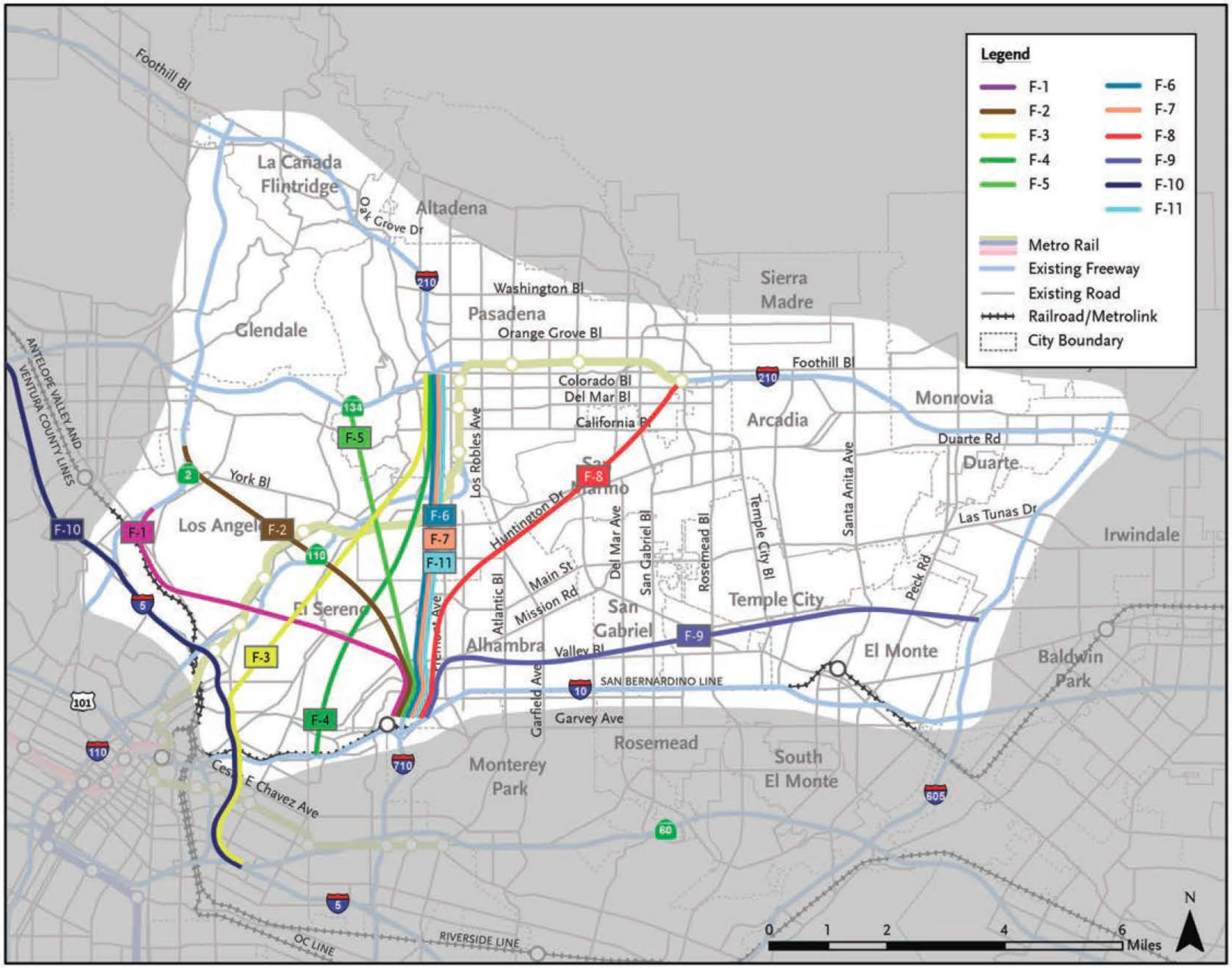
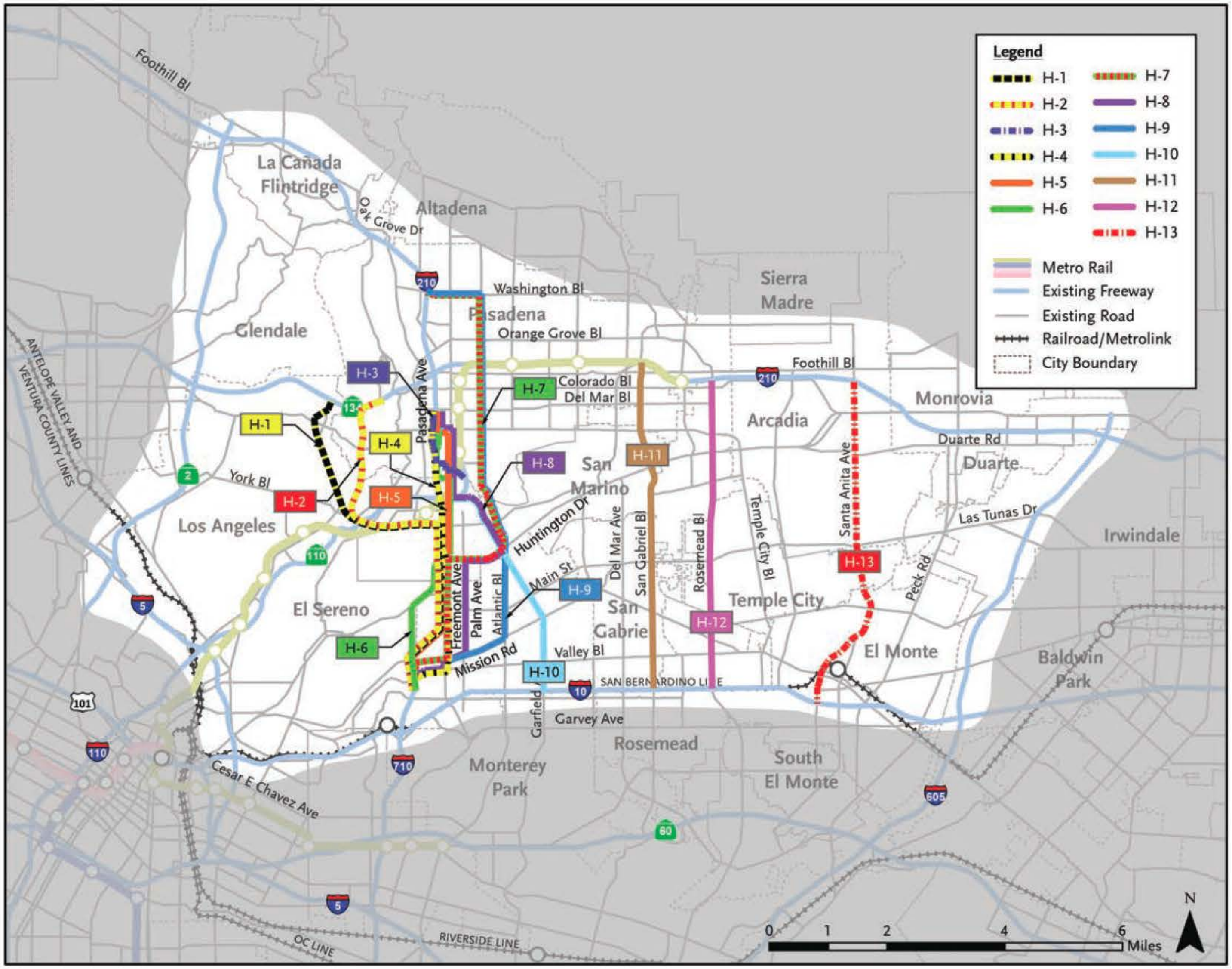


Figure 2-5: Highway Alternatives in the Preliminary Set of Alternatives



The performance of each alternative on each measure was evaluated using a five-point scale from worst performing to best performing. The highest performing alternatives from each mode were selected to be included in the initial set of alternatives. The detailed scoring of each alternative against the performance measures can be seen in the performance matrix in Appendix C.

As a result of the initial screening, the alternatives listed below were selected to be further evaluated as part of the initial set of alternatives, including the preparation of conceptual engineering plans and further assessment in the secondary screening. The rationale for retaining each alternative is provided.

- **No Build Alternative.** This is the baseline against which other alternatives are evaluated.
- **TSM/TDM Alternative.** This alternative performed well because of its low cost and its potential to improving connectivity and mobility.
- **Alternative BRT-1.** This alternative performed well on reducing trip travel times and improving connectivity by providing access to employment and other important destinations.
- **Alternative BRT-6.** This alternative performed similarly to Alternative BRT-1.
- **Alternative LRT-4.** This alternative reduced trip travel times, improved travel time reliability and improved the connectivity of the regional transit network more than any of the other LRT alternatives.
- **Alternative LRT-6.** This alternative, an LRT operating on the alignment of Alternative BRT-6, was added based on the potential performance of Alternative BRT-6. Sufficiently high transit demand could potentially justify an LRT alignment in this corridor.
- **Alternative F-2.** This alternative performed well on transportation performance measures such as minimizing travel times and reducing congestion on the freeway system, but with some potential for environmental and community impacts, such as potential effects to known cultural/historic resources and visual intrusion into communities.
- **Alternative F-5.** This alternative performed similarly to Alternative F-2, but with less access to the regional transit system and better ability to reduce freeway and local street congestion. It also had a similar potential for environmental and community impacts as Alternative F-2.
- **Alternative F-6.** This alternative performed the strongest on the measures related to the regional transportation system, the freeway system, and the local street system.
- **Alternative F-7.** This alternative performed similarly to Alternative F-6, but with a smaller right-of-way footprint and less potential to affect cultural and historic resources because it uses the existing Caltrans right-of-way and connects to both ends of the existing SR 710 stubs.
- **Alternative H-2.** This alternative was selected because it had the potential to improve travel time and local arterial traffic operations and north-south throughput.
- **Alternative H-6.** This alternative was also selected because it had the potential to improve travel time and local arterial traffic operations and north-south throughput.

No commuter rail alternatives performed well in the initial screening on the transportation system performance measures because the commuter rail rights-of-way in and near the study area are predominantly oriented in an east-west direction. In addition, no advanced technology alternative was identified that could accommodate regional north-south travel demands as a stand-alone alternative. More information on the evaluation of advanced technology alternatives in the initial screening can be found in Appendix B.

The result of the initial screening was the identification of 12 alternatives that best met the study's Need and Purpose and were technically viable. These 12 alternatives were evaluated in depth in the AA study. They are described in detail in the following section.

2.6 Initial Set of Alternatives

The initial set of alternatives was screened from the preliminary set of alternatives and represents a range of modes and alignments. The initial set of alternatives includes a No Build alternative, a TSM/TDM alternative, two BRT alternatives (with one additional design variation that was developed during the evaluation process), two LRT alternatives (with two additional design variations that were developed during the evaluation process), four freeway alternatives, and two highway/arterial alternatives. The alternatives in the initial set of alternatives are described in detail below.

2.6.1 No Build Alternative

The No Build Alternative includes all of the projects that are identified in the financially constrained project list of SCAG's *2008 Regional Transportation Plan (RTP): Making the Connections*, which was the officially adopted RTP at the commencement of the study. The No Build Alternative also includes currently planned projects in Los Angeles County that are identified in Measure R, such as the extension of the Metro Gold Line to Azusa, as well as those in the "Constrained Plan" of Metro's 2009 Long Range Transportation Plan (through the year 2035). The No Build Alternative does not include any project to improve the connection between the SR 710 and I-210 freeways. For informational purposes, the projects included in the No Build Alternative that are located in or near the study area are presented in Table 2-2 and illustrated in Figure 2-6. However, the No Build Alternative includes projects throughout the six-county SCAG region that are not included in the table or the figure.

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

The Transportation System Management/Travel Demand Management (TSM/TDM) Alternative consists of strategies and improvements to improve operational efficiency and capacity for all modes in the transportation system with lower capital cost investments and/or lower potential impacts. TSM elements aim to improve the operational efficiency of the existing transportation network, and the TDM elements are oriented to reducing traffic demands during peak periods. The TSM/TDM Alternative includes Intelligent Transportation Systems (ITS) elements, substantially increased bus service, active transportation (bicycle) facilities, congested intersection spot improvements, local street capacity enhancement improvements, adaptive traffic signal systems and freeway access improvements. The individual elements of the TSM/TDM Alternative are described below. A summary is included in Table 2-3.

2.6.2.1 Transportation System Management (TSM) Elements

The TSM portion of the TSM/TDM Alternative includes ITS elements, intersection spot improvements, and local street improvements.

Intelligent Transportation Systems (ITS) Improvements. The ITS improvements in the TSM/TDM Alternative are intended to integrate with the ITS Structure for the San Gabriel Valley developed by the San Gabriel Valley Traffic Forum, led by Los Angeles County and consisting of representatives of all San Gabriel Valley (Valley) cities. Figure 2-7 shows the proposed ITS improvements as part of the TSM/TDM Alternative. Many corridors in the Valley have already benefited from Metro's Traffic Signal Synchronization Program (TSSP), funded through various Metro Call-for-Projects since its inception in 1995. The only remaining major north-south corridor in the Valley in which TSSP has not been implemented is Garfield Avenue; therefore, TSSP on this corridor is included in the TSM/TDM Alternative.

Table 2-2: Projects in or Near the Study Area Included in the No Build Alternative

RTP ID	Route	From	To	Description
17860*	I-5	Sonora Ave	Allen St	Realign and modify the NB I-5 on- and off-ramps at Western Ave.
18850*	SR 134	Pass Ave	California St	Modify SR 134/Hollywood Way interchange; Add new ramps between Hollywood Way and Alameda.
1178A*	I-405	Route 90	Route 10	Add a HOV lane in both the NB and SB directions.
1C0401	I-710	Ports of Los Angeles and Long Beach	SR 60	Capacity enhancements to widen highway to 5 mixed flow lanes and 2 dedicated lanes for clean technology trucks in each direction; Interchange improvements.
20120K*	I-405	Route 405/101 Connector		Connector Gap Closure.
LA000274*	SR 2	Sepulveda Blvd	Moreno Dr	Construct divided parkway with transit parkway improvements (bike lanes and SR 2/I-405 interchange).
LA000320	Atlantic Blvd	Olympic Blvd	Whittier Blvd	Widen from 4 to 6 lanes to include left turn lanes.
LA000357	I-5	Route 170	Route 118	Add a HOV lane in both the NB and SB directions; Construct I-5/SR 170 HOV to HOV connector.
LA000358	I-5	Route 134	Route 170	Add a HOV lane in both the NB and SB directions; Add auxiliary lanes in both the NB and SB directions between Burbank Blvd and Empire Ave; Add auxiliary lane(s) in between Alameda and Olive; Construct modified interchange at I-5 Empire Ave.
LA000359*	I-10	Baldwin Ave	Route 605	Add a HOV lane in both the EB and WB directions.
LA000548	I-10	Puente Ave	Citrus St	Add a HOV lane in both the EB and WB directions.
LA01342	I-10	Route 605	Puente Ave	Add a HOV lane in both the EB and WB directions.
LA01344	I-5	Route 118	Route 14	Add a HOV lane in both the NB and SB directions.
LA0B7234	Overland Bridge	National Blvd / I-10 WB Ramps	National Blvd / National Pl	Widen the west side of Overland Ave Bridge over I-10; Add one lane in both the NB and SB directions.
LA0B875	I-10	Citrus St	Route 10 / 57 / 210 Interchange	Add a HOV lane in both the EB and WB directions.
LA0C10*	Exposition LRT Phase I	7th St / Metro Center	Culver City	Exposition LRT project (Phase I to Venice-Robertson Station).
LA0C40	Valley Blvd / West Mission Rd	I-710 alignment		Add a frontage road
LA0C8012	I-5	At Western Ave Interchange		Realignment of I-5 NB off- and on-ramps; NB off-ramp would begin as 2 lanes and widen to 4 lanes at Flower St.
LA0C8037	Soto St	Over Mission Rd & Huntington Dr	Radium Dr	Demolish and reconstruct Soto St Bridge; Add SB travel lane; Add bike lane.
LA0C8038	Laurel Canyon Blvd	Sheldon St	Wentworth St	Widen bridge from 4 to 6 lanes and upgrade railings.
LA0C8046	Burbank Blvd	Lankershim Blvd	Cleon Ave	Add a travel lane in both the EB and WB directions.
LA0C8054	Skirball Center Dr	I-405	Mulholland Dr Overpass	Widen roadway and add 1 SB travel lane.

RTP ID	Route	From	To	Description
LA0C8055	Moorpark Ave	Woodman Ave	Murietta Ave	Add travel lane in both the EB and WB directions; Upgrade highway to secondary highway standards.
LA0C8063	Riverside Dr	Barclay St	San Fernando Rd	Widen Riverside Dr bridge from 2 lanes to 4 lanes; Add bike lanes.
LA0C8064	San Fernando Mission Blvd	Sepulveda Blvd	I-5 freeway	Add travel lane in both the EB and WB directions.
LA0C8087	Magnolia Blvd	Cahuenga Blvd	Vineland Ave	Add travel lane in both the EB and WB directions; Upgrade highway to secondary highway standards.
LA0C8098	Santa Monica Blvd	Doheny Dr	Wilshire Blvd	Add travel lane in both the EB and WB directions.
LA0C8344	I-405	Greenleaf St		
LA0D190	Atlantic Blvd	Newmark Ave	Hellman Ave	Add a travel lane in both the NB and SB directions including an acceleration and deceleration lane option modification.
LA0D31	US-101	Van Nuys Blvd		Add one lane for both the NB and SB off-ramps.
LA0D328	I-110 (Harbor Freeway)	12th St	110 / I-10 connector	Add a auxiliary lane in both the NB and SB directions and modify ramps; Convert existing SB auxiliary lane to optional lane; Add storage lane on mainline and reconstruct ramps from 12th St to north end of 7th St.
LA0D441	Valley Blvd	I-605		Reconfigure Valley Blvd ramps to add 1 lane to all ramps.
LA0D442	Peck Rd	I-605		Widen existing bridge to 4 lanes (2 in each direction)
LA0D77	I-405 / US-101 Interchange	SB I-405	NB and SB US-101	Construct freeway connector from SB I-405 to NB & SB US-101; Add auxiliary lane from Burbank Blvd to NB US-101 connector and reconstruct existing connector.
LA0F021	Exposition LRT Phase II	Venice-Robertson Station	Ocean Ave / Colorado Blvd	Exposition LRT project (Phase II to Santa Monica).
LA0G407	Monterey Rd	Colorado Dr	Glenoaks Blvd	Add two lanes in both the EB and WB directions.
LA195900	I-405	Waterford Ave	Route 10	Add a HOV lane in the NB and SB directions.
LA29202V*	Gold line Eastside Light Rail Transit	Union Station	Atlantic Station	LRT between Union Station in downtown Los Angeles and Atlantic Blvd / Pomona Blvd.
LA29202W	Mid-City Transit Corridor / Wilshire Blvd Bus Rapid Transit-Phase 1	Wilshire Blvd / Valencia Blvd (Excludes City of Beverly Hills)	Wilshire Blvd / Centinela Ave (Excludes City of Beverly Hills)	Corridor improvements and bus rapid transit system from west of I-110 to Santa Monica city limits (excluding City of Beverly Hills).
LA29212XY	Gold line Foothill LRT Extension (Segment 1)	Pasadena	Azusa	Extend Metro Gold Line eastward to Azusa.
LA927107	Fremont Ave	Commonwealth Rd	Valley Blvd	Add SB through lane and right turn lane.
LA960018	Beverly Blvd	Montebello Blvd	West of Rea Dr	Add a lane in both the EB and WB directions.
LA960021	Peck Rd	Over 605 freeway		Widen bridge and add a lane in both the NB and SB directions.
LA98STIP4	US-101	Los Angeles St	Center St	SB improvements; Eliminate Hewitt St on- and off-ramps and Vignes off-ramp; Construct new on-ramp at Garey St.
LA990356	Mission Rd	1st St	East City Limits	Reconstruct and widen roadway to add 3 lanes in both the EB and WB directions.
LA996090	At Mission St & Meridian Ave			Construct 142 park-and-ride spaces.
LA996137*	SR 60	Route 605	Brea Canyon Rd	Add a HOV lane in both the EB and WB directions.

RTP ID	Route	From	To	Description
LA996415	Upper 2nd St	Grand Ave	Olive St	Construct a roadway with 1 lane in both the EB and WB directions between Grand Ave and Olive St.
LA996425	Sepulveda Blvd	Mulholland Tunnel	Wilshire Blvd	Add a center-reversible lane; Add bike lane; Intersection improvements
LAE0039	Myrtle Ave	Pomona Ave	Railroad crossing	Transit village project will provide satellite parking for Sierra Madre Villa Gold Line station, 246 parking spaces with bus connections to Metro line 270, foothill 494 and future gold line station stop
LAE1904	Azusa Ave / San Gabriel Ave	Azusa Ave	San Gabriel Ave	No new lanes will be added, change direction with a striped median.
LAE2299	Haskell Ave	Chase St	Roscoe Blvd	Add travel lane the NB and SB directions.
LAE2515	Bundy Dr	Wilshire Blvd	Santa Monica Blvd	Add travel lane the NB and SB directions.
LAE2517	Maine Ave	Ramona Blvd	Bogart Ave	Add 1 through travel lane.
LAE3018	Valley Blvd	I-710	Marguerita Ave	Add travel lane in both the EB and WB directions.
LAE3805	Robertson Blvd / National Blvd	I-10		Planning, design, and preliminary engineering of on/off-ramp system.
LAF1136	Grandview Ave	Air Way	San Fernando Rd	Widen roadway and add 1 EB lane.
LAF1455	Cross-town Transit Connector			Route from North Hollywood Red Line station to downtown Burbank Metrolink station;
LAOB422	Fair Oaks Ave	At 110 Freeway Interchange	Columbia	Widen SR 110 EB off-ramp and add 1 lane; Construct hook ramp from WB traffic entering freeway.
1TR1004	Gold Line Eastside Transit Corridor (Phase 2)	Pomona / Atlantic Station	Mar Vista in Whittier	Extend the Metro Gold Line from Atlantic Station eastward to Whittier.
1TR0404	Regional Connector	Alameda / 1st St	7th St / Metro Center	Construct 1.9-mile light rail in tunnel allowing through movements of Metro light rail trains (Blue, Gold, Expo Lines)
UT101	Westside Subway Extension (Segment 1)	Wilshire / Western Station	Fairfax Ave / Wilshire Blvd	Purple Line subway extension from Wilshire / Western to Fairfax Ave.
LA0D198	Crenshaw / LAX Transit Corridor	Exposition Crenshaw Station	Metro Green Line	Assume LRT until Metro Board adopts a preferred alternative.

Notes: EB = eastbound; WB = westbound; NB = northbound; SB = southbound; HOV = high occupancy vehicle
* Project has completed construction by 2012

Figure 2-6: Projects In or Near the Study Area Included in the No Build Alternative

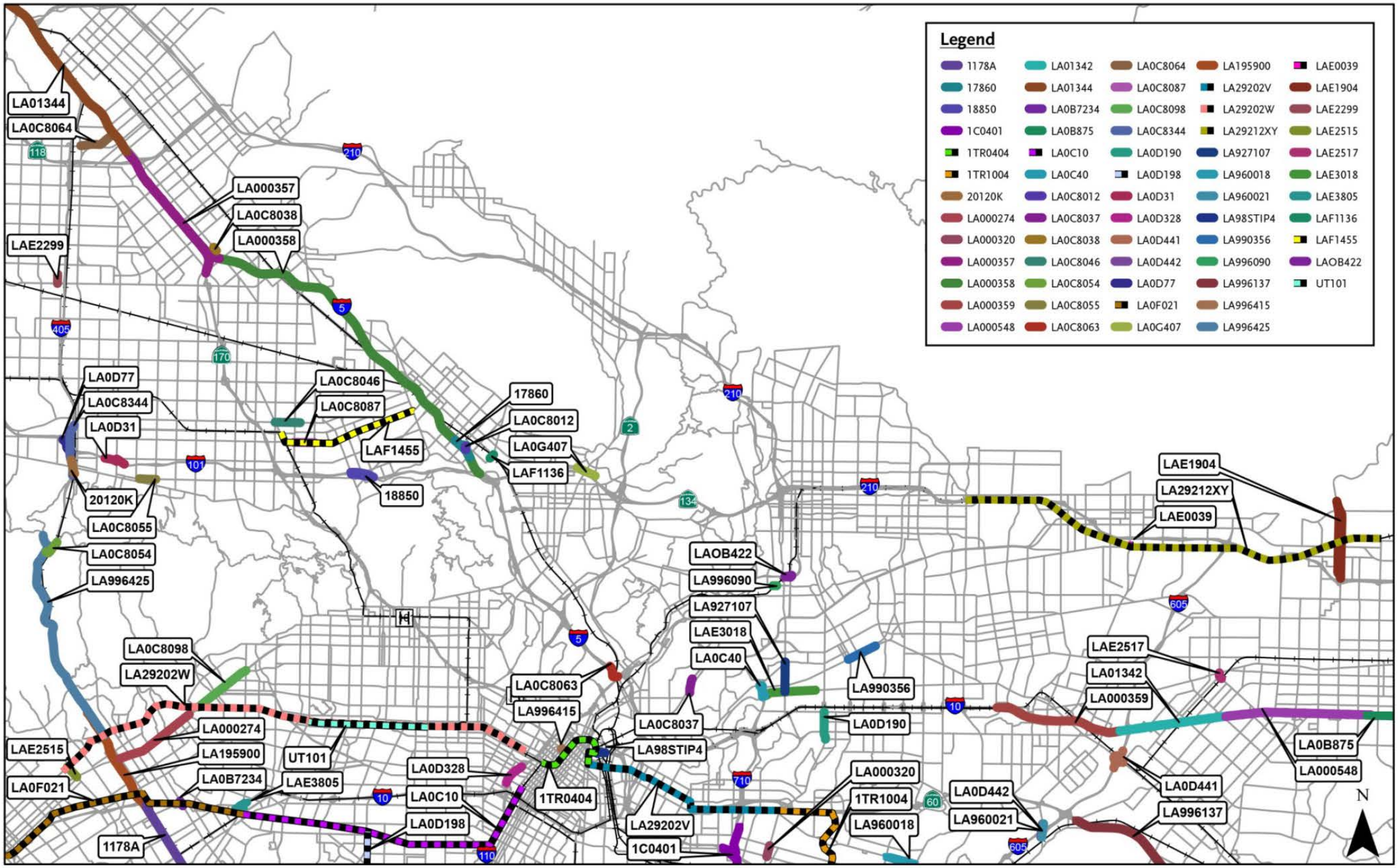


Table 2-3: TSM/TDM Alternative Elements

	Description	Location
ITS Improvements		
ITS-1	Transit Signal Priority	Rosemead Blvd (from Foothill Blvd to Del Amo Blvd)
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 Changeable Message Signs	At key locations in study area
ITS-6	Traffic signal synchronization on Garfield Ave	Huntington Dr to I-10
ITS-7	Signal optimization on Del Mar Ave	Huntington Dr to I-10
ITS-8	Signal optimization on Rosemead Blvd	Foothill Blvd to I-10
ITS-9	Signal optimization on Temple City Blvd	Duarte Rd to I-10
ITS-10	Signal optimization on Santa Anita Ave	Foothill Blvd to I-10
ITS-11	Signal optimization on Peck Rd	Live Oak Ave to I-10
Intersection Hot Spot Improvements		
I-1	Remove left turn movement from Colorado to Lockhaven Ave	Broadway/Colorado Blvd
I-2	Add a left turn lane west of Eagle Rock Blvd, remove parking on the north side of the intersection and along both sides of Eagle Rock Blvd and Ellenwood Dr/York Hill Pl, expand York to two lanes in each direction, add a north to east right turn lane (requiring an additional lane on York Blvd and Eagle Rock Blvd), widen York Blvd east approach to the intersection	Eagle Rock Blvd/York Blvd
I-3	Add a dedicated northbound right turn lane on Eastern Ave and potential dual left turn lanes on northbound Eastern Ave	Eastern Ave/Huntington Dr
I-4 & I-5	Add a dedicated right turn lane and eastbound Valley Blvd to southbound on-ramp, add an eastbound travel lane to Westmont, add an eastbound to southbound right turn lane at Westmont, add a southbound lane for on-ramp, and add a northbound right turn lane for off-ramp	SR 710 Southbound On-Ramp/Valley Blvd
I-6	Widen South Pasadena Avenue to a minimum of four traffic lanes and realign Fremont Ave on a curved alignment to connect to the South Pasadena and Columbia St intersection	Fremont Ave/Columbia Ave/Pasadena Ave
I-7	Optimize signal timing and implement adaptive traffic signal control	Fair Oaks Ave/Mission St
I-8	Add southbound to westbound right turn lane, sidewalk, plus right-of-way; add westbound to northbound right turn lane with signal and parkway modifications; and restripe to fit improvements	Fair Oaks Ave/Monterey Rd
I-9	Add eastbound to southbound right turn lane, sidewalk, plus right-of-way	Fremont Ave/Monterey Rd
I-10	Remove median portion to add third southbound left turn lane on Fair Oaks Avenue at Huntington Drive	Huntington Dr/Fair Oaks Ave

	Description	Location
I-11	Convert northbound and southbound right turn lanes to through-right lanes, widen southbound departure lane at southwest quadrant, and restripe to add westbound left turn lane	Fremont Ave/Huntington Dr
I-12	Add a second southbound through lane, add a third northbound through lane, and extend green time for eastbound left turn lane	Fremont Ave/Valley Blvd
I-13	Close Garfield Ave between Atlantic Blvd and Huntington Dr	Garfield Ave/Huntington Dr
I-14	Realign Garfield Avenue between Atlantic Blvd and Huntington Dr	Garfield Ave
I-15	On Atlantic Blvd: provide one northbound through lane, one northbound through-right lane, two westbound right turn lanes, one southbound left turn lane and two southbound through lanes at realigned Garfield Ave. At Huntington Drive: prevent southbound lanes from Garfield Ave across Huntington Dr by adding raised median island, convert southbound lanes to right turn lanes on Garfield Ave, add a second eastbound left turn lane on Huntington Dr at Los Robles Ave, widen to add southbound right turn lane on Los Robles Ave, add eastbound right lane with pork chop island on Huntington Dr at Atlantic Blvd.	Atlantic Blvd/Garfield Ave
I-16	Widen to provide one southbound through-right and one northbound right turn lane, and extend westbound left turn lane storage by 100 feet	Garfield Ave/Mission Rd
I-17	Widen to add one southbound through-right lane and extend eastbound right turn lane storage	Garfield Ave/Valley Blvd
I-18	Remove median portion and add second eastbound left turn lane on Huntington Dr and stripe eastbound right turn lane on Huntington Dr	San Gabriel Blvd/Huntington Dr
I-19	Widen at the intersection to allow for a right turn lane	San Gabriel Blvd/Mission Rd
I-20	Strip an additional lane in each direction to provide for 6 lanes of traffic, add eastbound to southbound right turn lane, sidewalk, signal, plus right-of-way; add westbound to northbound right turn lane with sidewalk, signal, plus right-of-way; and restripe lanes to fit improvements	Rosemead Blvd/Mission Rd
Local Street Hot Spot Improvements		
L-1	Additional studies needed to determine needed improvements	Figueroa St from SR 134 to Colorado Blvd
L-2a	Restripe lanes	Fremont Ave from Huntington Dr to Alhambra Rd
L-2b	Remove on-street parking, widen east side of the street, and restripe lanes	Fremont Ave from Poplar Blvd to Commonwealth Ave
L-2c	Remove raised median, widen west side of the street, and restripe lanes	Fremont Ave from Mission Rd to Valley Blvd
L-3	Remove portion of the raised median, remove left turn lanes, and restripe lanes	Atlantic Blvd from Glendon Wy to I-10
L-4	Remove left turn lanes between Valley Blvd and Norwood Pl, remove on-street parking and left turn pockets between Norwood Pl and Glendon Way, and restripe lanes along entire segment	Garfield Ave from Valley Blvd to Glendon Wy
L-5	Stripe an additional lane in each direction to	Rosemead Blvd from Lower Azusa Rd to Marshall St

	Description	Location
	provide for 6 lanes of traffic	
Bus Service Improvements		
Bus-1	Additional bus service	See Figure 2-9
Bus-2	Bus stop enhancements	Along TSM routes
Bicycle Facility Improvements		
Bike-1	Rosemead Blvd bike lanes (Class II/III)	Colorado Blvd to Valley Blvd (through County, Temple City, Rosemead)
Bike-2	Del Mar Ave bike lanes (Class II/III)	Huntington Dr to Valley Blvd (through San Marino, San Gabriel)
Bike-3	Huntington Dr bike lanes (Class II/III)	Mission Rd to Santa Anita Ave (through LA, South Pasadena, San Marino, Alhambra, County, Arcadia)
Bike-4	Foothill Blvd bike lanes (Class II/III)	In La Canada Flintridge
Bike-5	Orange Grove bike route (Class III)	Walnut St to Columbia St (in Pasadena)
Bike-6	California Blvd bike route (Class III)	Grand Ave to Marengo Ave (in Pasadena)
Bike-7	Add bike parking at transit stations	Gold Line stations
Bike-8	Improve bicycle detection at existing intersections	Along bike routes in study area

In addition, many of the early corridors that were implemented could benefit from an update to their signal timing due to changes in traffic volumes and patterns since implementation. Therefore, the TSM/TDM Alternative includes signal optimization on corridors along Del Mar Avenue, Rosemead Boulevard, Temple City Boulevard, Santa Anita Avenue, and Peck Road. Beyond TSSP, implementation of Transit Signal Priority (TSP) is included on Rosemead Boulevard to support the proposed expanded Metro Rapid Bus service in the TSM Alternative.

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 arterial changeable message signs (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 systems 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.

Intersection Hot Spot Improvements. As discussed in Chapter 1: Need and Purpose, there are many congested intersections within the study area during peak periods. The TSM/TDM Alternative includes intersection improvements at twenty intersections that were identified based on forecast 2035 average daily traffic (ADT) volumes using SCAG's 2008 RTP travel demand model. Intersections with the highest ADT relative to the total lanes on all roadway approaches were selected for inclusion in the TSM/TDM Alternative. These intersections are shown in Figure 2-8.

Because the TSM/TDM Alternative is intended to be a low cost/low impact alternative, intersection improvements generally consist of adding critical lanes to increase capacity while avoiding right-of-way acquisition as much as possible, and relying on lane additions via removal of on-street parking, median islands and left turn lanes as first measures. If such measures are not available, then limited

Figure 2-7: TSM/TDM Alternative – ITS Improvements

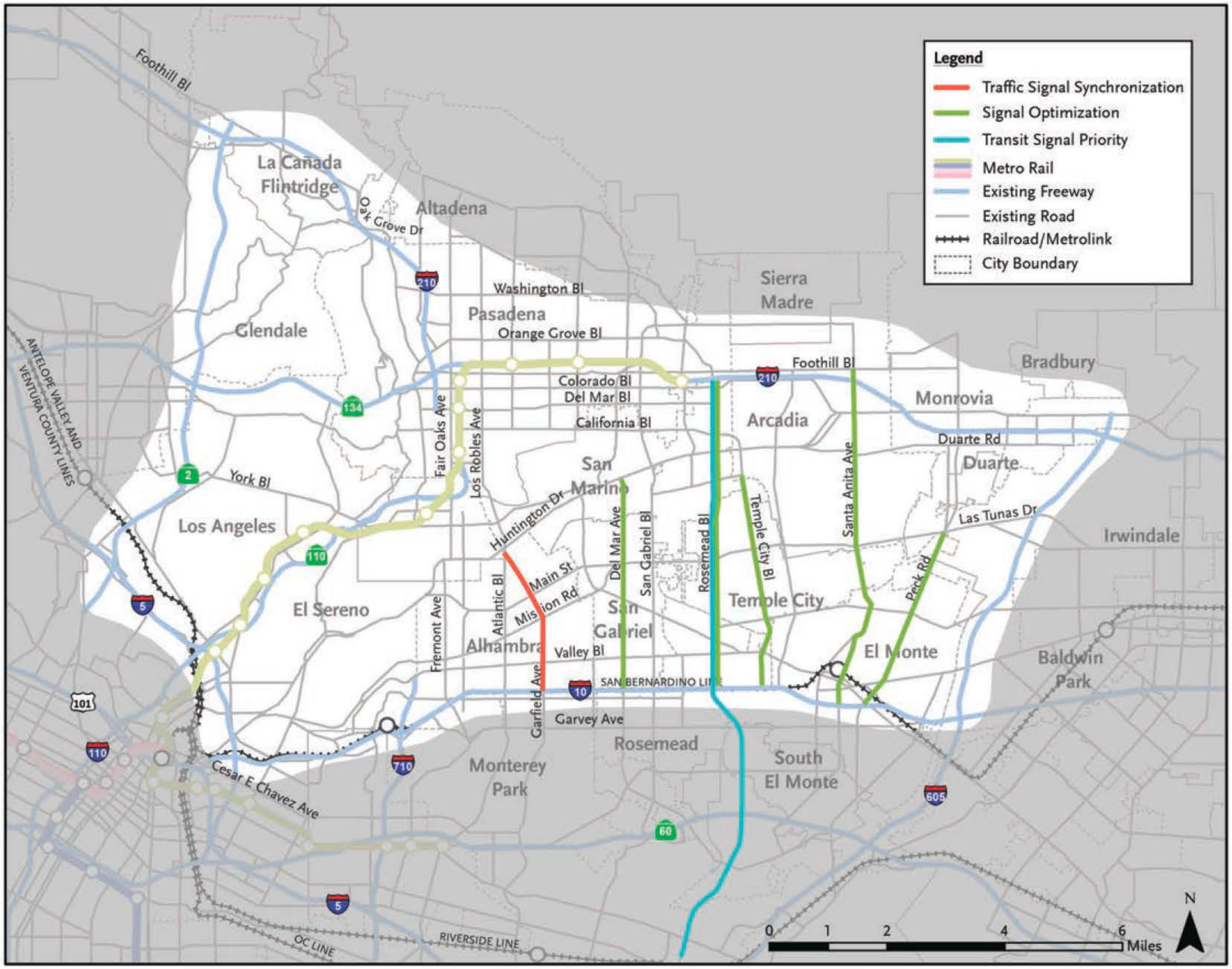
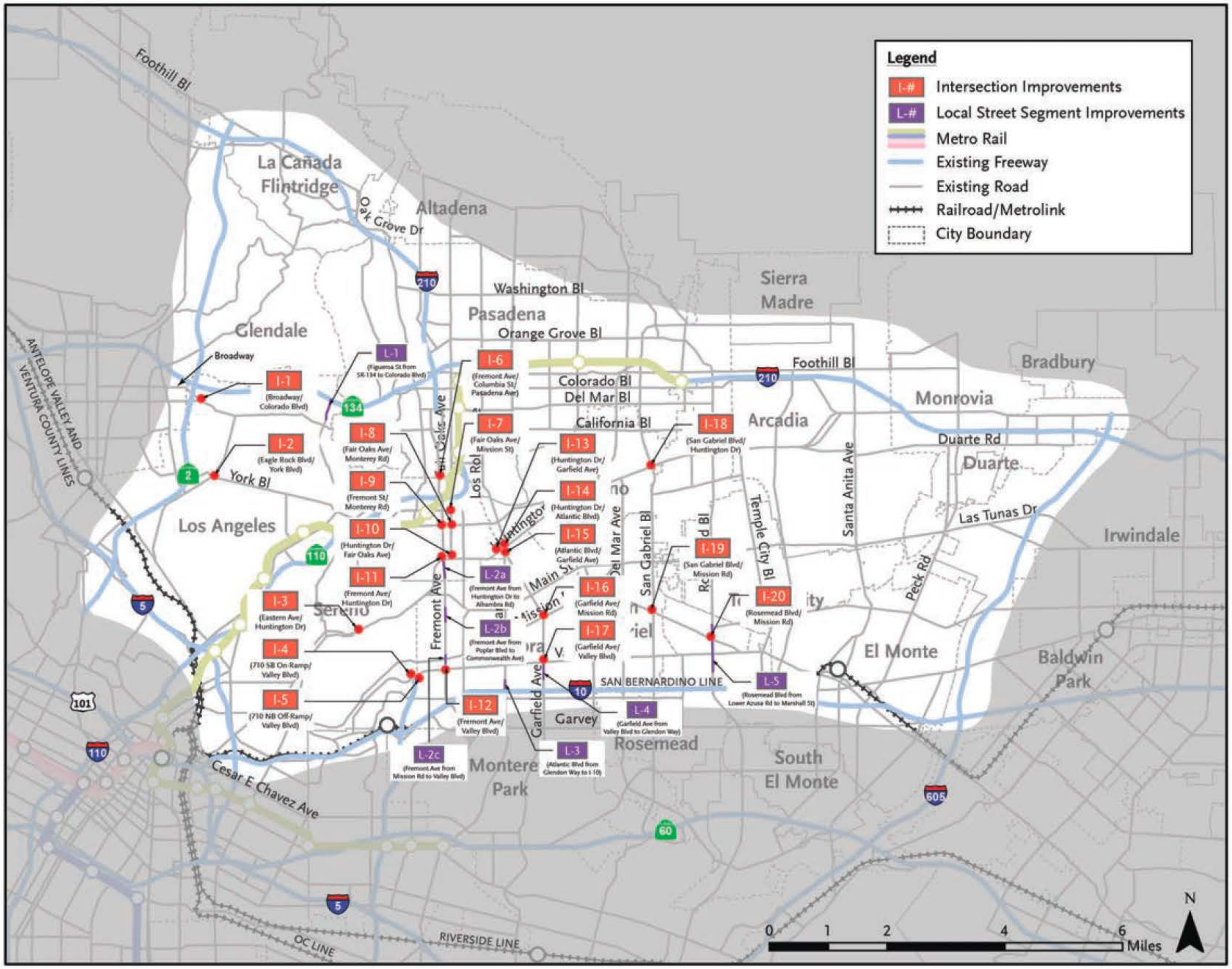


Figure 2-8: TSM/TDM Alternative – Intersection and Local Street Improvements



right-of-way acquisition has been identified to improve capacity at critical locations while minimizing acquisition impacts.

Local Street Improvements. A similar procedure to identifying hot spot improvement locations was used to identify roadway segment improvements locations for inclusion in the TSM/TDM Alternative. Congested segments were identified along major north-south arterials based on 2035 ADT volumes in the study area in comparison to the number of available lanes. Segments were ranked based upon ADT volumes per lane, and the ranking resulted in seven local street segments being identified as having the greatest need of capacity improvements. The segments included in the TSM/TDM Alternative are shown in Figure 2-8.

To the extent possible, the roadway improvements included in the TSM/TDM Alternative rely on using the available width of existing parking lanes, median islands, left turn lanes or surplus width built into the existing cross section, without widening the street. In some locations, widening of the street is required.

2.6.2.2 Travel Demand Management (TDM) Elements

Most TDM programs are implemented at the municipal level through the project development review and approval process. Metro does not have the authority to impose limits on project trip generation or alter municipality parking policies. Therefore, the TDM portion of the TSM/TDM Alternative focuses on expanded bus service and bicycle improvements.

Expanded Bus Service. The transit service improvements included in the TSM/TDM Alternative are illustrated in Figure 2-9. Consistent with federal guidelines for the evaluation of transit projects, these transit improvements are also included in the BRT and LRT alternatives; they are not included in the freeway and highway alternatives. The bus service improvements included in the TSM/TDM Alternative were developed using the Metro travel demand model to identify service improvements that could be implemented at reasonable productivity (passenger loads per vehicle). Some bus enhancements as much as double existing bus service. In addition, one new Metro Rapid service on Rosemead Boulevard is proposed.

No increase to existing LRT service is included in the TSM/TDM Alternative. The study area is currently served by the Metro Gold Line. Other Metro projects are studying alternatives for extending the Gold Line, and Metro plans ultimately to increase service to 5-minute frequency during peak hours. These improvements are included in the No Build Alternative. When combined with other Metro rail services, these improvements will result in LRT frequencies of 2.5 minutes during peak hours in the downtown Regional Connector, which is the capacity of that facility. Therefore, it is not feasible to increase Gold Line service beyond the improvements included in the No Build Alternative.

Bicycle Improvements. Bicycle improvements included in the TSM/TDM Alternative were developed by reviewing bicycle plans for Los Angeles County and for cities in the study area to determine bicycle facility improvements already identified by the jurisdictions of the study area, whether funded or not. The review focused on facilities that were at least in part Class I (off-street facility) or Class II (striped bicycle lanes). Consistent with the Need and Purpose of the project, proposed facilities included in the TSM/TDM Alternative were sought that serve north-south travel between employment and commercial areas, not exclusively recreational travel. Proposed facilities that improve access to transit stations were also identified. Installation of bicycle detection at traffic signals at 20 selected intersections in the study area to be identified in coordination with local cities is also included in the TSM/TDM Alternative. Figure 2-10 shows the locations for selected bicycle lane projects in the study area.

Figure 2-9: TSM/TDM Alternative – Expanded Bus Service

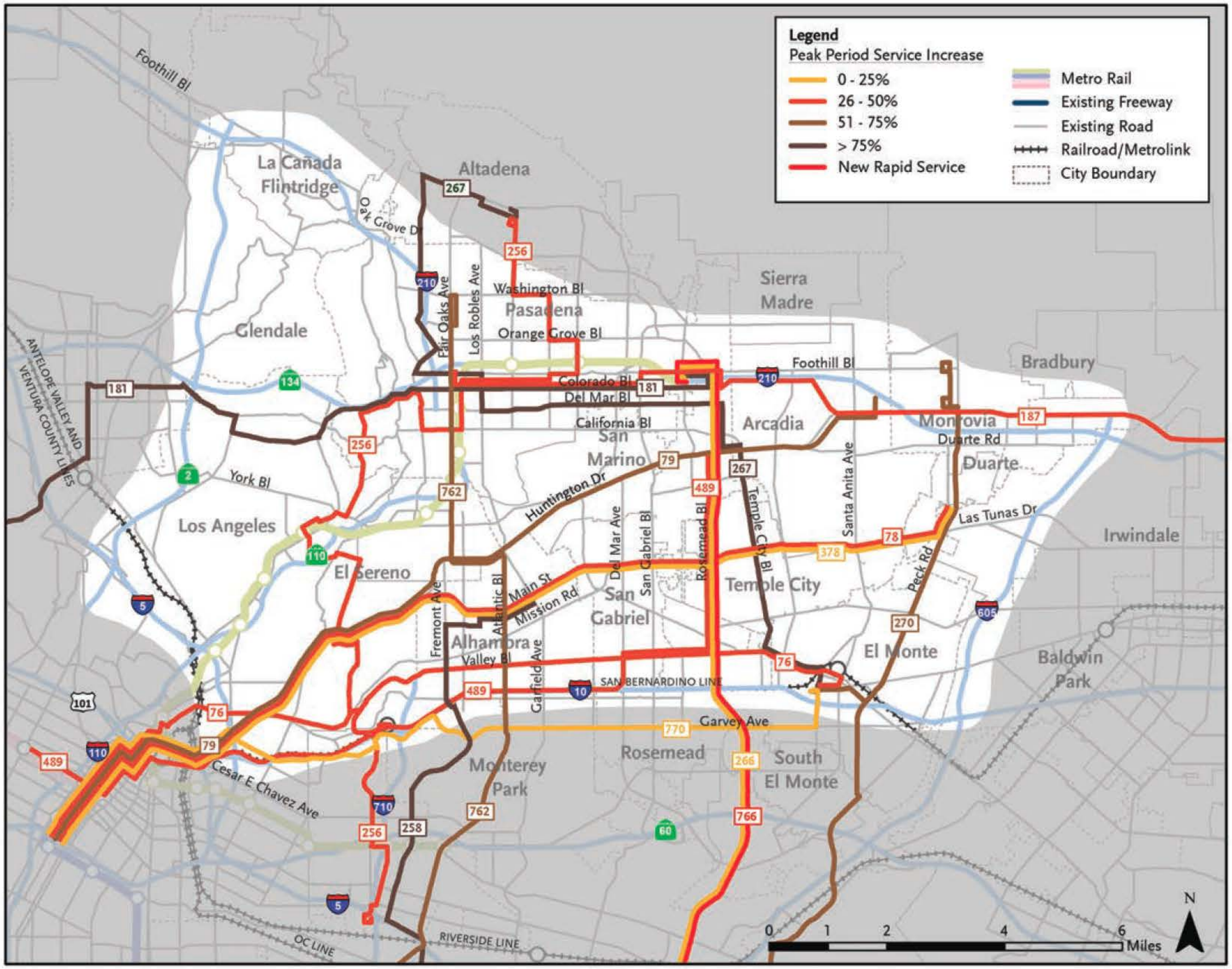
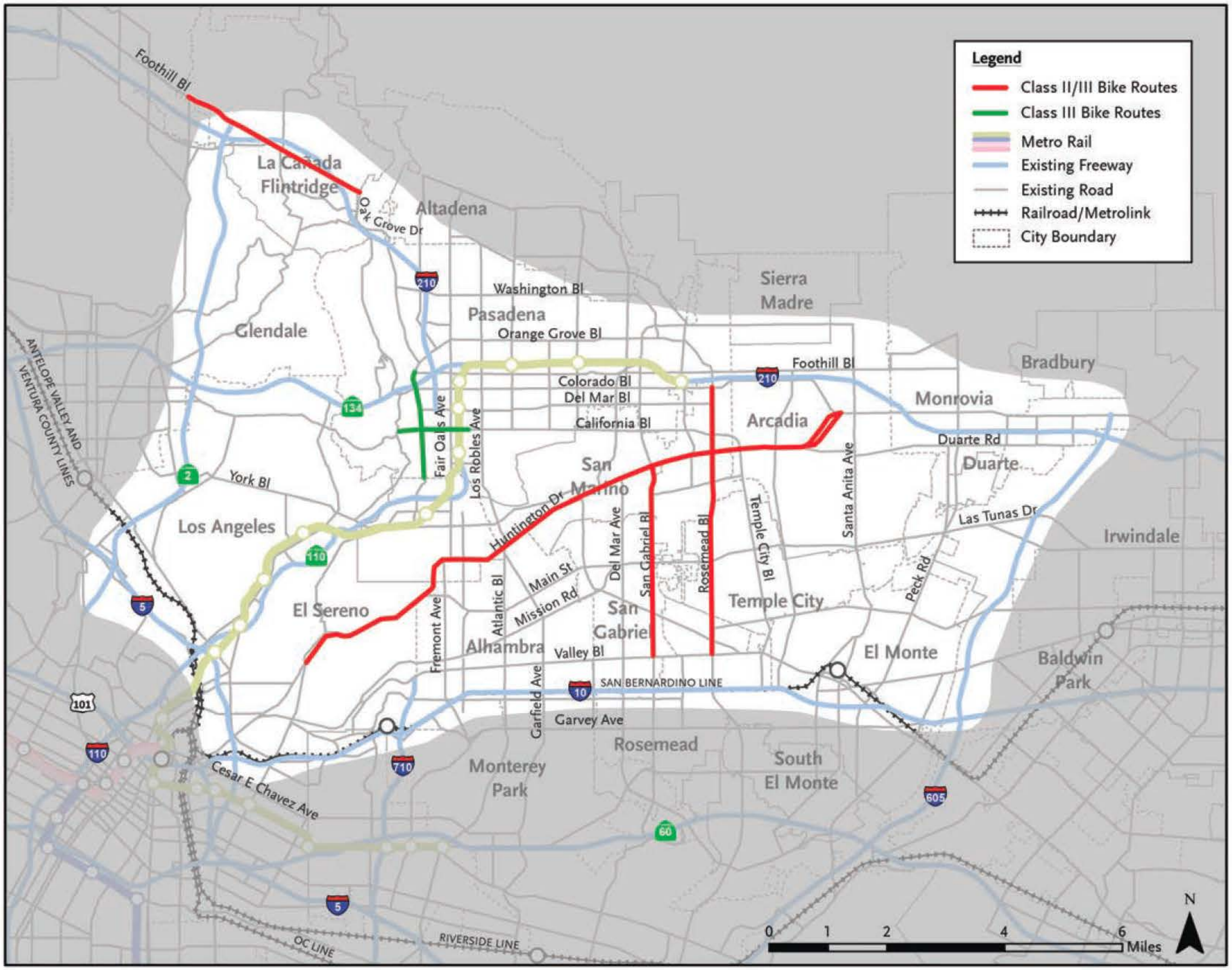


Figure 2-10: TSM/TDM Alternative – Bicycle Improvements



2.6.3 Bus Rapid Transit (BRT) Alternatives

The BRT alternatives would provide higher speed, high frequency bus service operating in a combination of new, dedicated bus lanes and existing, mixed-flow traffic lanes. Bus priority methods such as synchronized traffic signal timing and preferential treatment of bus arrivals at signalized intersections would also be incorporated into the BRT system. The BRT alternatives also include all of the additional transit service provided in the TSM/TDM alternative, except where those services overlap with the BRT service itself. Where feasible, BRT vehicles would operate in exclusive lanes, generally in existing right-of-way through restriping the roadway, prohibiting on-street parking, and narrowing medians, planted parkways, and sidewalks. During peak hours, buses would operate every 10 minutes. During off-peak hours, buses would operate every 20 minutes. Preliminary operating plans for the BRT alternatives are included in Appendix D.

2.6.3.1 Alternative BRT-1

Alternative BRT-1 would provide BRT service between Patsaouras Transit Plaza at Los Angeles Union Station and the Jet Propulsion Laboratory (JPL) in La Cañada Flintridge, a routing not currently served by Metro. BRT vehicles would travel along Mission Road and Huntington Drive to Fair Oaks Avenue in South Pasadena. They would then travel on Fair Oaks Avenue through South Pasadena and Pasadena, turning onto Woodbury Road and following Woodbury Road and Oak Grove Drive to JPL. The length of the improvements for Alternative BRT-1 would be 13.9 miles. Figure 2-11 illustrates the alignment of Alternative BRT-1.

Alternative BRT-1 would operate in exclusive bus lanes and mixed-flow lanes, as illustrated in Figure 2-11. The exclusive lanes would generally be adjacent to the curb. Other Metro routes that share part of the alignment would also be able to use these lanes.

The exclusive lanes would be created generally in existing right-of-way through a variety of methods, including restriping the roadway, prohibiting on-street parking, and narrowing medians, planted parkways, and sidewalks. Property acquisition for right-of-way would be required in a limited number of locations. In other areas, exclusive lanes could not be provided without substantial right-of-way acquisition. In these areas, the buses would share existing lanes with other traffic. Figure 2-12 illustrates the proposed roadway cross-sections at three typical locations for the BRT alternatives.

Alternative BRT-1 includes all of the additional transit service provided in the TSM alternative, with the following exceptions:

- Route 378 would be truncated on the west at Huntington Drive/Main Street to avoid duplicating the service provided by Alternative BRT-1.
- Headways of Route 78 would not be increased over the No Build Alternative.

Alternative BRT-1 bus stops would be placed at approximately ½ mile intervals, at major activity centers and cross streets, as shown on Figure 2-11.

Figure 2-11: Alternative BRT-1

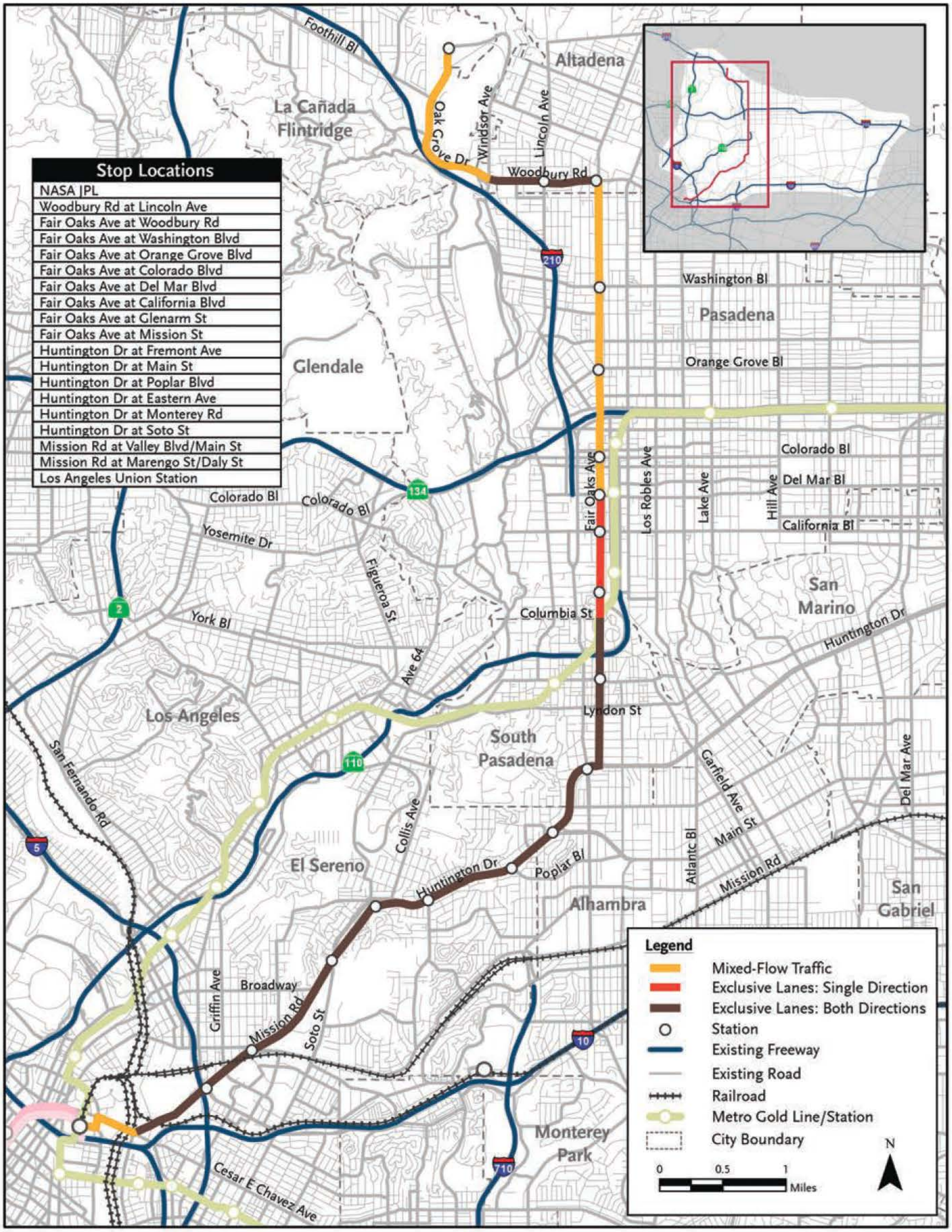
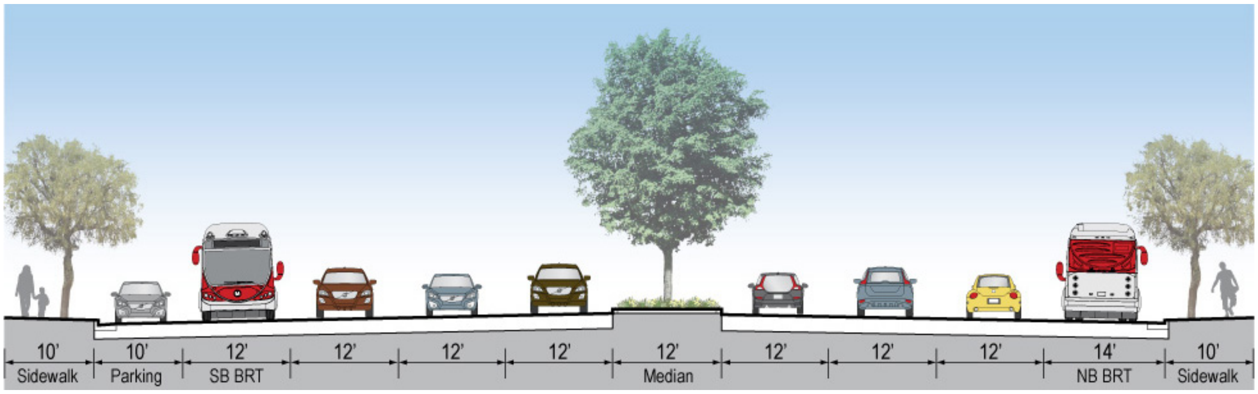
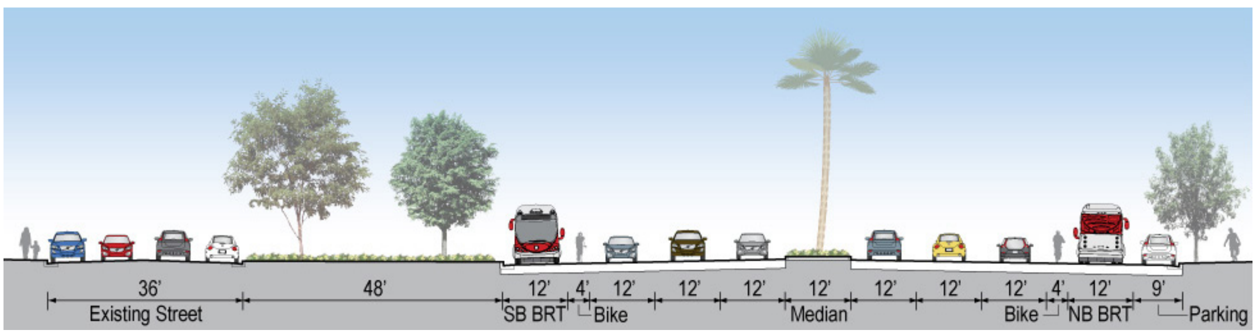


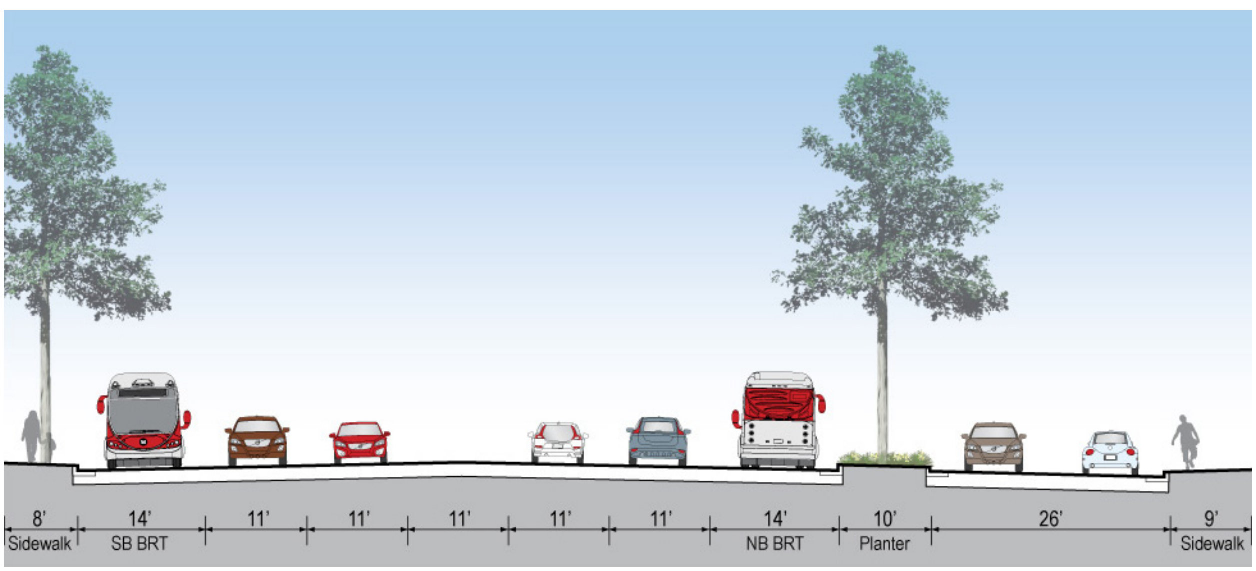
Figure 2-12: BRT Alternatives Typical Cross Sections



Alternative BRT-1/6/6A: Fair Oaks Avenue near Lyndon Street



Alternative BRT-1: Huntington Drive near Poplar Street



Alternative BRT-6: Atlantic Boulevard near Brightwood Street

2.6.3.2 Alternative BRT-6

Alternative BRT-6 would provide BRT service between Atlantic Boulevard at Whittier Boulevard and Pasadena City College (PCC) and the California Institute of Technology (Caltech) in Pasadena. BRT vehicles would travel along Atlantic Boulevard to Huntington Drive, then travel briefly west along Huntington Drive to Fair Oaks Avenue, before traveling north along Fair Oaks Avenue into Pasadena. In Pasadena, the BRT vehicles would travel along Colorado Boulevard, making a loop to PCC and Caltech via Hill Avenue, California Boulevard, and Lake Avenue. The total length of the route would be 13.8 miles. Figure 2-13 illustrates the alignment of Alternative BRT-6.

Alternative BRT-6 would operate in exclusive bus lanes and mixed-flow lanes, as illustrated in Figure 2-13. The exclusive lanes would generally be adjacent to the curb. Other Metro routes that share part of the alignment would also be able to use these lanes.

The exclusive lanes would be created generally in existing right-of-way through a variety of methods, including restriping the roadway, prohibiting on-street parking, and narrowing medians, planted parkways, and sidewalks. No property acquisition would be required for Alternative BRT-6. In some areas, exclusive lanes could not be provided without substantial right-of-way acquisition. In these areas, the buses would share existing lanes with other traffic.

Bus stops would be placed at approximately ½ mile intervals, at major activity centers and cross streets, as shown on Figure 2-13.

Alternative BRT-6 includes all of the additional transit service provided in the TSM/TDM Alternative, with the following exceptions:

- Route 762 would operate as Alternative BRT-6 in the areas where the two routes overlap.
- Route 260 would operate with headways of 10 minutes during peak periods and 20 minutes during off-peak periods.

Alternative BRT-6A is a design variation of Alternative BRT-6. Alternative BRT-6A is able to provide exclusive bus lanes for a longer part of the route than does Alternative BRT-6. Instead of traveling both eastbound and westbound on Colorado Boulevard, Alternative BRT-6A would travel only eastbound on Colorado Boulevard and return westbound on California Boulevard after stopping at PCC and Caltech. Alternative BRT-6A was developed to address right-of-way constraints on Fair Oaks Avenue north of Glenarm Street in Pasadena. There is sufficient room in this section for an exclusive bus lane in one direction only. By operating in only one direction on Fair Oaks Avenue in this section (and the other on Raymond Avenue), Alternative BRT-6A is able to provide exclusive bus lanes for a longer part of the route than does Alternative BRT-6. The total length of the route would be 14.2 miles. Figure 2-14 illustrates the alignment of Alternative BRT-6A.

Other BRT Alternatives Considered. Two additional variations of Alternative BRT-6 were considered but not ultimately included in the alternative. The first variation would have included an aerial station above the El Monte Busway in the median of I-10 at Atlantic Boulevard. The station would include ramps from the El Monte Busway, allowing it to be served by Alternative BRT-6 vehicles as well as buses operating on the Busway, so that passengers could transfer from a north-south bus to an east-west bus. Construction of the transfer station and the ramps to serve it would have required widening of I-10 for a substantial distance on either side of the station. This widening would require the acquisition and demolition of several dozen residential properties. Therefore, the aerial transfer station was not incorporated in Alternative BRT-6.

Figure 2-13: Alternative BRT-6

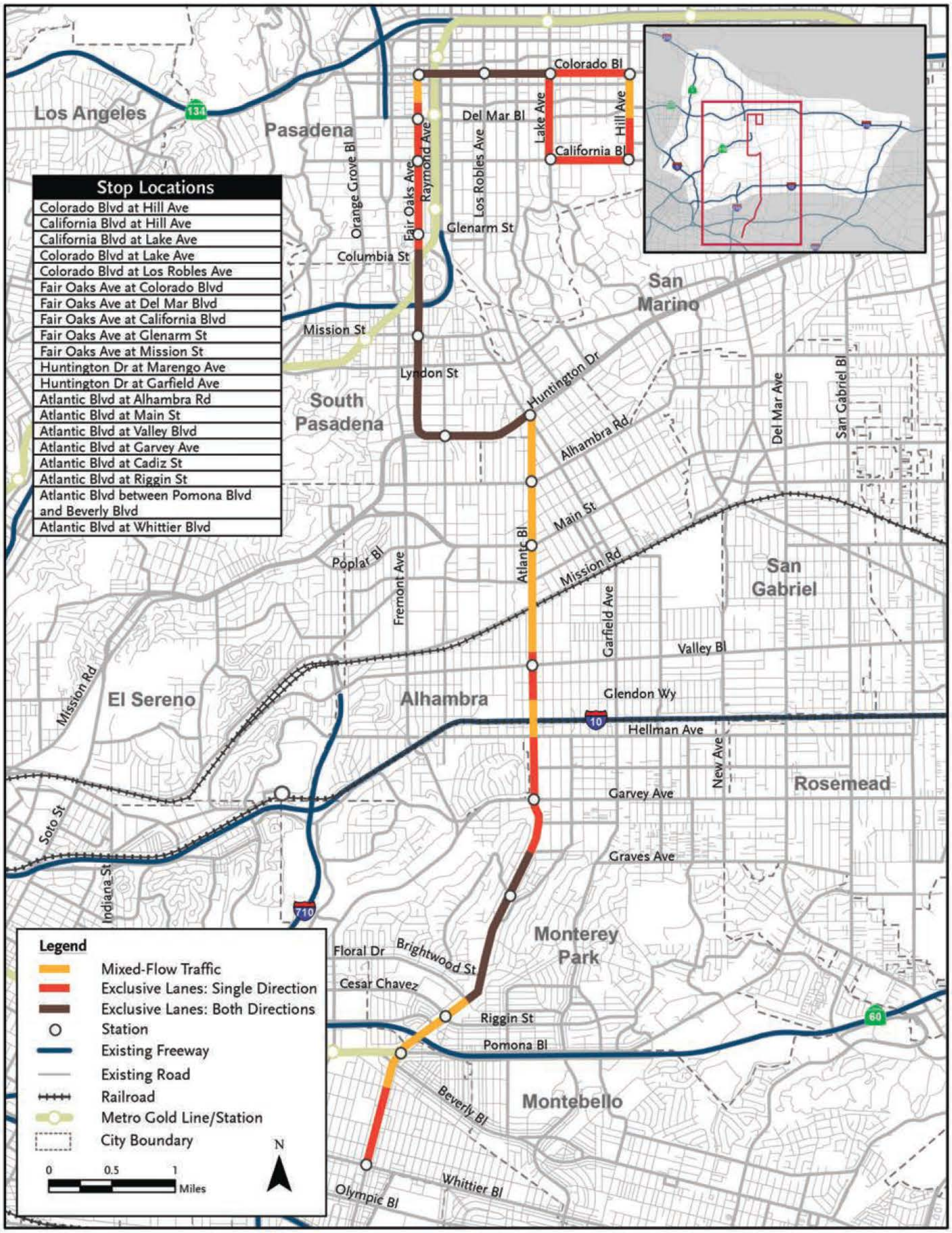
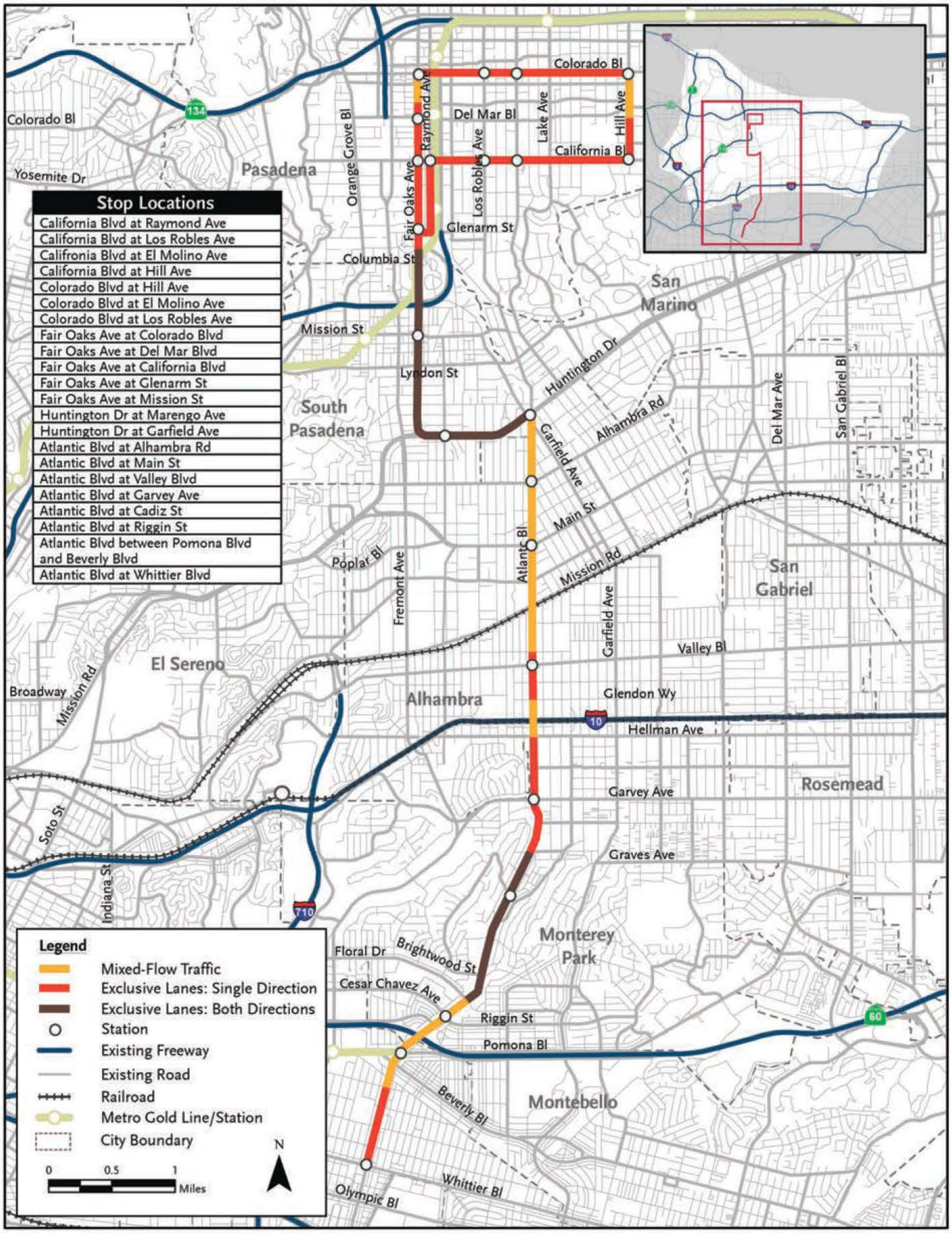


Figure 2-14: Alternative BRT-6A



2.6.3.3 Alternative BRT-6A

A second option was considered that consisted of an aerial flyover for Alternative BRT-6 at I-10. At-grade exclusive lanes cannot be provided on Atlantic Boulevard at this location because of the limited width of the roadway as it passes underneath the freeway. However, the vertical clearance requirement for the potential flyover above the Metrolink tracks in the median of I-10 would have required that the flyover extend north of Glendon Way and south of Hellman Avenue, resulting in a structure nearly half a mile long. Since Alternative BRT-6 does not include a northbound lane in this area and the southbound lane terminates just north of the area at Valley Boulevard, it was concluded that the additional cost and impact of an aerial flyover was not justified by the minimal potential benefit.

2.6.4 Light Rail Transit (LRT) Alternatives

The LRT alternatives would be similar to the Metro Gold Line and Metro Blue Line currently operated by Metro in Los Angeles County. LRT systems typically operate in dedicated rights-of-way; although they can operate in mixed-flow conditions with automobiles, only operations in dedicated rights-of-way are included in the alternatives in this study. LRT systems are often constructed at-grade, but they can be built in aerial or underground configurations where necessary. They are electrically powered through an overhead catenary system powered by traction power substations at approximately 1.5 mile spacing. In dedicated right-of-way, Metro LRT vehicles can operate at speeds of up to 55 mph. The LRT alternatives include all of the additional transit service provided in the TSM/TDM Alternative, except where those services overlap with the LRT service itself. Trains would operate every five minutes during peak hours and every ten minutes during off-peak hours. Figure 2-15 illustrates typical roadway cross-sections for each of the LRT alternatives. Preliminary operating plans for the LRT alternatives are included in Appendix E.

2.6.4.1 Alternative LRT-4A

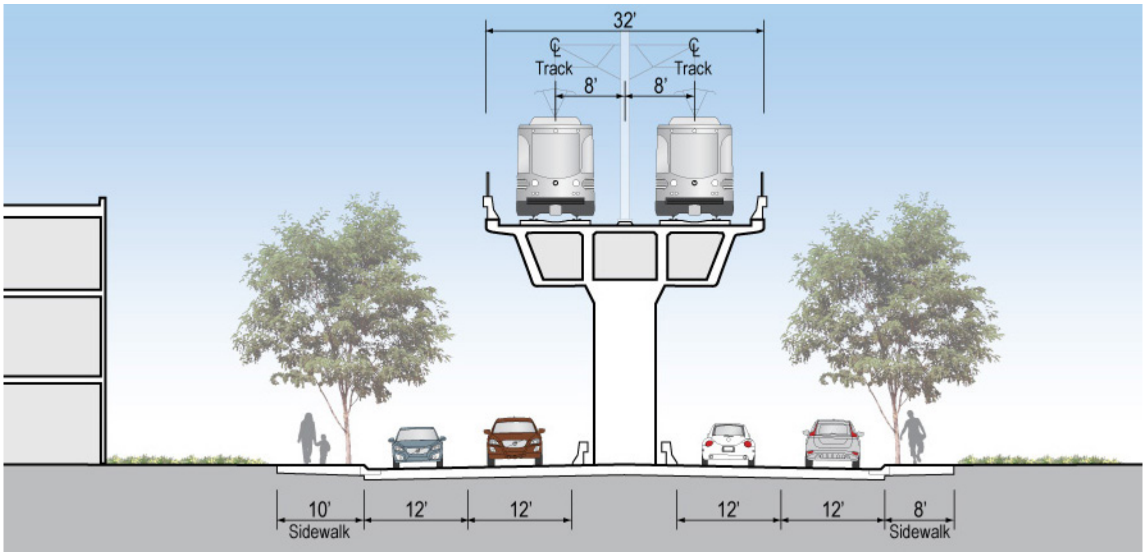
Alternative LRT-4A would begin at an aerial station on Mednik Avenue adjacent to the existing East LA Civic Center Station on the Metro Gold Line. From there, the line would run north on Mednik Avenue on an elevated structure, then turn west on Floral Drive, then turn north across Corporate Center Drive and enter the I-710 right-of-way. After entering the I-710 right-of-way, the alignment would travel north, with a station at California State University, Los Angeles (Cal State LA), providing a transfer location for El Monte Busway and Metrolink service. Continuing north of Cal State LA, the alignment would enter a bored tunnel between Valley Boulevard and Mission Road. The tunnel alignment would travel northeast to Fremont Avenue, with a station near the Los Angeles County office building in Alhambra. The alignment would then run north under Fremont Avenue, shifting slightly east to Fair Oaks Avenue, remaining in a tunnel. Stations would be placed under Fair Oaks Avenue near Huntington Drive and Mission Street. The alignment would continue in a tunnel under SR 110, and continue north to a terminus station near the existing Fillmore Station on the Metro Gold Line.

Figure 2-16 illustrates the alignment and station locations of Alternative LRT-4A; stations would be approximately 1¼ miles apart on average. . The length of Alternative LRT-4A would be approximately 7.6 miles. Park-and-ride facilities would be provided at all stations except for Cal State LA and Fillmore.

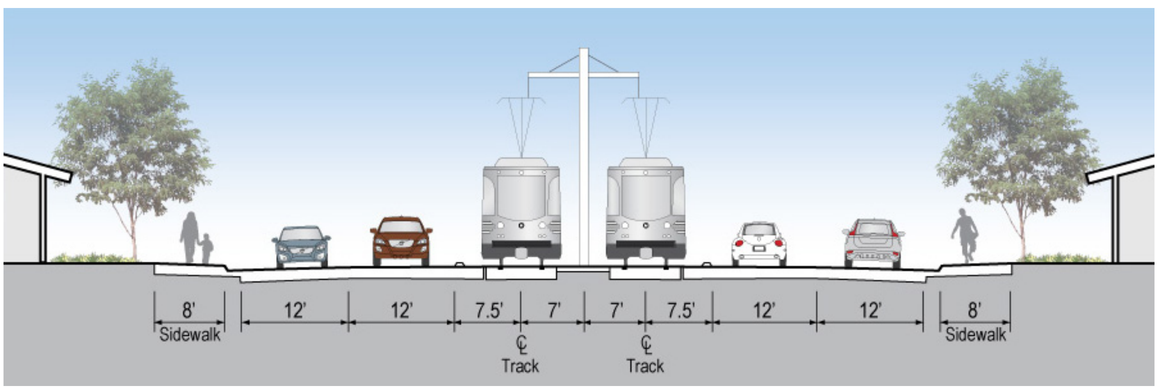
2.6.4.2 Alternative LRT-4B

Alternative LRT-4B was developed as a variation of Alternative LRT-4A to reduce the length of tunneling required. Alternative LRT-4B would also begin at an aerial station on Mednik Avenue

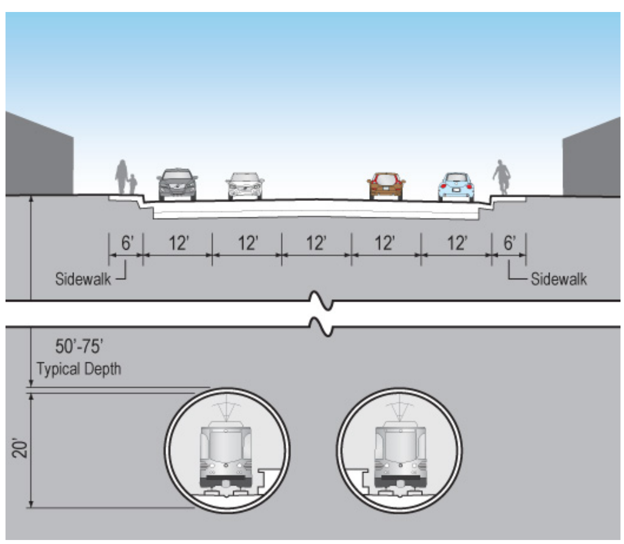
Figure 2-15: LRT Alternatives Typical Cross Sections



Alternatives LRT-4A/B/D: Mednik Avenue north of SR 60

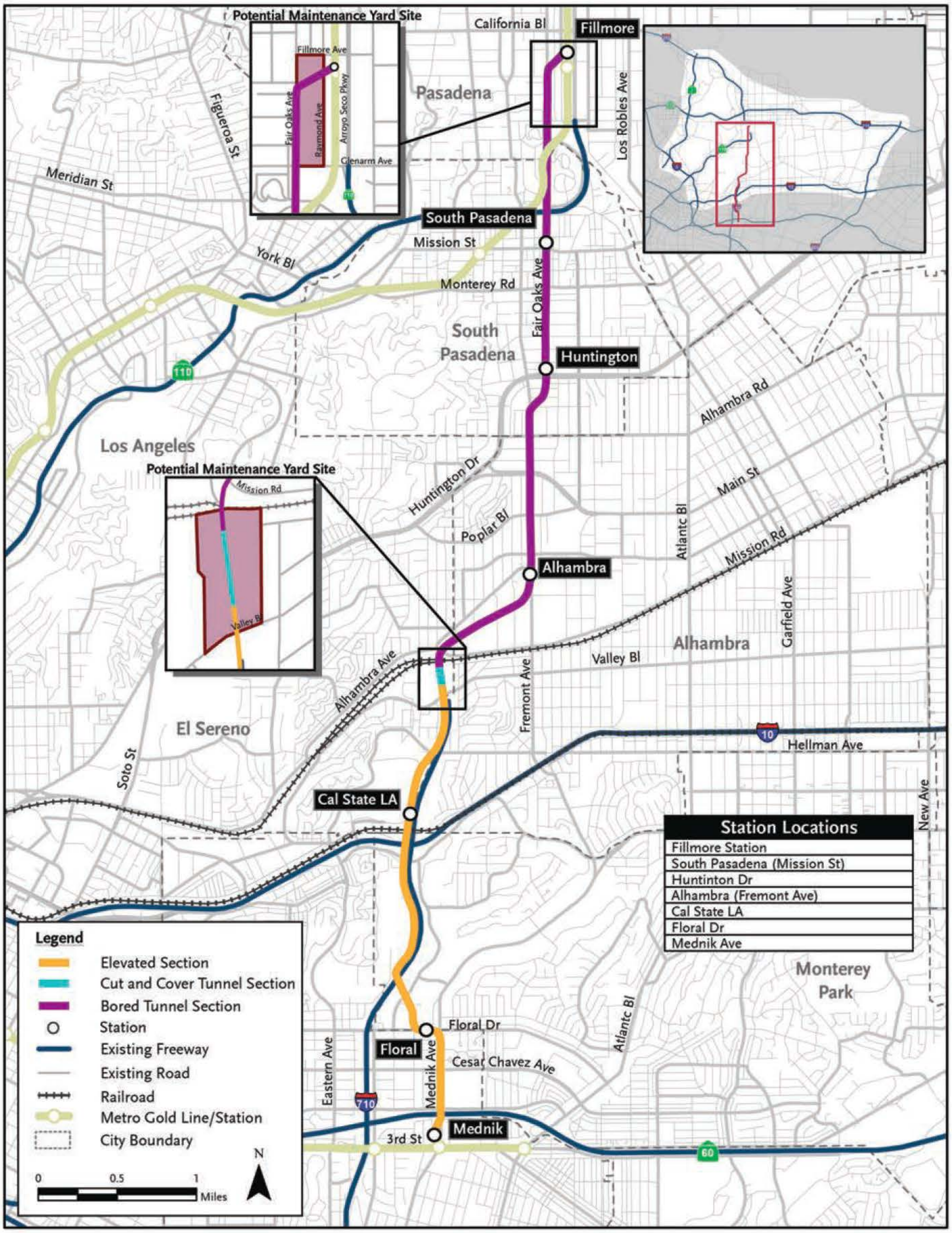


Alternative LRT-6: Atlantic Boulevard near Sevilla Street



Alternatives LRT-4A/B: Fremont Avenue near Huntington Drive

Figure 2-16: Alternative LRT-4A



adjacent to the existing East LA Civic Center Station on the Metro Gold Line and follow the same path as Alternative LRT-4A to the Cal State LA Station. Alternative LRT-4B would deviate from Alternative LRT-4A north of the Cal State LA station. Instead of immediately entering a tunnel, Alternative LRT-4B would continue on an elevated structure above Mission Road, turning north on Palm Avenue. The alignment would descend to grade on Palm Avenue, with an at-grade station near the intersection of Palm Avenue and Orange Street to serve the area around the Los Angeles County Public Works building. Alternative LRT-4B would then enter a bored tunnel before Main Street and continue along an alignment similar to that of Alternative LRT-4A. The length of Alternative LRT-4B would be approximately 8.3 miles. Figure 2-17 illustrates the alignment and station locations of Alternative LRT-4B; stations would be approximately 1¼ miles apart on average. Park-and-ride facilities would be provided at all stations except for Cal State LA and Fillmore.

2.6.4.1 Alternative LRT-4D

Alternative LRT-4D was developed as a variant of Alternative LRT-4A to eliminate the bored tunnel section and use only cut-and-cover tunnel techniques. Alternative LRT-4D would originate at an underground station beneath Beverly Boulevard, near the existing Atlantic Station on the Metro Gold Line. It would continue north underground, transitioning to an elevated structure on First Street. The elevated alignment would then turn north onto Mednik Avenue and follow the same alignment as Alternative LRT-4B to Palm Avenue. North of the Palm Avenue station, Alternative LRT-4D would enter a cut-and-cover tunnel under the Southern California Edison right-of-way adjacent to Raymond Avenue, following that right-of-way to Huntington Drive.

Alternative LRT-4D would continue underground beneath Huntington Drive to Fair Oaks Avenue, then follow generally the same alignment as Alternative LRT-4A and Alternative LRT-4B to the Fillmore Station. Park-and-ride facilities would be provided at all stations except Cal State LA and Fillmore. The length of Alternative LRT-4D would be approximately 8.7 miles. Figure 2-18 illustrates the alignment and station locations of Alternative LRT-4D; stations would be approximately 1¼ miles apart on average. Park-and-ride facilities would be provided at all stations except for Cal State LA and Fillmore.

2.6.4.2 Alternative LRT-6

Alternative LRT-6 would connect the existing Atlantic and Fillmore stations on the Metro Gold Line. Alternative LRT-6 would begin as an aerial station on Atlantic Boulevard near Pomona Boulevard to avoid impacting the SR 60/Atlantic Boulevard interchange. The alignment would run north on Atlantic Boulevard on an elevated structure across SR 60, with another elevated station at Atlantic Square, near East LA College. It would then descend to grade and continue north on Atlantic Boulevard, with stations at Monterey Park Hospital and Garvey Avenue. It would then return to an aerial configuration to cross above I-10, returning to grade prior to reaching stations at Valley Boulevard, Main Street, and Pine Street (Huntington Drive). It would turn west on Huntington Drive and then north along Fair Oaks Avenue, remaining at-grade with a station near Mission Street. After crossing SR 110, Alternative LRT-6 would again become elevated, turning eastbound onto Fillmore Street, with a new, elevated station above the existing Fillmore Station on the Metro Gold Line. The length of Alternative LRT-6 would be approximately 8.3 miles. Figure 2-19 illustrates the alignment and station locations of Alternative LRT-6. Park-and-ride facilities would be provided at all stations except Pomona Boulevard and Fillmore Street for Alternative LRT-6.

Figure 2-17: Alternative LRT-4B

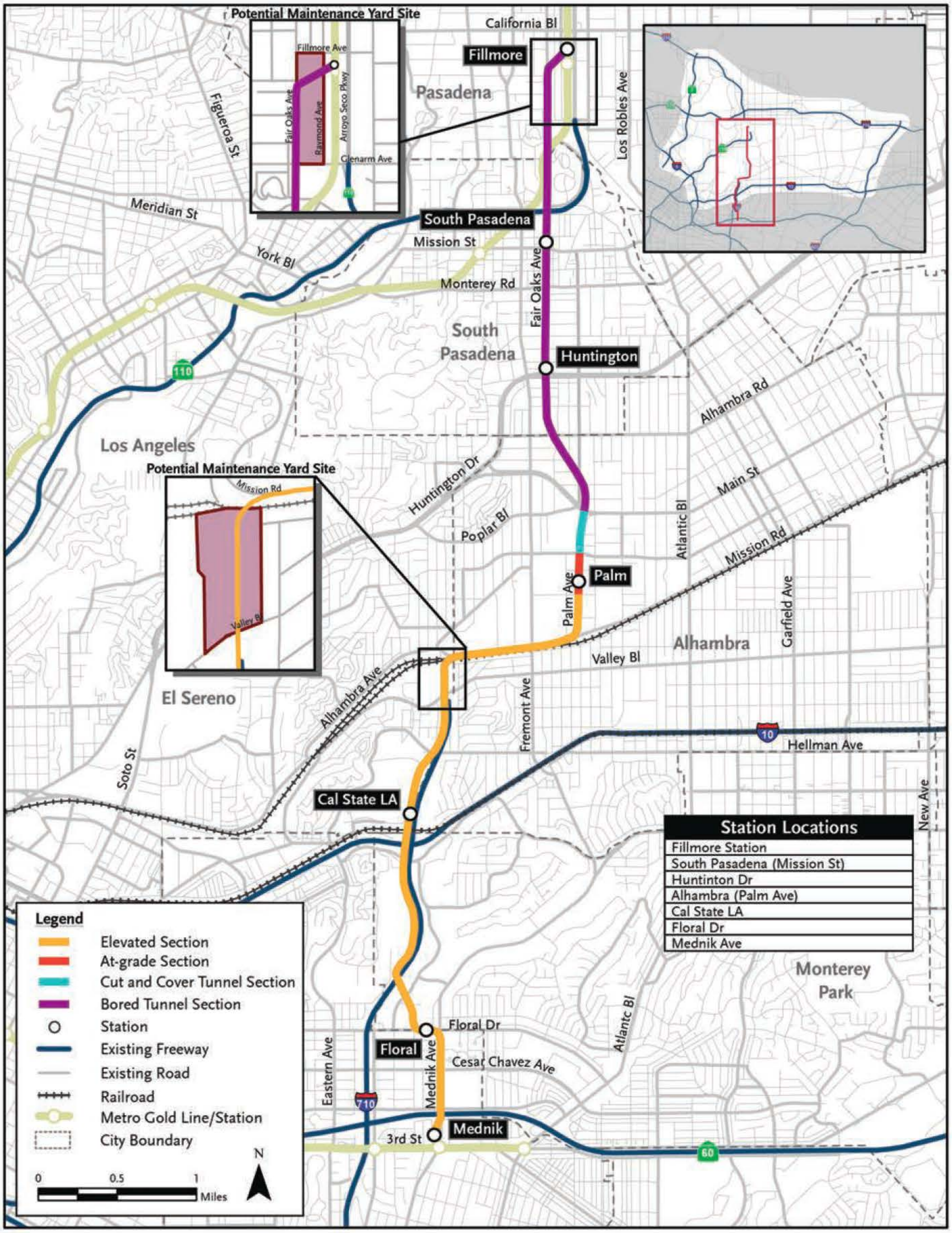


Figure 2-18: Alternative LRT-4D

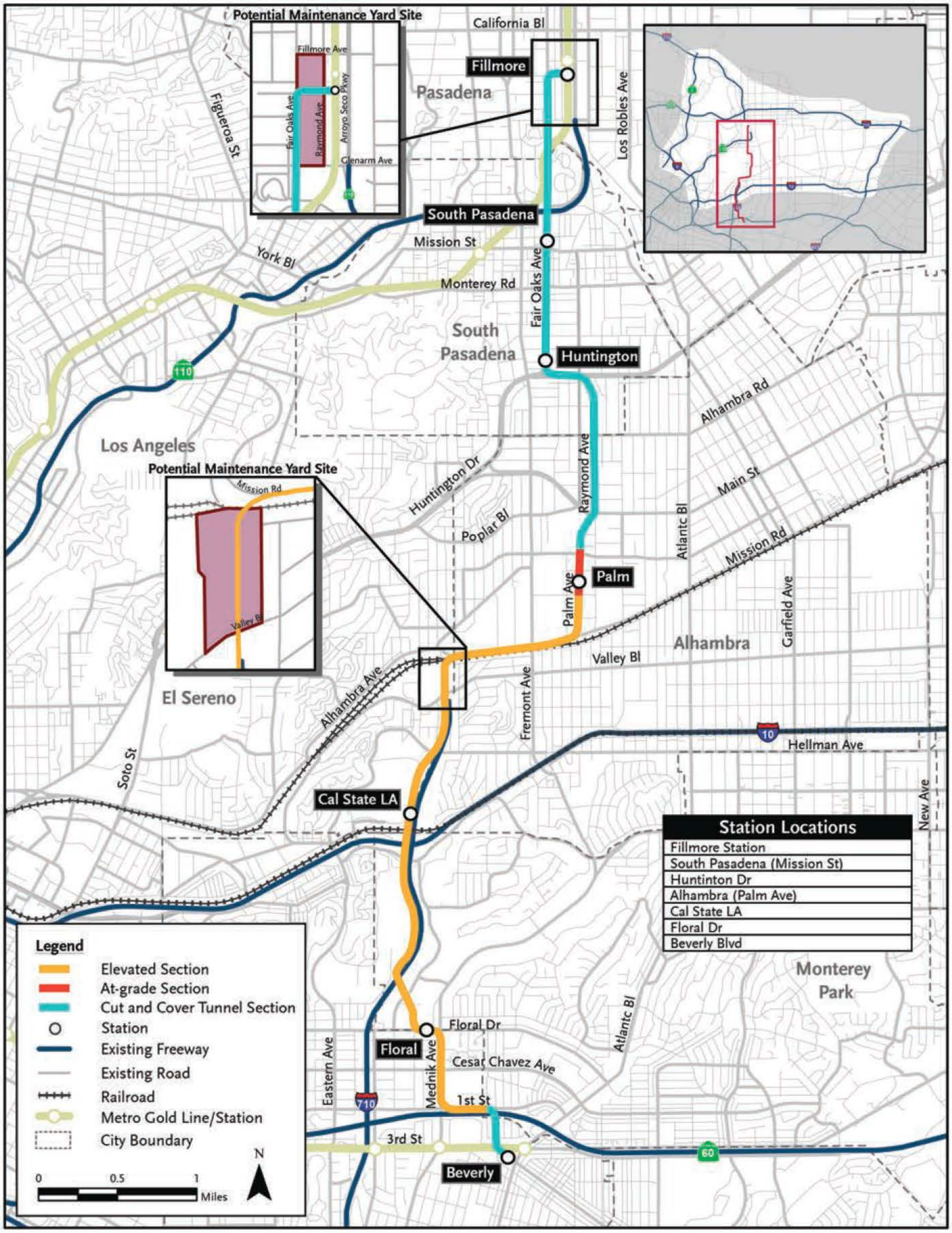
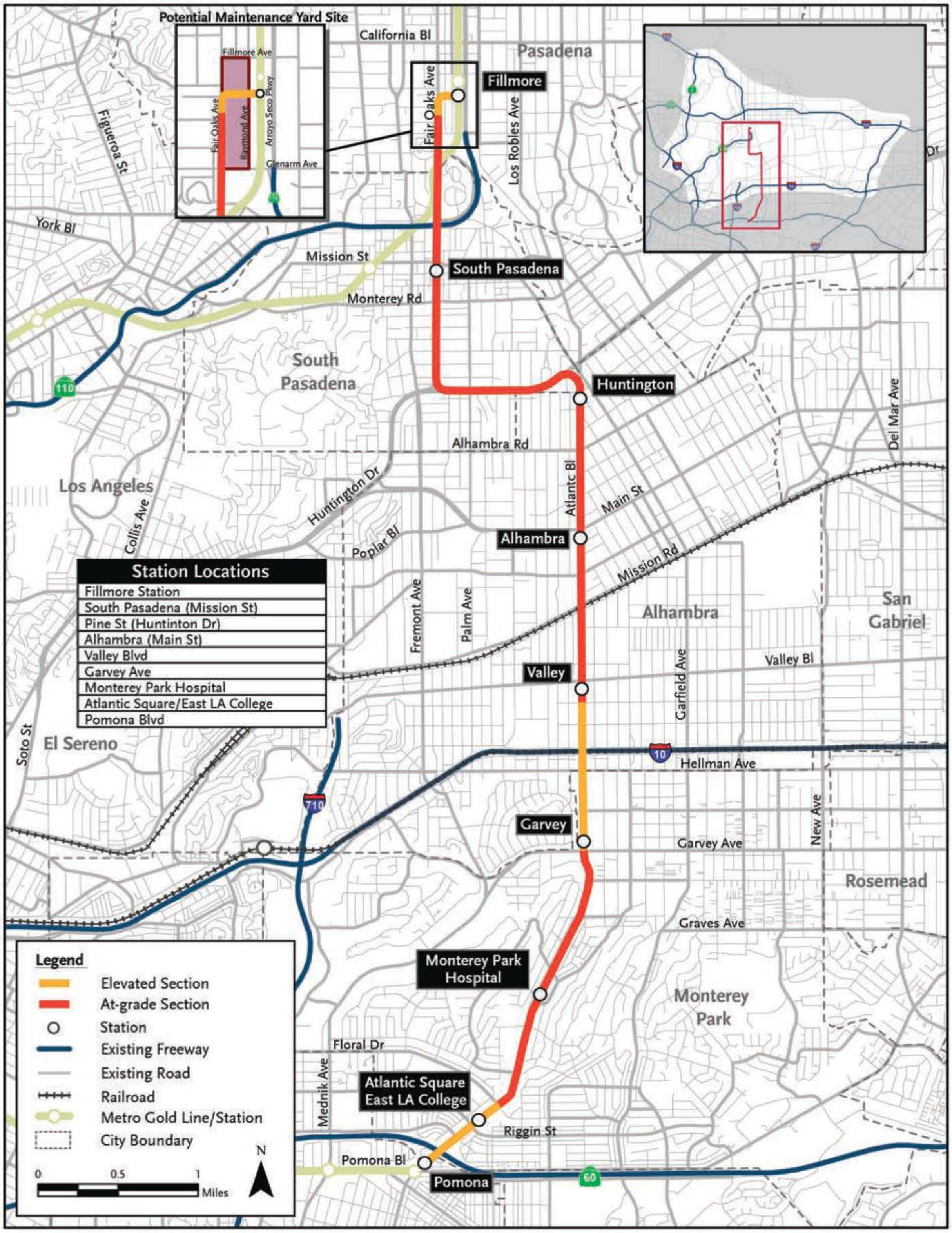


Figure 2-19: Alternative LRT-6



LRT Maintenance Yard. The proposed LRT alternatives would each require a maintenance yard at which light-rail vehicles (LRVs) would be cleaned, maintained, and stored. The maintenance yard would include a car wash, paint shop, and other maintenance facilities. It would also have enough storage tracks to accommodate all of the LRVs required to operate the light-rail line. Two potential sites have been identified for the maintenance yard, only one of which would be required:

- Valley Boulevard Site — This site is approximately 13 acres, located at the end of SR 710 primarily between Valley Boulevard and the Union Pacific Railroad's Alhambra Subdivision rail line, in the City of Los Angeles. Additional LRV storage would be located south of Valley Boulevard, within the Caltrans right-of-way. This site could be used for Alternatives LRT-4A, LRT-4B, or LRT-4D, but not for Alternative LRT-6 because the site is not close to the alignment of Alternative LRT-6.
- Glenarm Street Site — This site is approximately 18 acres, located between Glenarm Street and Fillmore Street on the south and north and between Fair Oaks Avenue and Raymond Avenue on the west and east, in the City of Pasadena. This site would require right-of-way acquisition and could be used for any of the LRT alternatives.

The locations of each of the proposed maintenance yard sites are illustrated on Figures 2-16 through 2-19 showing each of the LRT alignments.

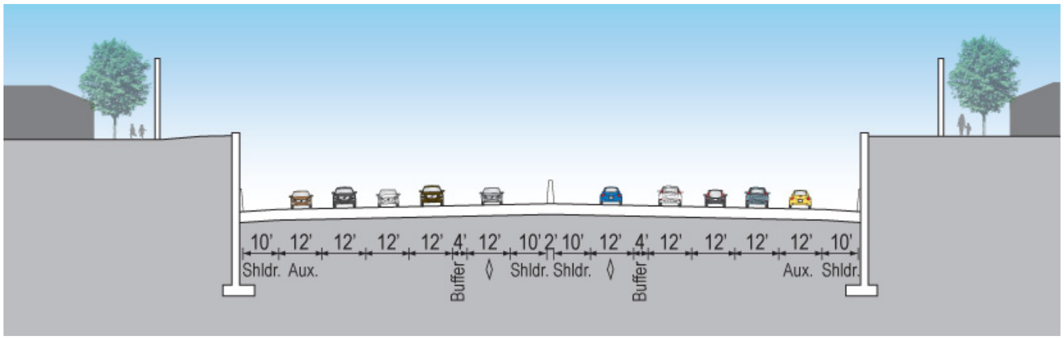
2.6.5 Freeway Alternatives

The four freeway alternatives would extend SR 710 as an access-controlled freeway with a total of four travel lanes in each direction. Three of the freeway alternatives (Alternatives F-2, F-5, and F-7) would be constructed in tunnels, using primarily bored tunnels with short segments of cut-and-cover tunnels to access the bored tunnel. The fourth freeway alternative (Alternative F-6) consists primarily of a combination of surface and depressed segments, with one short cut-and-cover tunnel segment. The freeways would be open to all vehicles without restrictions, except for a prohibition on hazardous materials in tunnels. Figure 2-20 illustrates typical cross sections for the freeway alternatives.

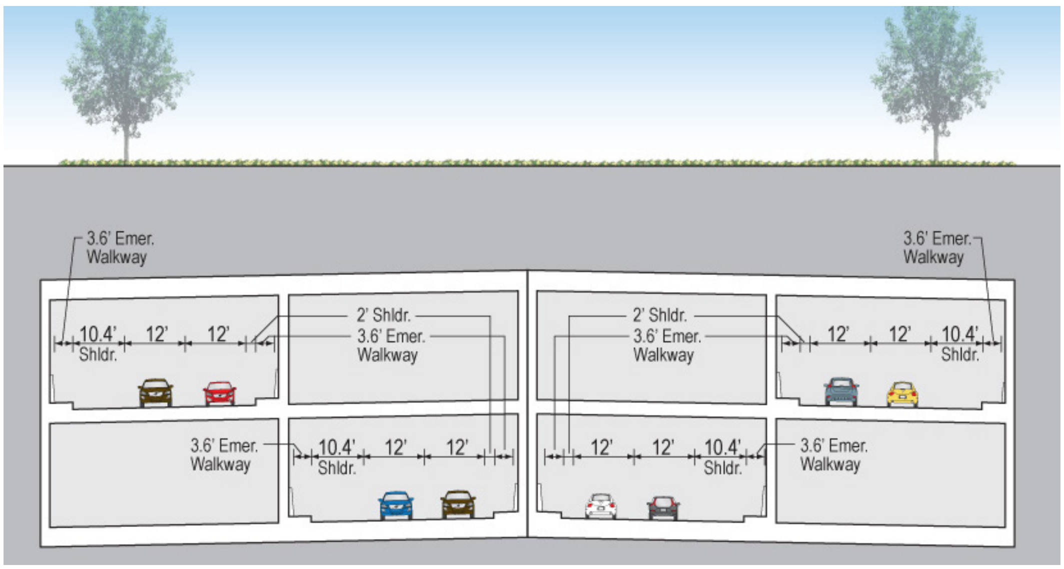
2.6.5.1 Alternative F-2

Alternative F-2 would originate at the existing SR 710 south stub, at the I-10 freeway in Alhambra, and connect to the SR 2 freeway in the vicinity of the existing Verdugo Road and York Boulevard interchanges, as shown in Figure 2-21. The alternative would be an eight-lane freeway primarily constructed in two bored tunnels. Each tunnel would be dedicated to either northbound or southbound travel, with two lanes on each of the two levels in each tunnel, the upper level and the lower level. Cut-and-cover tunnels would be used for the tunnel entry and exit points (portals) at the south and north termini, north of I-10 and south of SR 2. Figures 2-22 and 2-23 show the details of the portal areas. At the south terminus, Alternative F-2 would proceed under Valley Boulevard and the railroad tracks, while maintaining access to Valley Boulevard to and from the south. For the northbound tunnel, both the upper and lower levels would connect to northbound SR 2. The upper and lower levels of the southbound tunnel would provide different access opportunities. For the southbound tunnel, the upper level would connect to all directions at the SR 710/I-10 interchange, but the lower level would connect only to southbound SR 710. The length of improvements for Alternative F-2 would be approximately 6.9 miles, including 5.0 miles of tunnel (4.3 miles of bored tunnel and 0.7 miles of cut-and-cover tunnel).

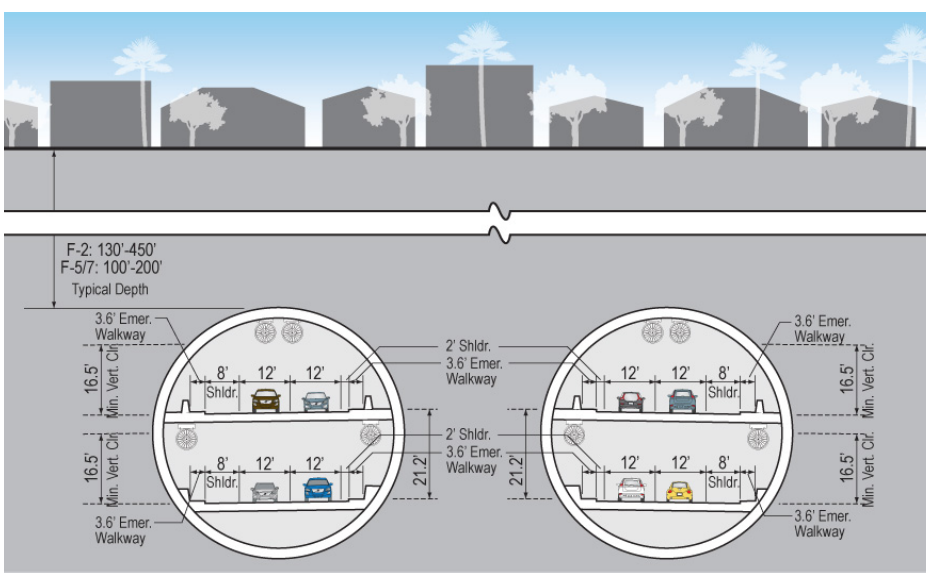
Figure 2-20: Freeway Alternatives Typical Cross Sections



Alternative F-6: North of Mission Road



Alternatives F-2/5/7: Cut-and-Cover Tunnel Entry



Alternatives F-2/5/7: Bored Tunnel

Figure 2-21: Alternative F-2

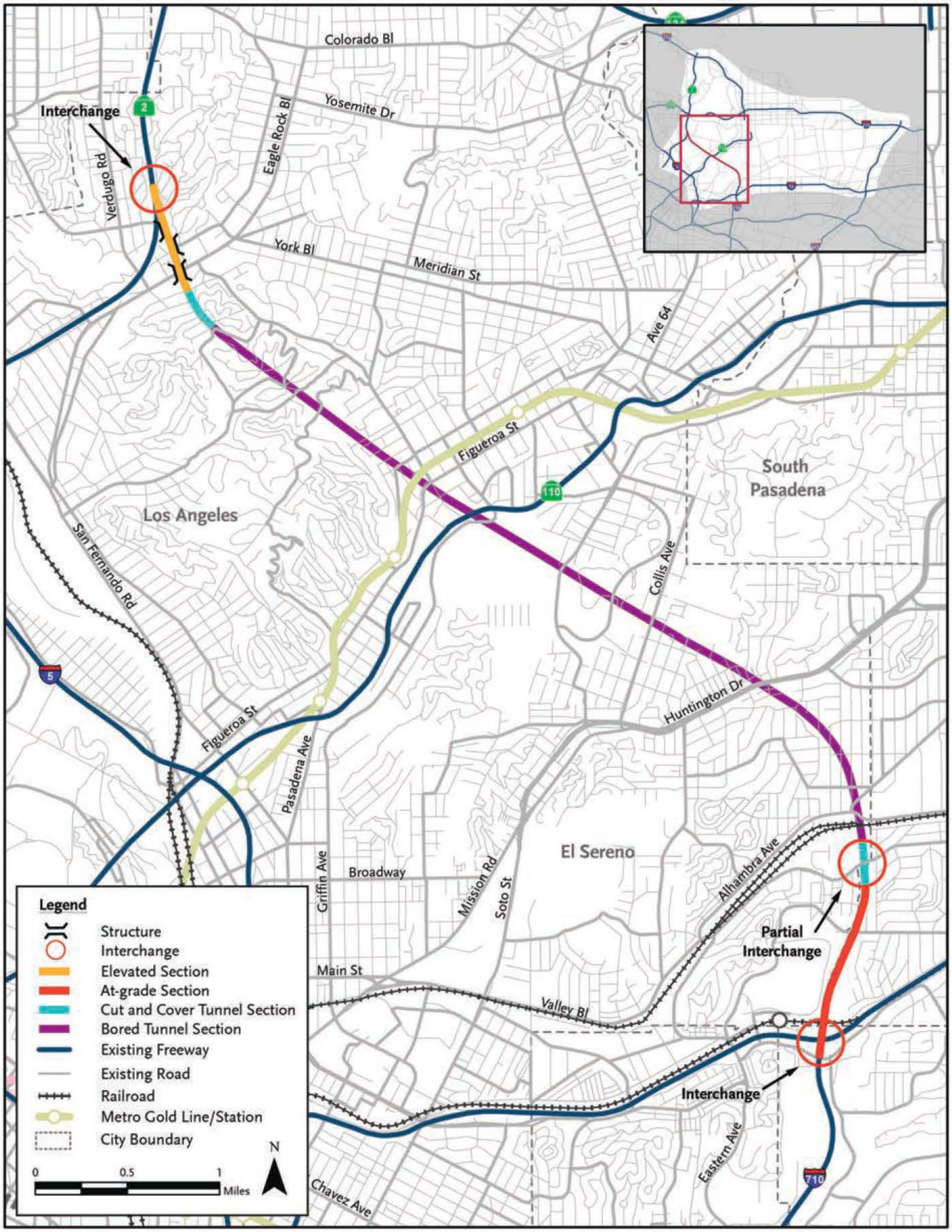


Figure 2-22: Alternatives F-2/5/7: South Portal Area

Figure 2-23: Alternative F-2: North Portal Area

2.6.5.1 Alternative F-5

Alternative F-5 would also originate at the existing SR 710 south stub near I-10, and continue northward connecting to SR 134 near the Colorado Boulevard interchange, as shown in Figure 2-24. The tunnel portal for Alternative F-5 would be the same as the Alternative F-2 portal shown in Figure 2-22. This alternative would also be an eight-lane freeway with two bored tunnels for directional travel similar to Alternative F-2. Figure 2-25 illustrates the alignment of Alternative F-5. The SR 134/SR 710 interchange would provide ramps to and from SR 134 for both eastbound and westbound travel. Colorado Boulevard would be realigned in the vicinity of the new interchange. At the south terminus, Alternative F-5 would proceed under Valley Boulevard and the railroad tracks, while maintaining access to Valley Boulevard to and from the south. Similar to Alternative F-2, the upper and lower levels of the northbound and southbound tunnels would provide different access opportunities. For the northbound tunnel, the upper level would connect to the eastbound and westbound SR 134, but the lower level would connect only to eastbound SR 134. For the southbound tunnel, the upper level would connect to all directions at the SR 710/I-10 interchange, but the lower level would connect only to southbound SR 710. The length of improvements for Alternative F-5 would be approximately 5.8 miles, including 4.4 miles of tunnel (3.8 miles of bored tunnel and 0.6 miles of cut-and-cover tunnel).

Figure 2-24: Alternative F-5: North Portal Area

2.6.5.2 Alternative F-6

Alternative F-6 would also originate at the existing SR 710 south stub near I-10, and would consist of a combination of surface, depressed, cut-and-cover, and elevated freeway segments, ultimately connecting to the existing SR 710 north stub south of the I-210/SR 134 interchange. Generally, Alternative F-6 would follow a very similar alignment to the "Depressed Meridian Variation" approved in the Record of Decision in 1992. From the existing SR 710 south stub the freeway travels over Valley Boulevard, the Union Pacific Railroad (UPRR) tracks, and Mission Road/Alhambra Avenue. Figure 2-26 illustrates the alignment of Alternative F-6. Alternative F-6 would be an eight-lane freeway providing three general purpose lanes and one high occupancy vehicle (HOV) lane in each direction. A typical cross-section for a depressed portion can be seen in Figure 2-20. Ramps would provide full access to the freeway from Valley Boulevard and Mission Road/Alhambra Avenue. The freeway would then transition from an aerial alignment to a depressed alignment along Sheffield Avenue, and then pass under Huntington Drive. A full interchange would be provided at Huntington Drive, as shown in Figure 2-27. North of Huntington Drive, the freeway would turn slightly to the east and continue north just west of Meridian Avenue until the vicinity of Columbia Street, passing under the Metro Gold Line and SR 110. Turning to the east again, the freeway would travel under Pasadena Avenue in a short cut-and-cover section approximately 0.4 miles long, shown in Figure 2-28, and then enter the existing Caltrans right-of-way between St. John Avenue and Pasadena Avenue connecting to the existing SR 710 north stub and then connecting to the I-210/SR 134 interchange, shown in Figure 2-29. Alternative F-6 would be grade separated at major arterials; minor streets that currently cross the alignment would become discontinuous. The length of improvements for Alternative F-6 is approximately 5.8 miles, including 0.4 miles of cut-and-cover tunnel.

2.6.5.3 Alternative F-7

Alternative F-7 would also originate at the existing south SR 710 stub north of I-10. It would connect via a bored tunnel to the existing north SR 710 stub south of the I-210/SR 134 interchange in Pasadena. The tunnel portal for Alternative F-7 would be the same as the Alternative F-2 portal shown previously in Figure 2-22. This alternative would also be an eight-lane freeway with two bored tunnels for directional travel similar to Alternatives F-2 and F-5, and each tunnel would have two travel lanes on two levels. At the south terminus, Alternative F-7 would proceed under Valley Boulevard and the

Figure 2-25: Alternative F-5

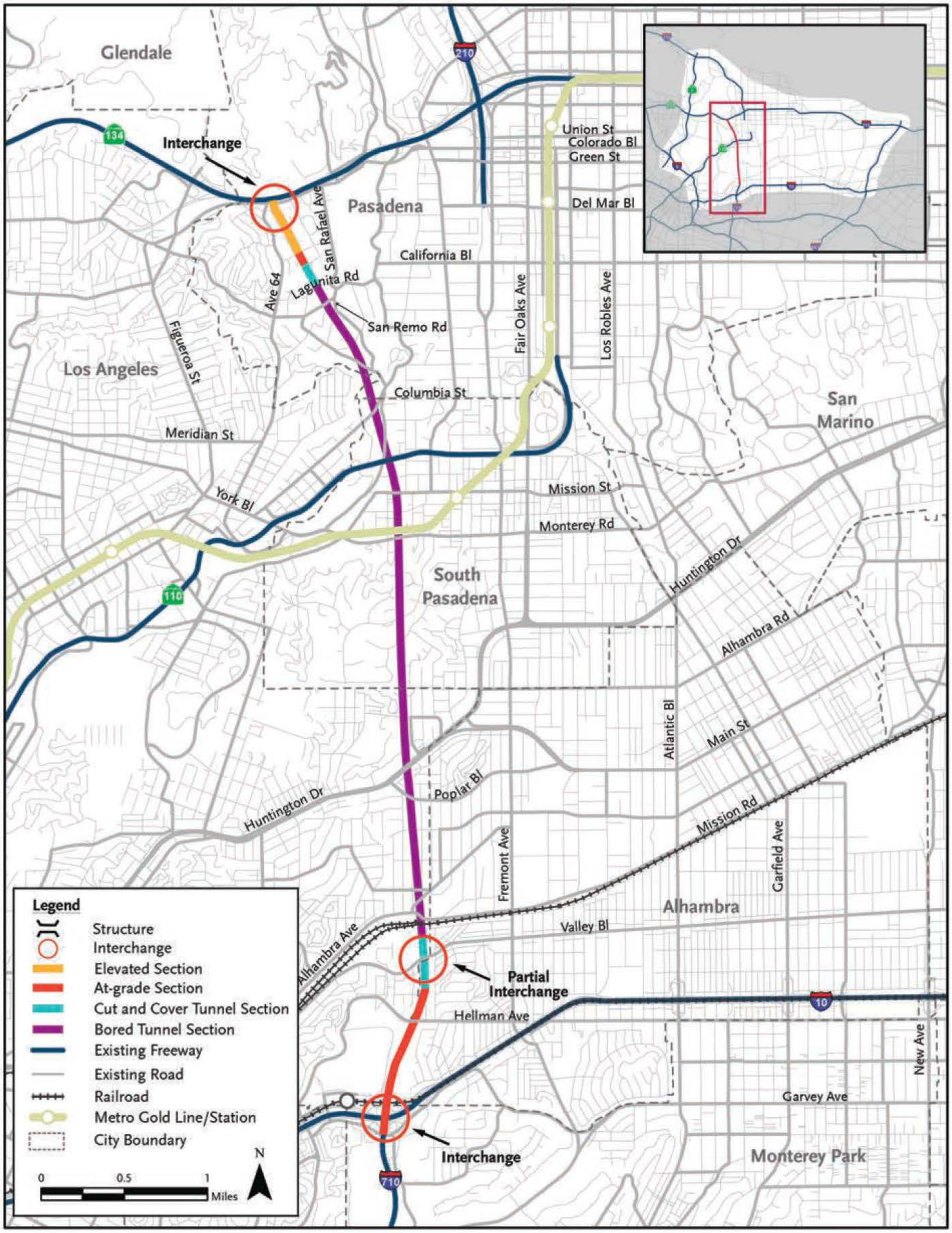


Figure 2-26: Alternative F-6

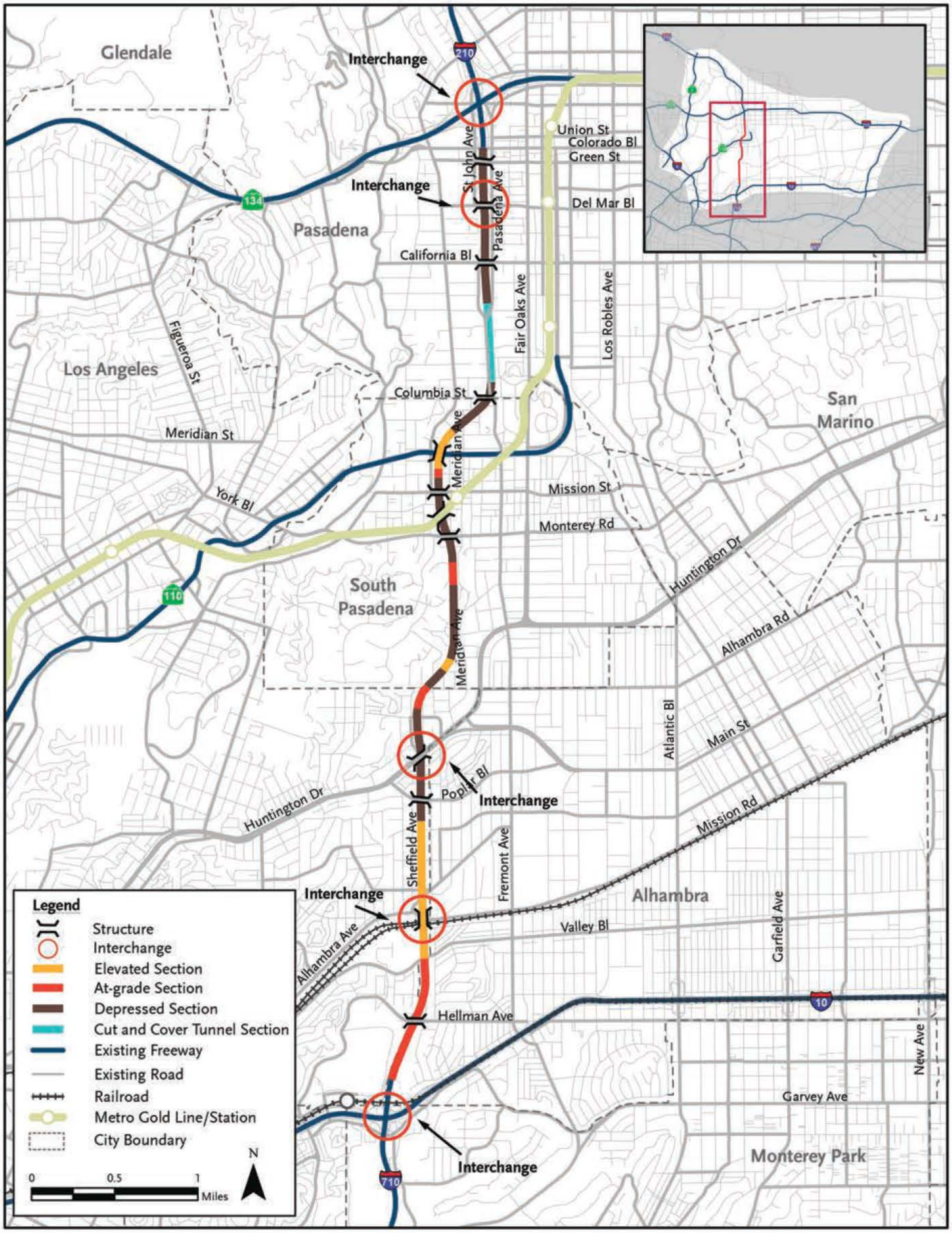


Figure 2-27: Alternative F-6: Huntington Drive Interchange

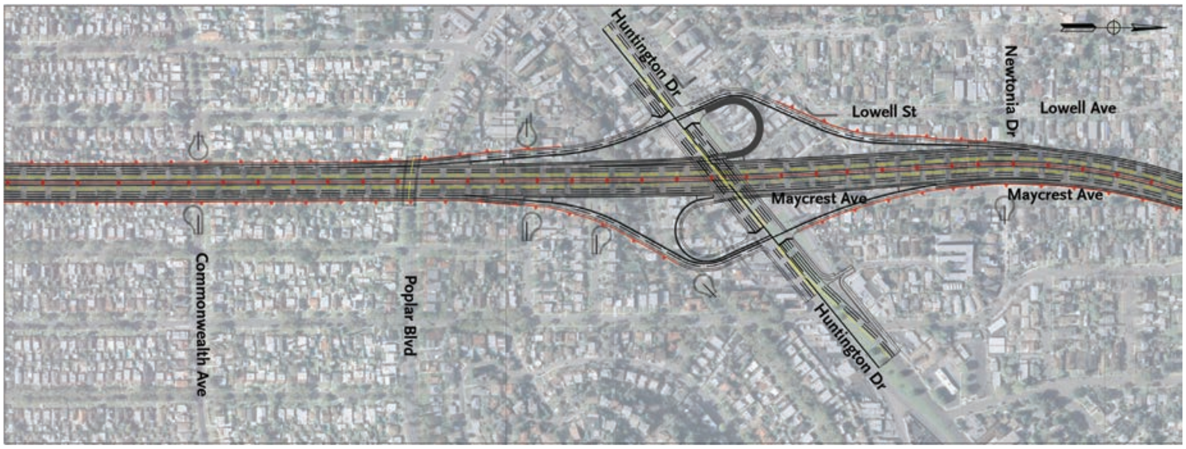


Figure 2-28: Alternative F-6: Cut-and-cover Section Under Pasadena Avenue

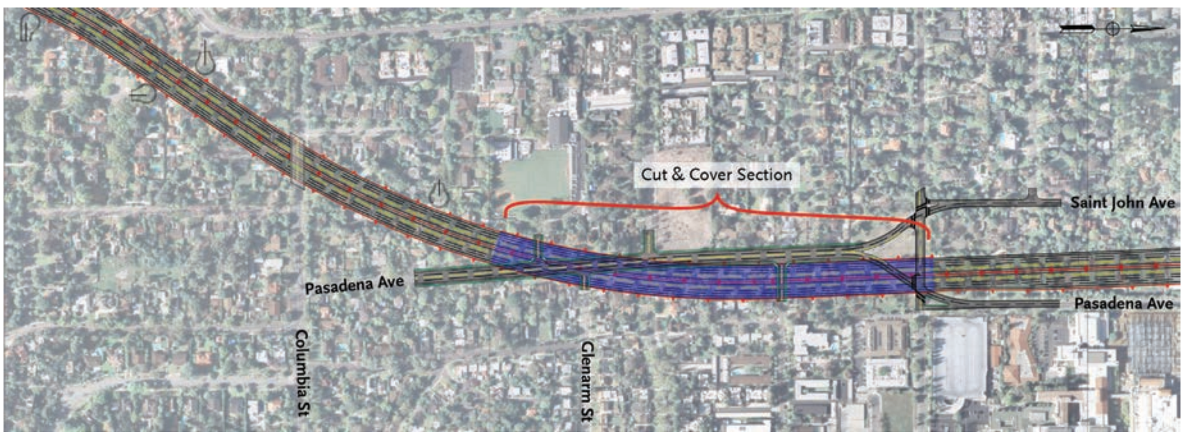
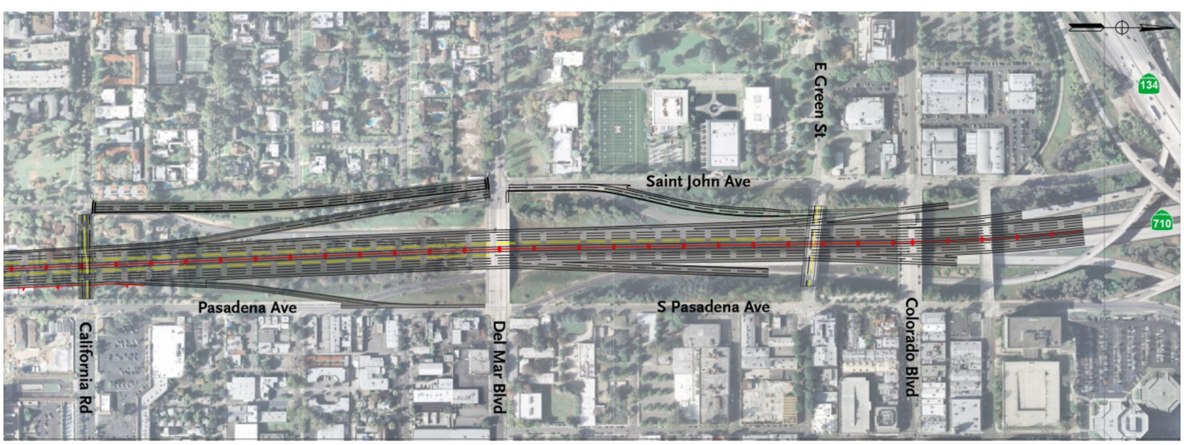


Figure 2-29: Alternative F-6: Approach to I-210/SR 134 Interchange

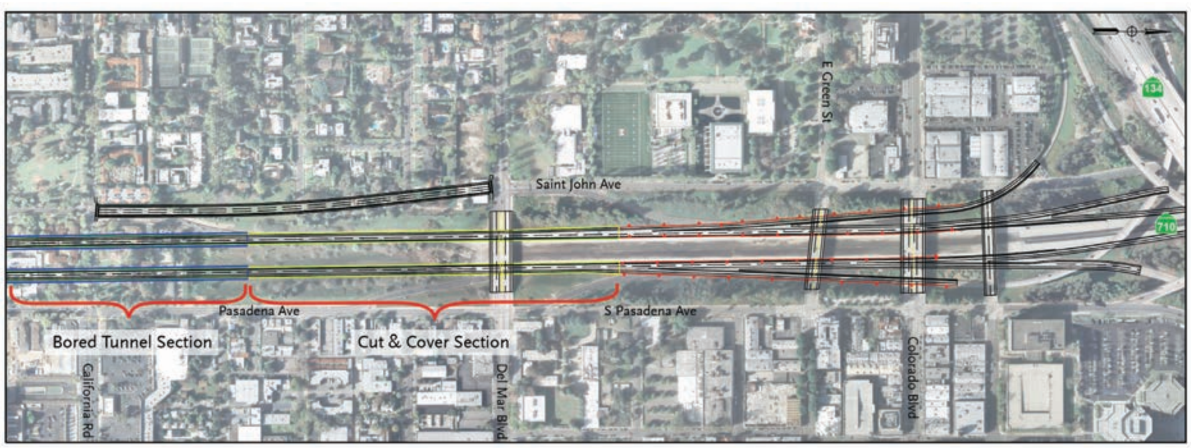


UPRR tracks, while maintaining access to Valley Boulevard to and from the south. Similar to Alternative F-5, the upper and lower levels of the northbound and southbound tunnels would provide different access opportunities.

For the northbound tunnel, the upper level would connect to all directions at the I-210/SR 134 interchange, but the lower level would connect only to westbound I-210. For the southbound tunnel, the upper level would connect to all directions at the SR 710/I-10 interchange, but the lower level would connect only to southbound SR 710. The length of improvements for Alternative F-7 would be approximately 6.3 miles, including 4.9 miles of tunnel (4.2 miles of bored tunnel and 0.7 miles of cut-and-cover tunnel). The tunnel portal for Alternative F-7 connecting to the I-210/SR 134 interchange is shown in Figure 2-30. Figure 2-31 illustrates the alignment of Alternative F-7.

This alternative also includes the extension of St. John Avenue from its current terminus at Del Mar Boulevard to California Boulevard, since the existing access to the St John Avenue/California Boulevard intersection would be eliminated. The Del Mar Boulevard crossing over the freeway would become part of the tunnel cover, so there would no longer be a separate bridge structure.

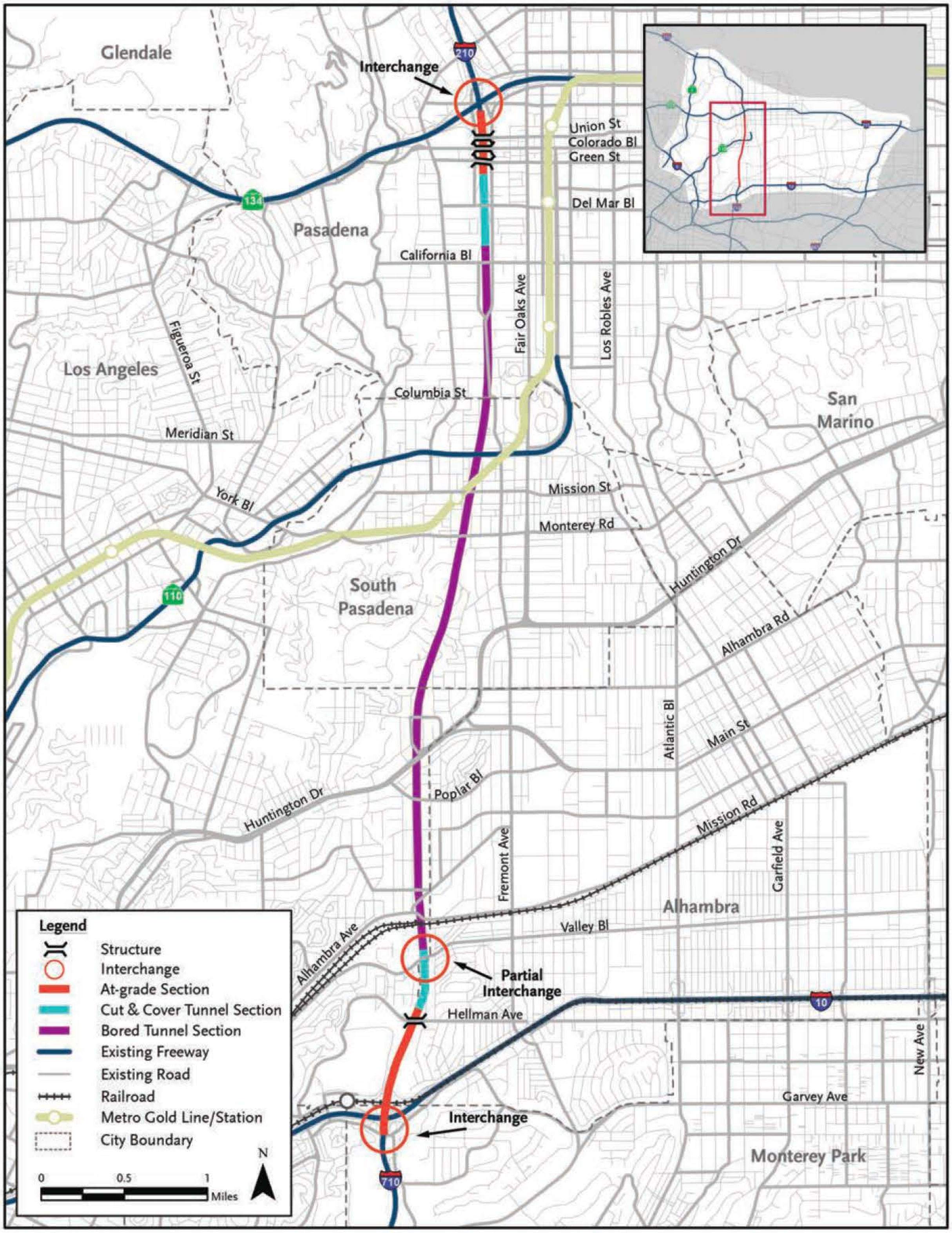
Figure 2-30: Alternative F-7: North Portal Area



Tunnel Design Considerations. Portal locations, which are defined as the transition from uncovered roadway to the cut-and-cover tunnel sections, were determined by design constraints on the geometry of the roadway approaches (e.g., design speed, curve radii, and profile) and surrounding surface conditions. The intent was to locate portals away from structures and roads on the surface, to allow room for control and ventilation buildings, to limit the height of approach walls, to limit the length of the cut-and-cover tunnels, and to start the bored tunnel as soon as possible to reduce impacts to the existing ground surface. The tunnel boring machines (TBMs) for freeway alternatives would be launched after the cut-and-cover section has reached a depth of 100 to 120 feet below grade. An important constraint on the location of the beginning of the bored tunnels is the need for a suitable launch site for the TBMs.

All freeway tunnel alternatives (Alternatives F-2, F-5 and F-7) share the same configuration at the south portal, including cut-and-cover transitions and TBM launch locations. The south portal would be located within the Caltrans right-of-way to reduce impacts to the surrounding community. The portal would be located south of Valley Boulevard. As the freeway enters the cut-and-cover section, the upper roadway would be in the process of transitioning to align horizontally with the lower roadway; therefore, the upper roadway would dip below grade approximately 750 feet farther north along the alignment than the lower roadway. After entering the cut-and-cover tunnel section, the upper and

Figure 2-31: Alternative F-7



lower roadways would align horizontally as they enter the section of the tunnel constructed using the tunnel boring machine roughly 600 feet north of Valley Boulevard, just south of the railroad tracks. The distance from the surface to the top of the bored tunnels at this location would be approximately 85 feet.

The portal for the northbound tunnel of Alternative F-2 would be located in the vicinity of the intersection of Avenue 42 and Verdugo View Drive; the portal for the southbound tunnel would be located approximately 300 feet farther west. The location is influenced by the alignment's aerial tie-in point with SR 2. It is not possible for Alternative F-2 to remain in tunnel configuration connecting directly with SR 2 because of the required tunnel depth and minimum curve radius. As a result, the portal would be located in a residential area, where the freeway would transition to aerial bridges. Bridges between the end of the cut-and-cover tunnel and the tie-in to SR 2 would cross residential and commercial areas. Both the top and bottom levels of the cut-and-cover tunnel would align horizontally to join the tunnel boring machine section roughly between Division Street and El Paso Drive, near Oban Drive. The distance from the surface to the top of the bored tunnel at this location would be approximately 70 feet.

The location of the north portal of Alternative F-5 is largely influenced by the alignment's tie-in elevation with SR 134. Due to vertical constraints, bridges from the end of the cut-and-cover tunnel to the tie-in with SR 134 would cross residential and commercial areas. The required geometry also results in the north portal being located in a residential area, near Lagunita Road and approximately 900 feet south of San Rafael Elementary School. Both the top and bottom levels of the cut-and-cover tunnel would align horizontally to join the tunnel boring machine section, roughly 200 feet south of the intersection of San Remo Road and San Rafael Avenue. The distance from the surface to the top of the bored tunnel at this location would be approximately 110 feet.

The north portal of Alternative F-7 would be situated within the Caltrans right-of-way, and located approximately 500 feet north of the existing Del Mar Boulevard bridge. The bored tunnel would begin north of California Boulevard. Locating the portal north of Del Mar Boulevard would eliminate the need for Del Mar Boulevard to be reconstructed as a bridge over SR 710. The location of the portal first considered that the bored tunnel must begin north of Sequoyah School to minimize impacts to the school. Secondly, the portal was moved as far south as design would allow, thus decreasing the length of the cut and cover tunnel. The top and bottom levels of the tunnel would align horizontally to join the tunnel boring machine section approximately 800 feet north of California Boulevard. The distance from the surface to the top of the bored tunnel at this location would be approximately 50 feet.

2.6.6 Highway/Arterial Alternatives

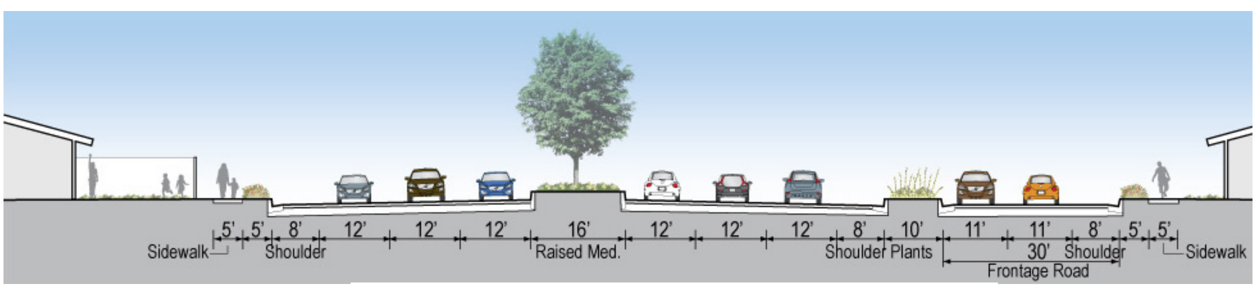
The highway/arterial alternatives would provide major widening of existing streets along the alignments. Each of these alternatives would provide three lanes in each direction, with a 16-foot wide raised median along the length of the alignments. Where possible, the roadway widening associated with each alternative is limited to one side of the existing roadway to reduce the number of required property acquisitions. Sensitive properties such as retail centers, businesses, churches, schools and historic properties were considered when selecting which side of the street to widen. Properties would be maintained on the other side of the roadway. In many areas, a frontage road would be provided for access. The frontage roads would also reduce the number of driveways and access points along the major arterial to improve highway safety and operations. The number of intersections with the new highway/arterial would be reduced to provide for more throughput capacity. In addition, smaller local side streets with existing access to the streets to be widened would be converted to cul-de-sacs in many locations. Figure 2-32 illustrates typical cross sections for the highway alternatives.

2.6.6.1 Alternative H-2

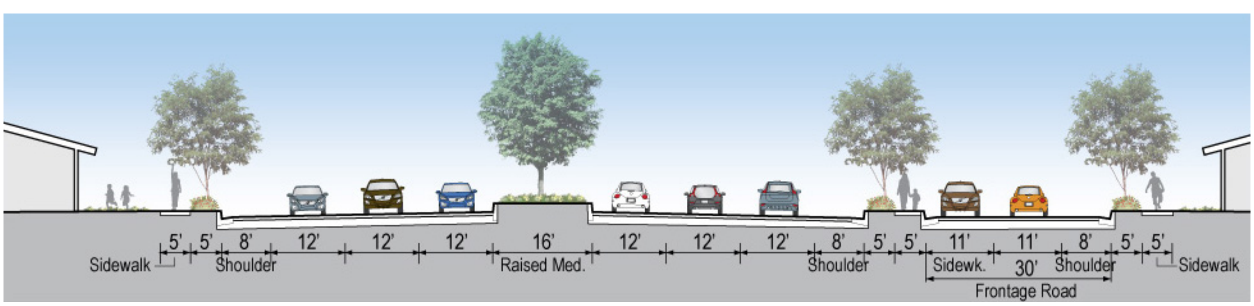
Alternative H-2 would begin at the existing south SR 710 stub north of I-10 and connect the SR 710 freeway directly to Concord Avenue. The SR 710 freeway would come to an end at Valley Boulevard and transition to a highway/arterial at Concord Avenue that would travel over Valley Boulevard, the UPRR tracks, and Mission Road/Alhambra Avenue to Concord Avenue. The alignment would then continue along Concord Avenue to Fremont Avenue, to Monterey Road, to York Boulevard, to Avenue 64, and to Colorado Boulevard, ending near the intersection of San Rafael Avenue and Linda Vista Avenue. Since the alignment is elevated above Mission Road, a connector roadway between Mission Road and the main alignment of the alternative would be provided.

The addition of a frontage road is not always feasible due to the hilly terrain. Access to the local streets is provided by connector roads to the local streets and by intersections with access to the local streets. Minor alignment modifications are proposed along the mid-segment of Avenue 64 to increase the existing curve radii. The profile of this alignment takes advantage of existing abutments already in place for SR 710 to pass over Valley Boulevard and allows for protection of utilities along Valley Boulevard and Mission Road. The at-grade railroad crossing at Pasadena Avenue/Monterey Road is maintained because an underpass or overpass would necessitate significant property impacts adjacent to the alignment. Furthermore, access to local streets would be limited, and additional earthwork, retaining walls and utility relocations would be required. The length of improvements for Alternative H-2 would be approximately 7.4 miles. Figure 2-33 illustrates the alignment of Alternative H-2. Figure 2-34 illustrates Alternative H-2 connecting the SR 710 freeway directly to Concord Avenue. Figure 2-35 illustrates Alternative H-2 ending near the intersection of San Rafael Avenue and Linda Vista Avenue, connecting to Colorado Boulevard.

Figure 2-32: Highway/Arterial Alternatives Typical Cross Sections



Alternative H-2: Fremont Avenue near Main Street



Alternative H-6: Sheffield Avenue near Norwich Avenue

Figure 2-33: Alternative H-2

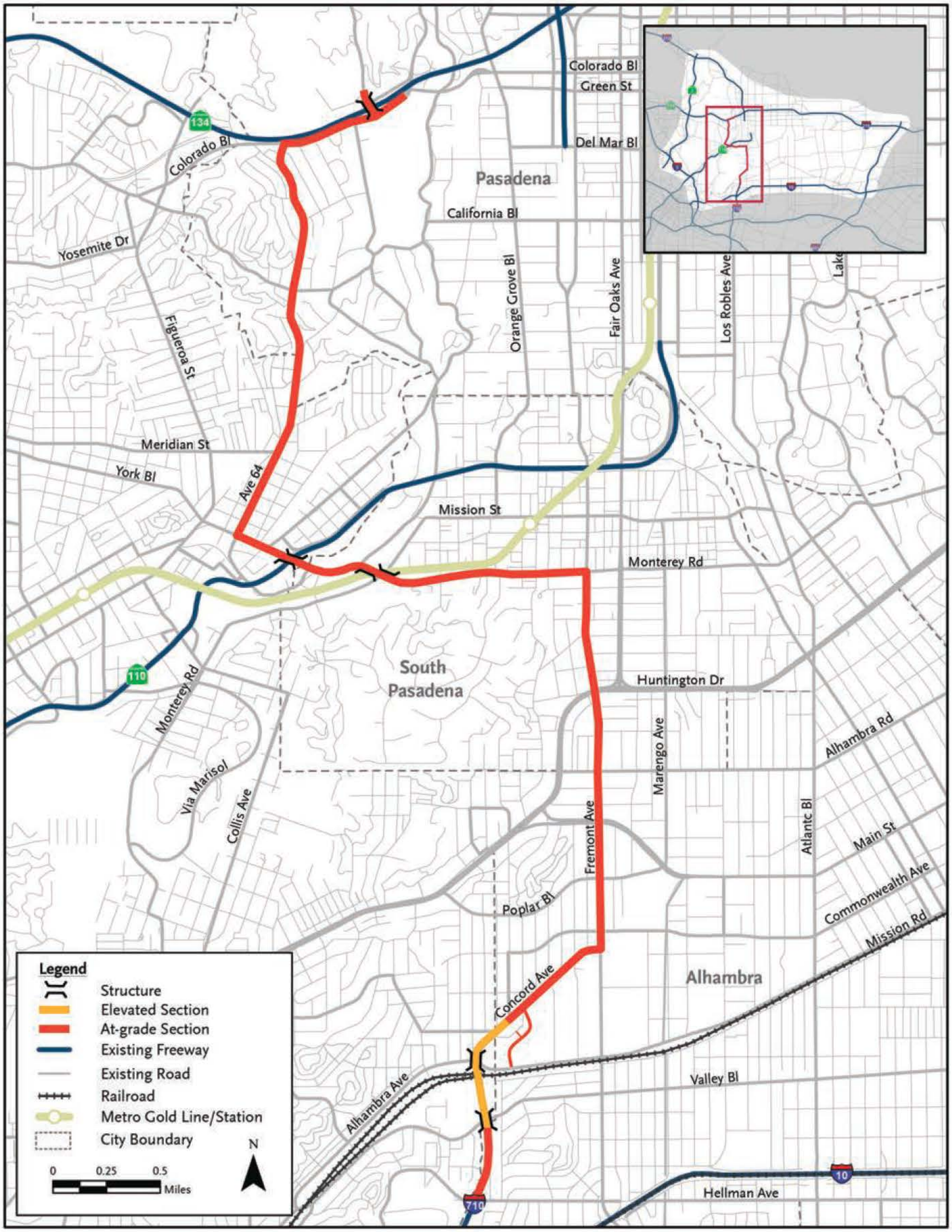


Figure 2-34: Alternative H-2: South Connection to SR 710

Figure 2-35: Alternative H-2: North Connection to SR 134

2.6.6.2 Alternative H-6

Alternative H-6 would also begin at the existing south SR 710 stub north of I-10 and connect the SR 710 freeway directly to Sheffield Avenue. The SR 710 freeway would come to an end at Valley Boulevard and transition to a major highway/arterial that would travel over Valley Boulevard, the UPRR tracks, and Mission Road/Alhambra Avenue to Sheffield Avenue. The alignment would then continue along Sheffield Avenue to Huntington Drive, to Fair Oaks Avenue, to Columbia Street, to Pasadena Avenue. Just north of the intersection of Pasadena Avenue and Bellefontaine Street, the roadway would split between St John Avenue and Pasadena Avenue with ramp connections on existing alignments. Since the alignment is elevated above Mission Road, a connector roadway between Mission Road and the main alignment of the alternative would be provided.

The addition of a frontage road is not always feasible due to right-of-way constraints, specifically along Fair Oaks Avenue. The profile of this alignment takes advantage of existing abutments already in place for the SR 710 to pass over Valley Boulevard and allows for protection of utilities along Valley Boulevard and Mission Road. Figure 2-36 illustrates the alignment of Alternative H-6. Figure 2-37 illustrates Alternative H-6 connecting the SR 710 freeway directly to Sheffield Avenue. Figure 2-38 illustrates Alternative H-6 ending near Pasadena Avenue and St John Avenue. The improvements in both directions would end near Del Mar Boulevard. The length of improvements for Alternative H-6 would be approximately 6.3 miles.

Figure 2-36: Alternative H-6

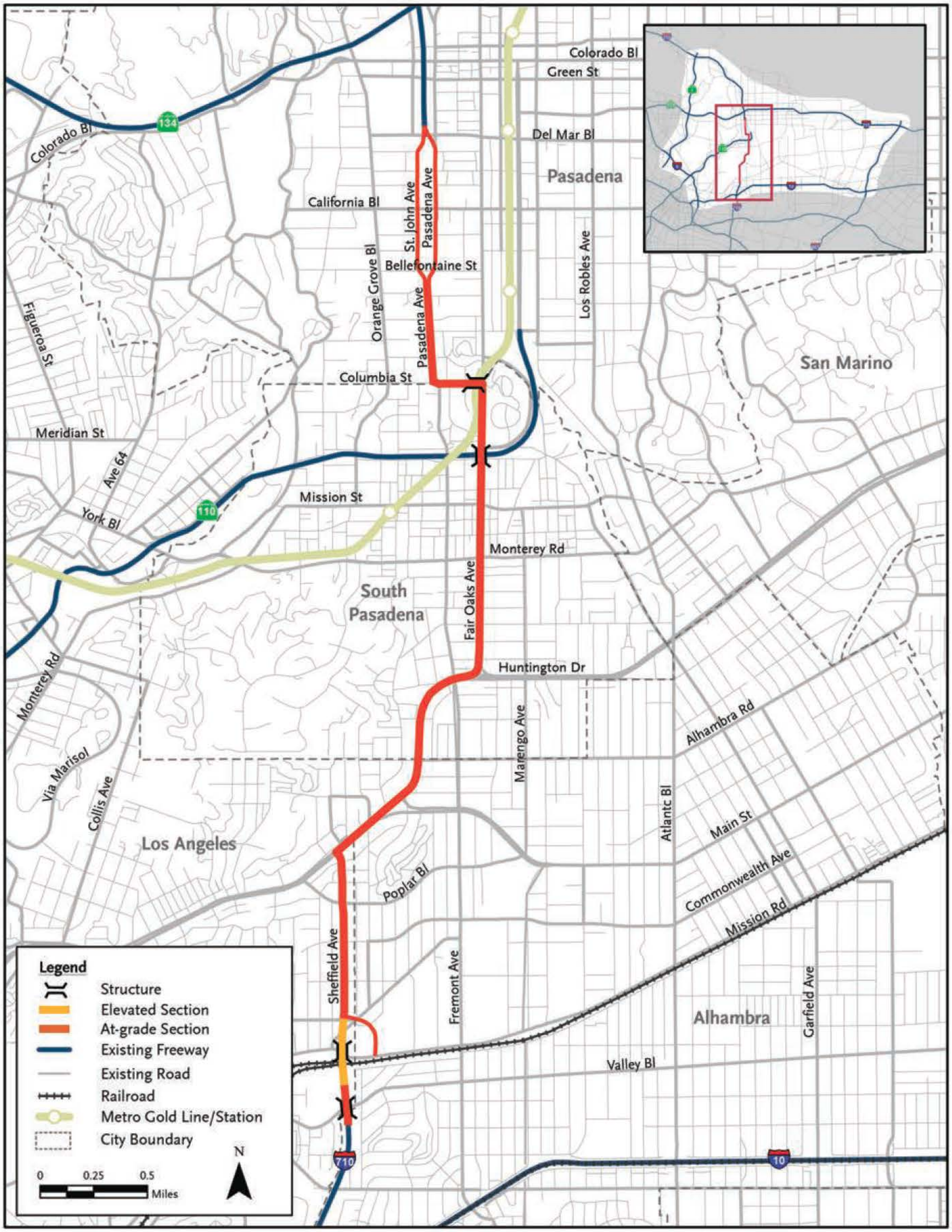


Figure 2-37: Alternative H-6: South Connection to SR 710

Figure 2-38: Alternative H-6: North Connection to SR 710

2.7 Secondary Screening

For the secondary screening, more refined performance measures were developed to take advantage of the more detailed information available at the conceptual engineering level. For each of the project objectives, more detailed performance measures were developed, resulting in a total of 42 performance measures.

Twenty of the performance measures are related to the five objectives pertaining to the project need. The other 22 performance measures are related to the three objectives pertaining to environmental impacts, planning considerations, and cost efficiency. Table 2-4 summarizes the performance measures associated with each of the project objectives.

The performance of each of the alternatives on each of these measures was evaluated based on the results of the conceptual engineering plans for each alternative, the travel demand and ridership forecasting conducted specific to each alternative, and environmental assessments using the results of the conceptual engineering and travel demand forecasts. The conceptual engineering plans are included in the Conceptual Engineering Report in Appendix F. The travel demand modeling methodology report is included in Appendix G.

Detailed descriptions of the performance measures related to the objectives pertaining to the project need are provided in Chapter 3, followed by the results of the evaluation of each alternative. Detailed descriptions of the performance measures related to the objectives pertaining to environmental impacts and planning considerations are provided in Chapter 4, followed by the results of the evaluation of each alternative. Detailed descriptions of the performance measures related to the objectives pertaining to cost efficiency are provided in Chapter 5, followed by the results of the evaluation of each alternative.

Table 2-4: Secondary Screening Performance Measures

Element of Need/Value or Concern	Objective	Performance Measures
Regional Transportation System	1. Minimize travel time	Point-to-point travel time - vehicular Point-to-point travel time - transit Reduction in VHT Percentage of travel on managed facilities
	2. Improve connectivity and mobility	New interchanges/transit connections Jobs reachable within fixed time Transit boardings Arterial volumes Freeway throughput
Freeway system in the study area	3. Reduce congestion on freeway system	Facility miles operating at level of service (LOS) F1 or worse Facility miles operating at LOS E or F0 VMT on congested roadway segments
Local street system in the study area	4. Reduce congestion on local street system	Percent of congested intersections Average v/c ratios on arterials Vehicle-miles-traveled (VMT) on arterials Arterial cut-through percentage North-south travel on arterials
Transit system in the study area	5. Increase transit ridership	Increase in transit riders Percent of population within 1/4 mile of transit Transit mode share
Environment and communities	6. Minimize environmental and community impacts related to transportation	Right-of-Way Full or partial residential or business acquisitions Human Environment Recreational/community sites impacted Archeological sites impacted Properties over 45 years old impacted Significant historic resources impacted Increase in noise exposure Increase in mobile-source air toxics (MSATs) Increase in regional criteria pollutants Increase in greenhouse gas (GHG) emissions Hazardous waste sites impacted Visual intrusion in communities Scenic corridors impacts Natural Environment Areas of high paleontological sensitivity impacted Exposure to adverse geotechnical conditions Sensitive habitats impacted

Element of Need/Value or Concern	Objective	Performance Measures
		Drainages impacted
Consistency with plans	7. Assure consistency with regional plans and strategies	Consistency with RTP/SCS goals Consistency with Measure R goals Consistency with Metro LRTP goals
Provide financially feasible transportation solutions	8. Maximize the cost-efficiency of public investments	Construction and right-of-way costs Available funding Technical feasibility

3.0 Transportation System Performance

The initial set of alternatives described in Chapter 2 was evaluated against the project objectives. Five objectives are focused on the project need: minimizing travel times, improving connectivity and mobility, reducing congestion on the freeway system, reducing congestion on the local street system, and increasing transit ridership. The objectives related to environmental impacts and planning considerations are described in Chapter 4.

For each of the objectives related to transportation system performance, detailed performance measures were developed. This section describes the performance of each of the alternatives in the initial set of alternatives on the 20 performance measures related to these five project objectives. Table 3-1 presents the performance measures associated with each of these objectives. The Existing Conditions System Performance Report is included in Appendix H, and the Forecast Results and Future System Performance Report is included in Appendix I.

Table 3-1: Transportation System Performance Measures

Element of Need	Objective	Performance Measures
Regional Transportation System	Minimize travel time	• Point-to-point travel time - vehicular • Point-to-point travel time - transit • Reduction in VHT • Percentage of travel on managed facilities
	Improve connectivity and mobility	• New interchanges/transit connections • Jobs reachable within fixed time • Transit boardings • Arterial volumes • Freeway throughput
Freeway system in the study area	Reduce congestion on freeway system	• Facility miles operating at LOS F1 or worse • Facility miles operating at LOS E or F0 • VMT on congested freeway segments
Local street system in the study area	Reduce congestion on local street system	• Percent of intersections with congested approaches • Average v/c on arterials • VMT on arterials • Arterial cut-through percentage • North-south travel on arterials
Transit system in the study area	Increase transit ridership	• Increase in transit ridership • Percent of population and employment within 1/4 mile of transit • Transit mode share

3.1 Descriptions of Performance Measures

Each of the 20 performance measures related to the project need was developed to meet the elements of need presented in Table 3-1 above. The performance measures are described in the following sections under the element of need that they support.

3.1.1 Regional Transportation System

There are two objectives associated with improving the regional transportation system: minimize travel time and improve connectivity and mobility.

3.1.1.1 Minimize Travel Time

Minimizing travel time gives people more opportunities to get to destinations important to them in their daily life, and it gives them more time to engage in the activities of their choice. The objective of minimizing travel time was measured through point-to-point travel time for both vehicular and transit trips, reduction in regional VHT, and percentage of travel in managed facilities.

Point-to-Point travel time – Vehicles and Transit

The performance of the alternatives on reducing point-to-point travel times was calculated using travel times for two sets of nine trips. The first set of trips included those with origins and destinations inside the study area. The second set of trips included those with origins and destinations outside the study area, but that would be expected to travel through the study area. Each set of nine trips was constructed by selecting a western, central, or eastern origin on the south side of the study area and pairing it with a western, central, or eastern origin on the north side of the study area. The regional and study area origin and destination (O-D) pairs are listed in Table 3-2 and illustrated in Figure 3-1.

Because the trips vary greatly in length, the values for trip travel time have been reported on a normalized scale from 0 to 100 (slower to faster) to allow for a comparison of the range of change among the alternatives. On this scale, the No Build Alternative has the longest travel time, so it scores 0. The alternative with the shortest travel time scores 100. The travel time is calculated separately for transit and vehicular travel, resulting in two performance measures.

Table 3-2: Regional and Study Area Origin-Destination Pairs

Regional O-D Pairs	Study Area O-D Pairs
Downtown Long Beach to Hansen Dam Park	Union Station to La Cañada Town Center
Downtown Long Beach to Citrus College	Union Station to Pasadena City College
Downtown Long Beach to Stevenson Ranch	Union Station to Santa Anita Fashion Park
The Citadel to Stevenson Ranch	Cal State LA to La Cañada Town Center
The Citadel to Hansen Dam Park	Cal State LA to Pasadena City College
The Citadel to Citrus College	Cal State LA to Santa Anita Fashion Park
Puente Hills Shopping Center to Stevenson Ranch	El Monte Transit Center to La Cañada Town Center
Puente Hills Shopping Center to Hansen Dam Park	El Monte Transit Center to Pasadena City College
Puente Hills Shopping Center to Citrus College	El Monte Transit Center to Santa Anita Fashion Park

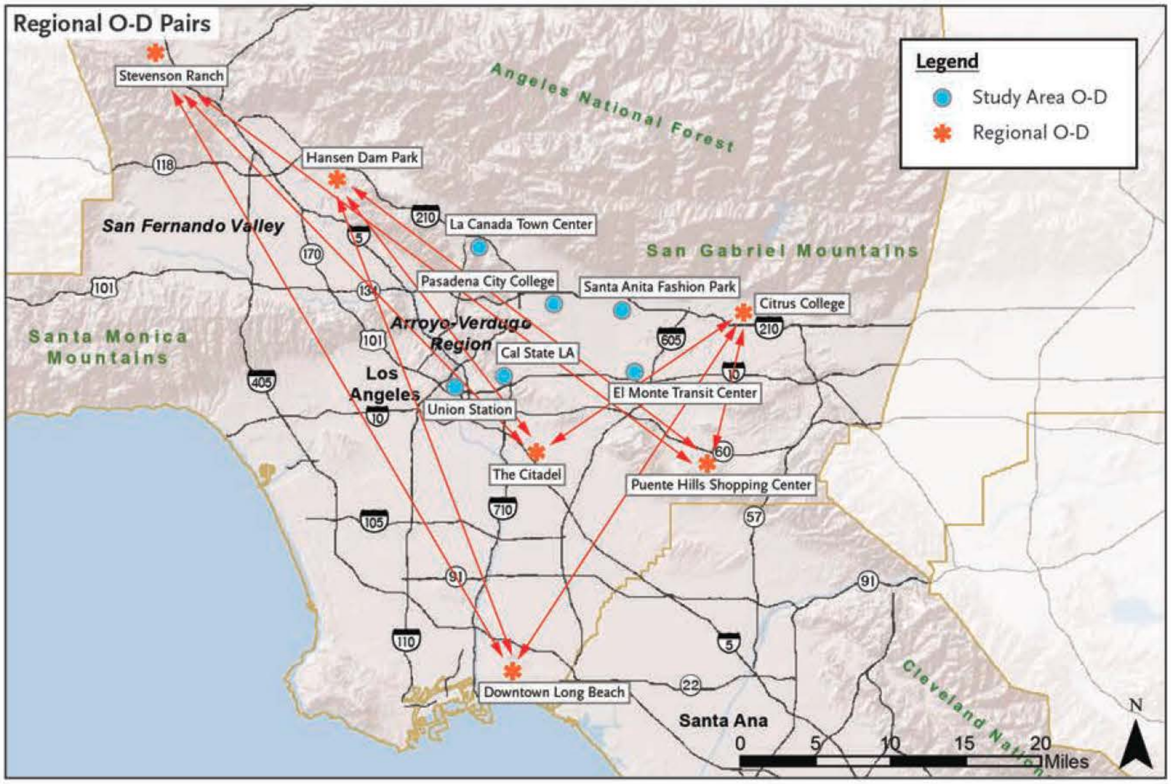
Reduction in Regional Vehicle Hours of Travel

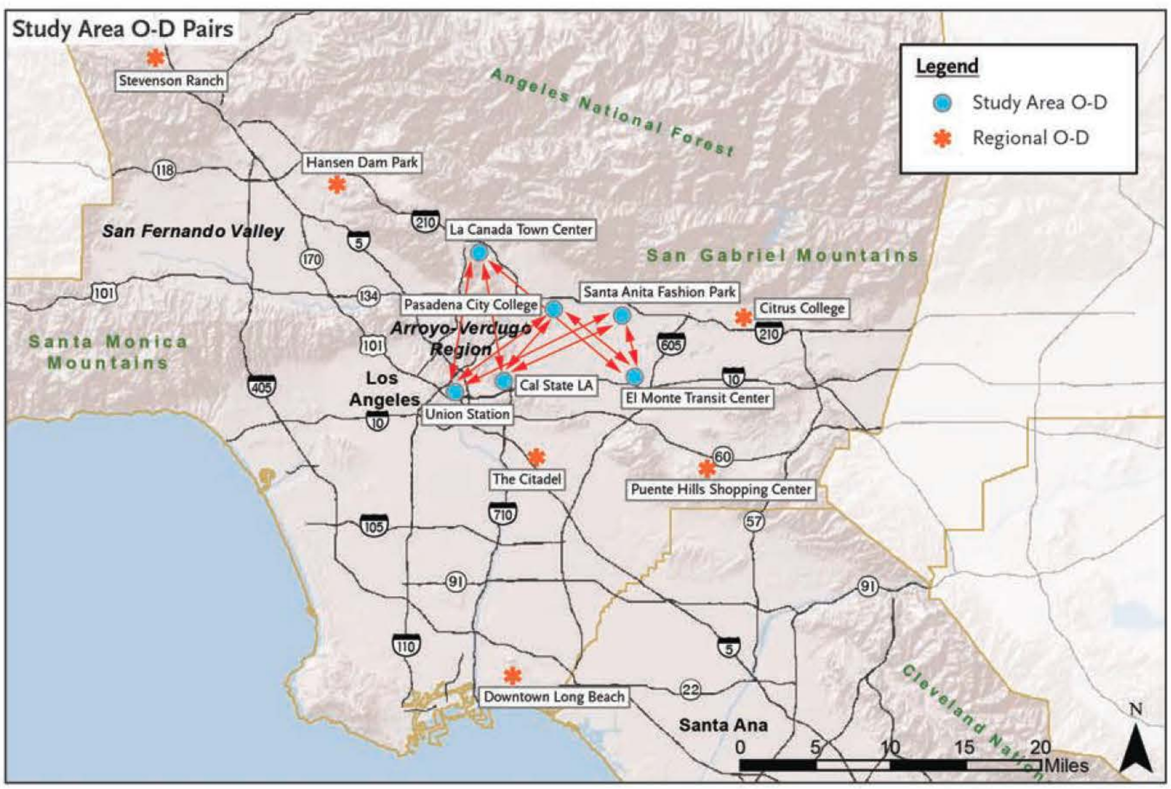
The reduction in VHT includes all vehicular (automobile and truck) trips made during the a.m. and p.m. peak periods in the six-county SCAG region. The a.m. peak period is 6:00 to 9:00 a.m., and the p.m. peak period is 3:00 to 7:00 p.m. The reduction is compared to the No Build Alternative, so the No Build Alternative scores zero on this measure.

Percentage of Travel in Managed Facilities

The percentage of travel on facilities in the study area that have dedicated or managed lane operations (HOV facilities or tolled facilities) was used as a measure of travel time reliability. Managed lanes provide more reliable travel times than general purpose lanes, and are operated to keep traffic moving at a consistently high speed, typically 45 mph or higher.

Figure 3-1: Regional and Study Area Trips for Trip Travel Time





3.1.1.2 Improve Connectivity and Mobility

The second objective for meeting the regional transportation system needs is to improve connectivity and mobility in the region and in the study area. Five performance measures were developed to allow for comparisons of how well the alternatives meet this objective.

New Interchanges and Transit Connections

In a dense transportation system, such as the one in LA County, it is beneficial to measure the access to regional freeway and transit systems. Travel on freeways is typically at a faster speed, and often a more direct route to destinations. In addition, in a more efficient system, roadway users are able to choose among alternative routes, allowing traffic to be distributed more evenly and reducing the amount of travel that must take place on congested facilities. The number of new interchanges that connect to existing facilities and the extensions of existing highways are considered new connections to the regional freeway system.

For the transit system, it is beneficial to increase the number of transfer locations between routes with high frequency service. More connections among routes with high frequency service provide riders with more options to reach their destinations and reduce transfer and travel time. The performance measure representing new transit connections is simply the number of new transfer points between any new transit service and existing fixed-guideway service in the study area (the Metro Gold Line, Metrolink, and the El Monte Busway).

Jobs Reachable Within Fixed Time

Employment accessibility is a measure of how many jobs are accessible to residents within a defined time interval. The evaluation tool for this measure looks at the average number of jobs accessible by residents of twelve areas in the study area. Figure 3-2 shows the origins that were used to determine employment accessibility.

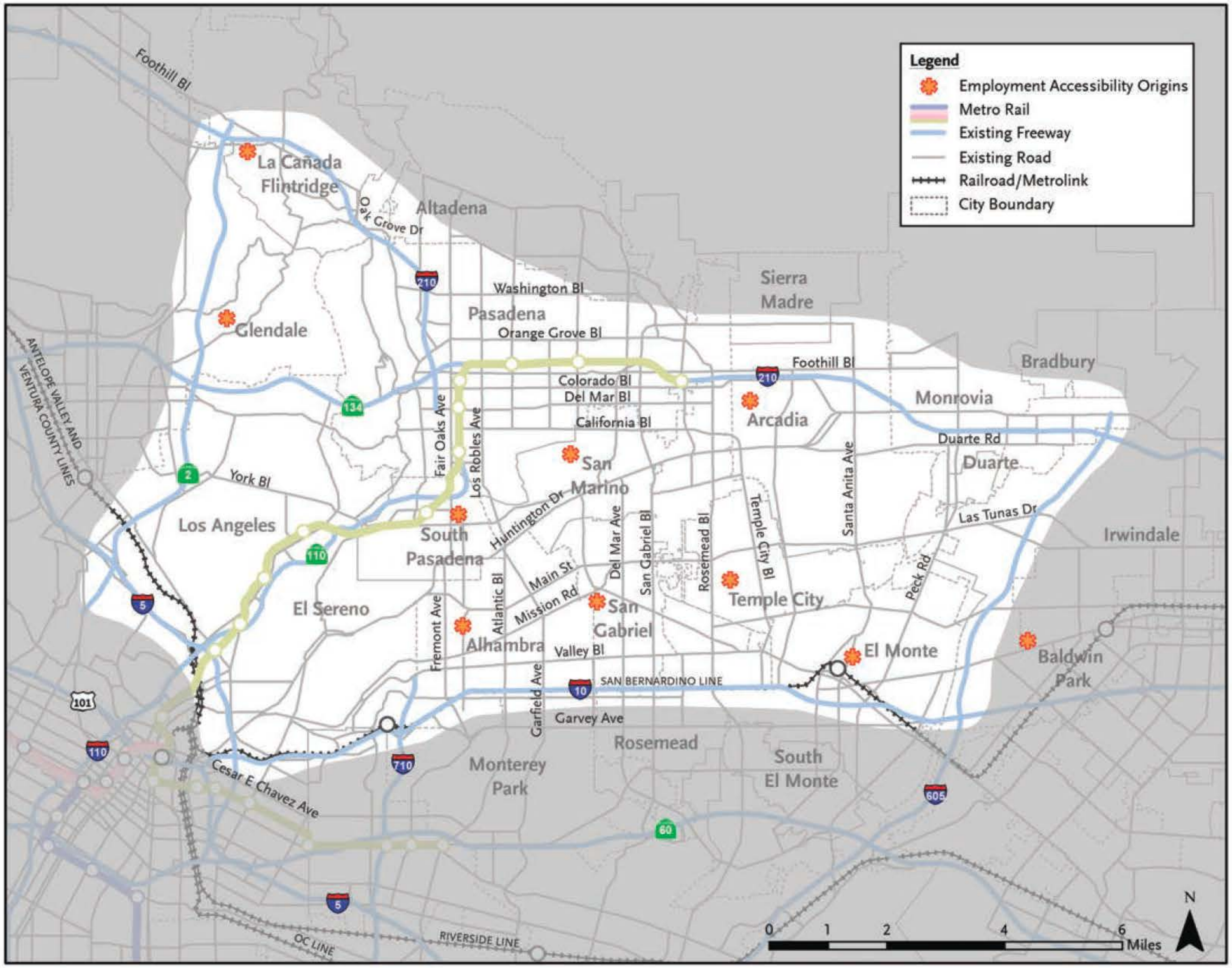
Due to increasing congestion and delay on the regional transportation network (including freeways and arterials), the number of jobs accessible to residents of the study area within 25.3 minutes (the average commute time in the United States (U.S.) in 2010, according to the U.S. Census Bureau) will decrease by 2035. For this measure, the number of jobs reachable within 25.3 minutes from the 12 origins by automobile or transit during the peak periods was calculated. The number of jobs accessible by vehicle and transit access were calculated separately, but then combined so no job is double counted. The final performance measure was the average number of jobs accessible from all 12 origins by vehicular and transit modes of travel.

Compared to the No Build Alternative, the other alternatives will restore lost job accessibility. The employment accessibility performance measure is reported as a percentage calculated by dividing the increase in the number of jobs accessible under the alternative compared to the No Build Alternative by the number of accessible jobs lost between 2008 and the No Build Alternative.

For example, if the 2008 average number of jobs accessible from the 12 origins was 100,000, the 2035 No Build Alternative value was 85,000, and the 2035 value for an alternative was 95,000 then the performance measure would be $(95{,}000-85{,}000)/(100{,}000-85{,}000) \times 100 = 67$. If the alternative returned the average of the accessible jobs to 2008 levels, the value of the performance measure would be 100, and if the alternative increased the average number of jobs accessible to a value greater than the 2008 levels, the performance measure would be greater than 100.

Alternative performance measures using different commute times (e.g., 40 minutes instead of 25.3 minutes) were also analyzed, and the pattern of results was found to be similar.

Figure 3-2: Employment Accessibility Origins



Transit Boardings

Transit speeds in the study area are relatively low, because most transit travel takes place on buses that experience the same traffic congestion as other vehicles. Regional travel on transit routes through the study area is reduced because travelers have faster options. A performance measure to capture the increase in use of transit for regional trips was created to reflect the total boardings on north-south transit routes that traverse the study area. This measure is the sum of all daily boardings on all routes that cross the east-west screenline shown in Figure 3-3, regardless of their origin or destination. (A screenline is an imaginary line across a section of freeways, arterials, and transit routes.) The screenline extends west to include the Metro Red Line to North Hollywood so that the measure of transit boardings would count a shift of existing trips from the Red Line to a new transit route in the study area as new transit boardings.

North-South Arterial Volumes

Mobility within the study area is limited by congestion caused by regional traffic using the arterial roadways within the study area. A decrease in regional traffic on local streets would improve arterial performance and mobility. A performance measure that represents the improvement in mobility within the study area was created to capture the number of daily vehicle trips removed from north-south arterials within the study area. This measure is calculated as the reduction in the number of daily vehicle trips crossing the east-west screenline shown in Figure 3-3 that take place on arterials. The reduction is compared to the No Build Alternative.

North-South Freeway Throughput

Regional mobility is limited by congestion on the freeways in the study area resulting from demand in excess of capacity. A performance measure that represents the improvement in regional mobility through the study area was created to capture the increase in north-south freeway throughput through the study area. This measure is calculated as the increase in the number of daily trips crossing the east-west screenline shown in Figure 3.3 (i.e., traveling in a north-south direction) that take place on freeways. The screenline extends west to US 101 to ensure that the measure of north-south throughput would not count a shift of existing trips from US 101 to freeways in the study area as additional freeway throughput. The increase in throughput is compared to the No Build Alternative.

3.1.2 Freeway System Operations

The second element of need identified for the SR 710 study is operations on the freeway system in the study area. North-south travel demand in excess of capacity affects mobility, resulting in increased delay and unpredictable travel times on study area freeways. The objective derived from these conditions on the freeway system is to reduce congestion on the freeway system. Three performance measures were developed to represent the level of congestion on the freeway system. Two of the measures calculate the total directional miles of roadway facilities experiencing different levels of congestion. The third measure calculates the total number of miles of vehicle travel that occur on congested facilities each day.

3.1.2.1 Facility Miles Operating at LOS F1 or Worse

Severe congestion is defined as demand in excess of 110 percent of capacity. This condition can also be described as a v/c ratio of greater than 1.1, which is also sometimes referred to as a “level of service” (LOS) of “F1”. (LOS uses a letter range from A to F, with increasingly worse congestion rated as F0, F1, F2, etc.). This performance measure represents the total number of roadway facility miles operating at LOS F1 (v/c ratio greater than 1.1) during either the a.m. or p.m. peak periods.

Figure 3-3: East-West Screenline

3.1.2.2 Facility Miles Operating at LOS E or LOS F0

This performance measure represents the total number of roadway facility miles operating at LOS E or F0 (v/c ratio between 0.9 and 1.1) during either the a.m. or p.m. peak periods.

3.1.2.3 VMT on Congested Facilities

This performance measure represents the total number of miles of vehicle travel that occur on congested facilities (v/c ratio greater than 1.0) each day. In a more efficient system, roadway users are able to choose among alternative routes, allowing traffic to be distributed more evenly and reducing the amount of travel that must take place on congested facilities.

3.1.3 Local Street System in the Study Area

The third element of need identified for the SR 710 study is congestion on the local street system. The use of the local streets by regional traffic contributes to low speeds on local arterials. The objective related to the local street system is to reduce congestion on local streets. Several performance measures were developed to reflect operations on the local street system in the study area: percentage of congested intersections, average v/c ratios on arterials, VMT on arterials, arterial cut-through percentage, and north-south travel on arterials.

3.1.3.1 Percentage of Congested Intersections

One indication of how well the local street system is operating is the number of intersection approaches with a v/c ratio greater than 1.0. This performance measure represents the performance of a sample of 50 intersections in the study area, shown in Figure 3-4. The measure is calculated as the percentage of approaches to these intersections having a v/c ratio greater than 1.0 during the p.m. peak period. Each intersection has multiple approaches (frequently four).

3.1.3.2 Average V/C Ratios on Arterials

A second performance measure for local street operations is the average v/c ratio of arterials. This measure is the average of the v/c ratios during the a.m. or p.m. peak periods on all arterials crossing the screenline shown in Figure 3-3. The greater of the average v/c ratios during either the a.m. or p.m. peak periods is the value reported for this measure.

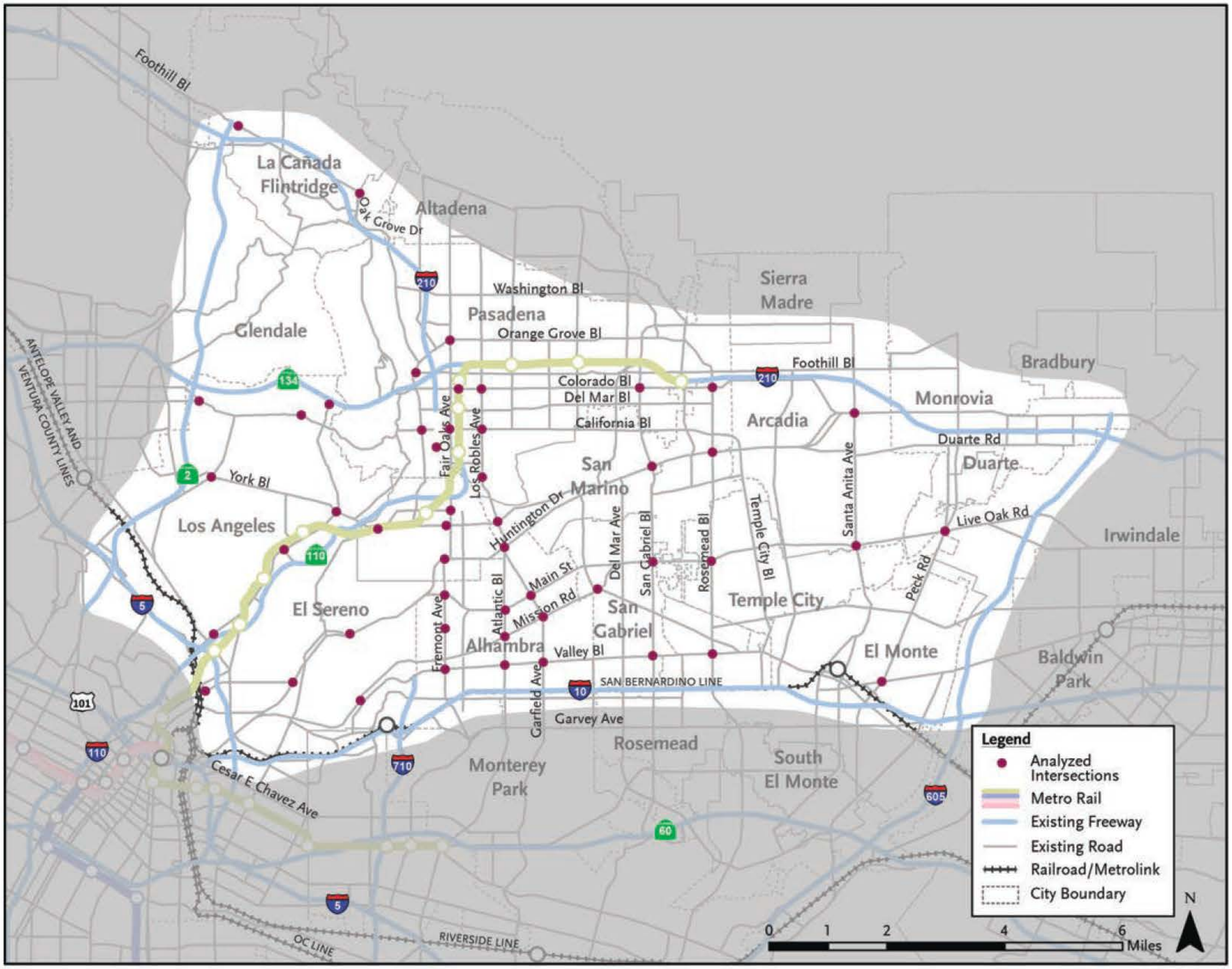
3.1.3.3 VMT on Arterials

Congestion in the regional transportation system causes regional travel to shift to the arterial street network, increasing the total VMT on arterials. Increased VMT on local streets results not only in delay to local travelers, but increased localized air quality impacts, quality of life impacts, and increased accidents. One performance measure related to local arterial operations is the reduction in daily VMT on arterials and collectors compared to the No Build Alternative.

3.1.3.4 Arterial Cut-Through Percentage

Another performance measure related to congestion on the local street system is the use of local arterials for long distance trips. These “cut-through” trips create congestion and quality of life impacts by adding vehicles traveling for extended distances to local roadways rather than on the freeway system. This performance measure is calculated as the percentage of trips on arterials with both an origin and a destination outside of the study area. For this calculation, four major arterials in the center of the study area were used to represent cut-through travel:

Figure 3-4: Intersections Analyzed for Congested Approaches



- Huntington Drive East of Fremont Avenue
- Monterey Road South of SR 110
- Fremont Avenue South of Huntington Drive
- Rosemead Boulevard South of Huntington Drive

Figure 3-5 shows the four representative locations to determine study area cut-through travel. The total number of trips traveling on any of these four roadway segments throughout the day was divided into the number with both an origin and a destination outside of the study area. The performance measure is the percentage of trips with both an origin and a destination outside of the study on these four roadway segments.

3.1.3.5 North-South Person Travel on Arterials

Another measure of congestion on local streets is the total amount of travel using the streets. This measure is calculated as the total daily person trips on arterials crossing the east-west screenline shown in Figure 3-3.

3.1.4 Transit System in the Study Area

The fourth element of need identified for the SR 710 study is the transit system in the study area. The transit system in the study area suffers from the same operational deficiencies of the roadway system that affect private vehicles, resulting in low travel speeds for buses and increased delay for peak hour trips. In addition, the transit system currently has only a limited number of north-south routes. The objective for the transit system in the study area is to increase transit ridership. Three performance measures were developed to quantify an increase in transit ridership in the study area: new transit ridership, transit accessibility, and transit mode share.

3.1.4.1 New Transit Riders

New transit ridership is both an objective of the project and an indicator of how well the transit system is performing. Increases in the number of transit riders can result from increases in transit service, reduced transfer times, or new services that are available. This performance measure is calculated as the change in total daily transit riders (also known as "linked transit trips") compared to the No Build Alternative.

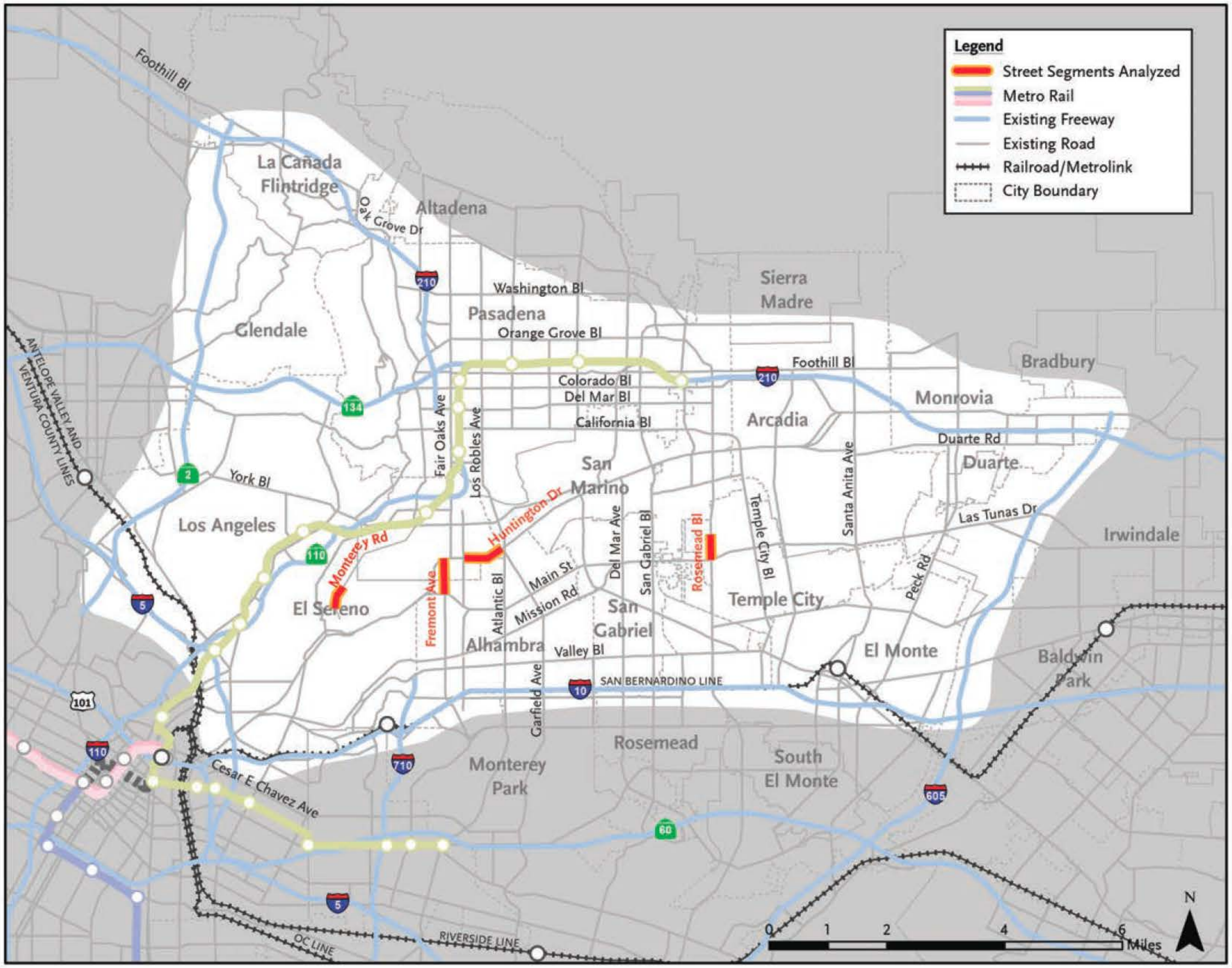
3.1.4.2 Transit Accessibility

The potential for additional future increases in transit ridership can be created with an increase in transit accessibility. Transit accessibility is defined as the percentage of the study area population and employment that is located within one-quarter mile of a transit stop with high frequency service (headways less than 15 minutes). A higher percentage of the study area population or employment within this proximity to high frequency service provides a basis for a continuing increase in transit ridership. For this performance measure, the percentages of population and employment are calculated separately, and the average of the two is reported as the transit accessibility percentage.

3.1.4.3 Transit Mode Split

Transit mode split (or "mode share") is the ratio of transit trips to total person trips within the study area. This measure is calculated for daily trips within the study area, and is an indicator of how competitive the transit system is relative to other modes of travel. A higher mode split for transit indicates an increase in transit trips relative to other modes of travel.

Figure 3-5: Study Area Cut-Through Travel Locations



3.2 Performance of Alternatives

The evaluation of the transportation system performance measures for each of the alternatives is presented below. The performance of each alternative was evaluated using a travel demand modeling (forecasting) process combining the SCAG 2008 RTP travel demand model and the Metro Measure R transit forecasting model. This blended modeling approach was designed to take advantage of the strengths of each tool (highway and transit forecasts). The forecast year of both models is 2035. Details of the evaluation methodology are included in the Forecast Results and Future System Performance Report in Appendix I. Detailed performance results for each alternative on each performance measure are included in Appendix J. The performance measures are categorized into the four elements of need, which are addressed by five objectives as previously listed in Table 3-1. The performance of each of the alternatives on each performance measure is described below.

3.2.1 Regional Transportation System

The objectives related to the need of the regional transportation system are minimizing travel time and improving connectivity and mobility. Each of these objectives is discussed below.

3.2.1.1 Minimizing Travel Time

The objective of minimizing travel times in the region was evaluated using four performance measures, including average point-to-point travel times for trips made by private vehicles, average point-to-point travel times for trips made by transit, total VHT, and percentage of travel in managed facilities.

Point-to-Point Travel Time – Vehicles

As described in Section 3.1, a normalized scale was used to evaluate point-to-point travel time for both vehicular and transit trips, with a score of 100 reflecting the maximum reduction in travel time, compared to the No Build Alternative. Figure 3-6 shows the performance of each of the alternatives in minimizing travel time for vehicular trips. Since the performance is relative to the No Build Alternative, that alternative receives a score of zero. As shown in the figure, the TSM/TDM Alternative, the BRT alternatives, and the LRT alternatives provide only a small benefit in minimizing travel time for vehicular trips, primarily because they result in only a small reduction in roadway congestion. The freeway alternatives are more effective in minimizing vehicular travel time, with Alternative F-5 providing somewhat less benefit than Alternatives F-2, F-6 and F-7. The highway alternatives are also not very effective in minimizing travel time for vehicular trips.

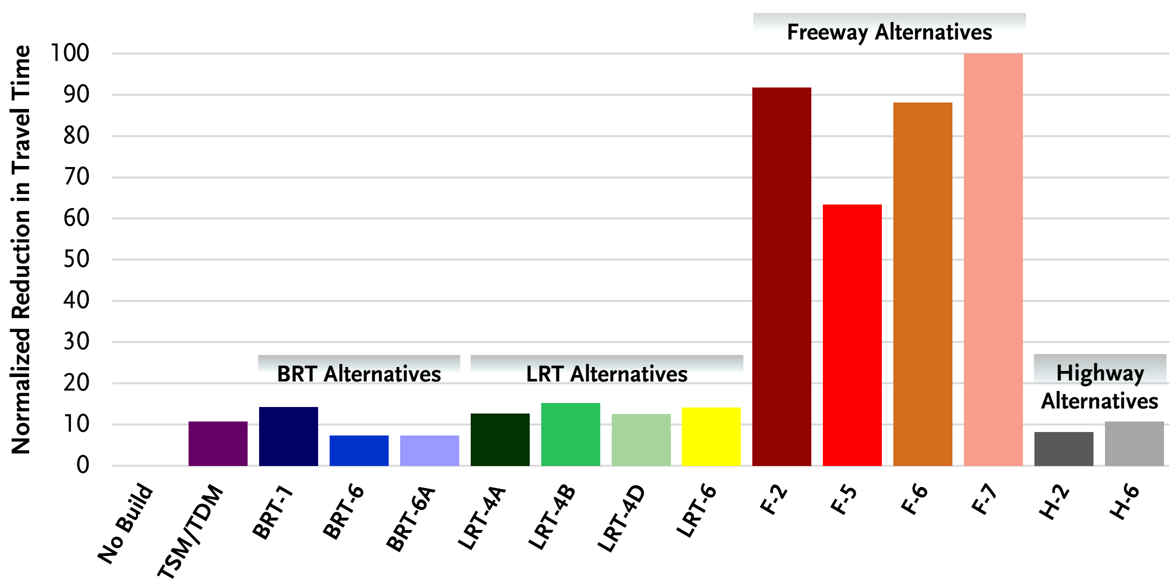
Point-to-Point Travel Time – Transit

Figure 3-7 shows the performance of each of the alternatives in minimizing regional travel time for transit trips as compared to the No Build Alternative. As shown in the figure, the TSM/TDM Alternative is somewhat effective in minimizing transit times, with a score of 41. Alternative BRT-1 is the most effective in minimizing transit travel time, with a score of 100. Alternatives BRT-6 and BRT-6A are effective, with scores over 50. Alternatives LRT-4A, LRT-4B and LRT-4D are only slightly less effective than Alternative BRT-1 in minimizing transit travel time. The freeway and highway alternatives show some improvements in transit travel times as a result of reduced congestion on local streets that are shared by both automobiles and buses. Alternative H-2 is the least effective in minimizing transit travel time, while Alternative H-6 performs similarly to the TSM/TDM Alternative.

Reduction in Regional Vehicle Hours of Travel

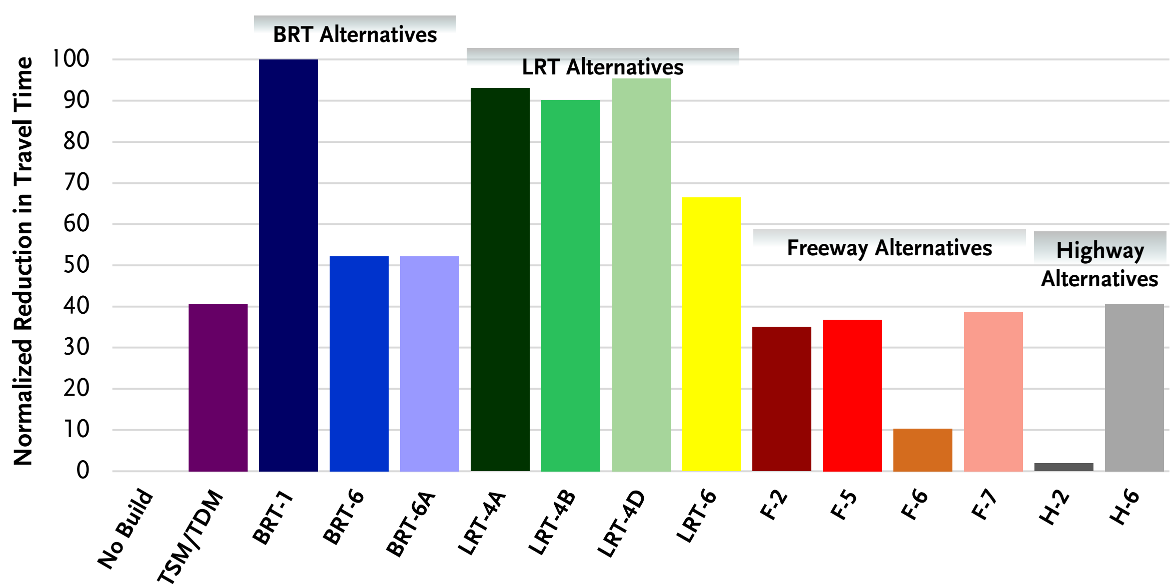
In 2008, total VHT in the region during the a.m. and p.m. peak periods was 5.5 million hours. Under the No Build Alternative in 2035, this number will increase to 8.3 million. As shown in Figure 3-8, the TSM/TDM Alternative and the transit alternatives are more effective at this measure than are the freeway and highway alternatives, primarily because they remove some vehicular trips. The TSM/TDM Alternative reduces total VHT during the a.m. and p.m. peak periods by 89,000 hours compared to the No Build Alternative.

Figure 3-6: Regional Vehicular Travel Time Performance



Note: A score of 100 represents the maximum reduction in travel time.

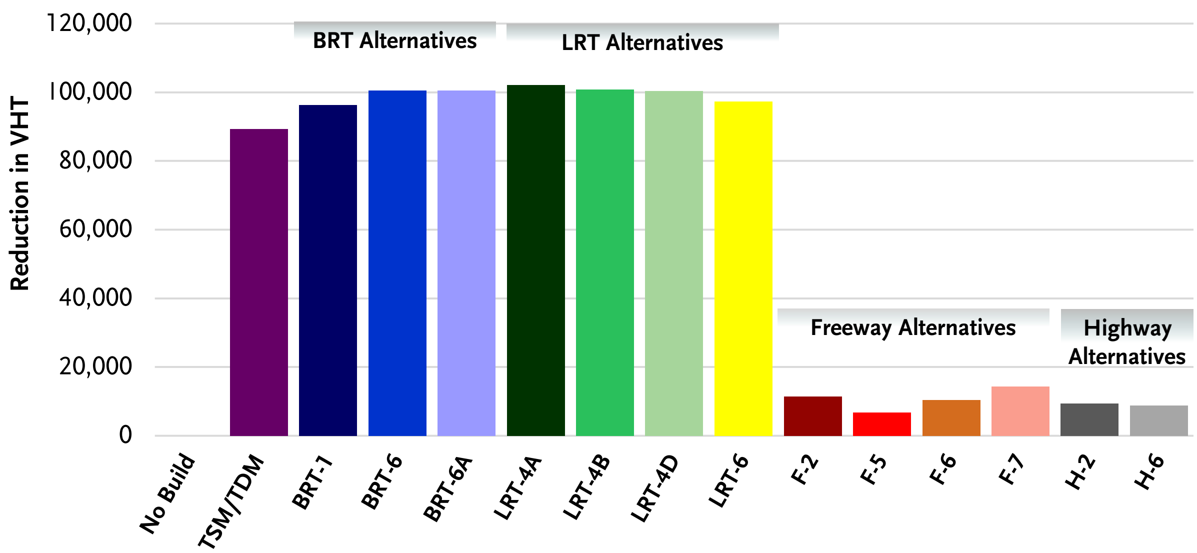
Figure 3-7: Regional Transit Travel Time Performance



Note: A score of 100 represents the maximum reduction in travel time.

Alternatives BRT-1, BRT-6/6A, LRT-4A/B/D, and LRT-6, which include the transit service improvements of the TSM/TDM alternative, each reduce total VHT by 96,000 to 102,000 hours compared to the No Build Alternative. Alternatives F-2, F-5, F-6, and F-7 each reduce total VHT by a total of 7,000 to 14,000 miles, since they do not include the transit improvements from the TSM/TDM Alternative. Alternatives H-2 and H-6 each reduce total VHT by a total of 9,000 hours.

Figure 3-8: Reduction in Regional Vehicle Hours of Travel



Percentage of Travel in Managed Facilities

As described in Section 3.1, the percentage of travel on facilities in the study area that have dedicated or managed lane operations (HOV facilities, or tolled facilities) is used as a measure of travel time reliability. All the alternatives except Alternative F-6 perform the same on this measure, with 8.6 percent of travel on facilities in the study area with dedicated or managed lane operations. Alternative F-6 performs better, at 9.9 percent, because it is the only alternative that includes HOV lanes.

3.2.1.2 Improving Connectivity and Mobility

The objective of improving connectivity and mobility in the region was evaluated using five performance measures: new interchanges and transit connections, jobs reachable within fixed time, increase in transit boardings, reduction in arterial volumes, and increase in north-south freeway throughput.

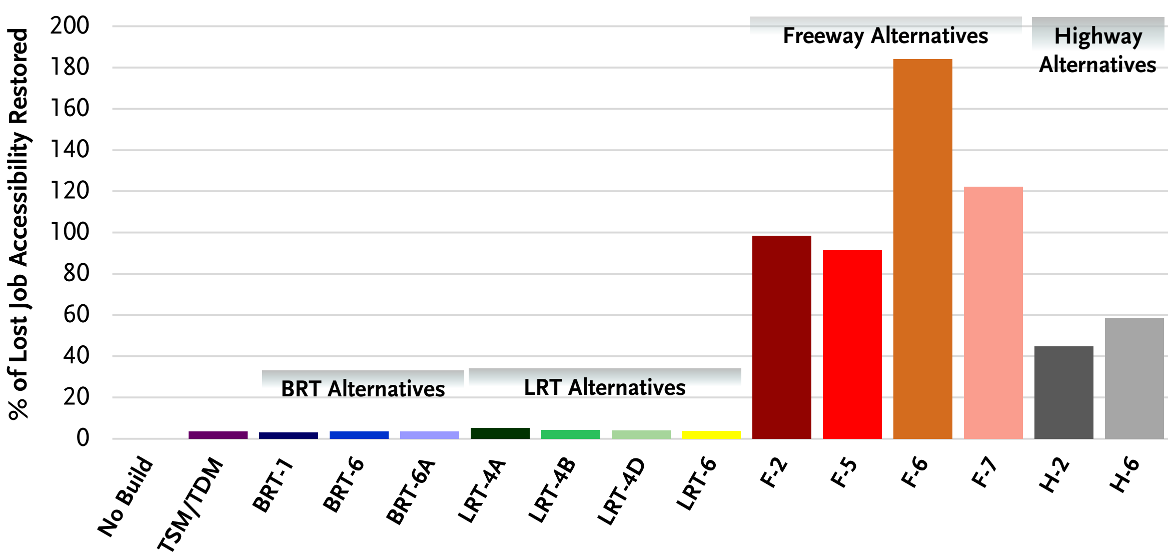
New Interchanges and Transit Connections

One of the measures used to evaluate the improvement in connectivity and mobility is the number of new connection points in the transportation network. For freeway and highway alternatives, a connection point is the number of new interchanges that connect to existing facilities, and the extensions of existing highways. For the transit system, it is the number of transfer locations between high frequency services. The No Build Alternative and the TSM/TDM Alternative do not include any new freeway interchanges or transit connections. Alternative BRT-1 includes one new connection, with the existing El Monte Busway at Union Station. Alternative BRT-6 includes one new connection with the existing Metro Gold Line at the Atlantic Station. Alternative BRT-6A includes two new connections with the existing Metro Gold Line, at the Atlantic and Fillmore stations. Alternative LRT-4A, Alternative LRT-4B and Alternative LRT-4D include three new connections: two with the existing Metro Gold Line, at the East LA Civic Center and Fillmore stations, and one with the Metrolink San Bernardino Line and the El Monte Busway at the Cal State LA Station. Alternative LRT-6 includes two new connections with the existing Metro Gold Line, at the Atlantic and Fillmore stations. All of the freeway and highway alternatives include new connections at the north and south termini. Alternative F-6 includes new connections at Mission Road and Huntington Drive.

Jobs Reachable Within Fixed Time

Under the No Build Alternative, 100,000 fewer jobs will be accessible to residents of 12 locations in the study area within a travel time of 25.3 minutes. As described in Section 3.1, the percentage of this lost job accessibility recovered by each of the alternatives was calculated. Figure 3-9 shows the percentage of recovered job accessibility for each of the alternatives. Since the performance is relative to the No Build Alternative, that alternative receives a score of zero. As shown in the figure, the TSM/TDM Alternative, the BRT alternatives, and the LRT alternatives will result in a negligible increase in job accessibility. The freeway alternatives provide the most significant increase in job accessibility, with Alternative F-6 performing the best at over 180 percent, meaning that in addition to restoring all the lost job accessibility, it makes additional jobs available within 25.3 minutes. The highway alternatives perform moderately well in restoring job accessibility.

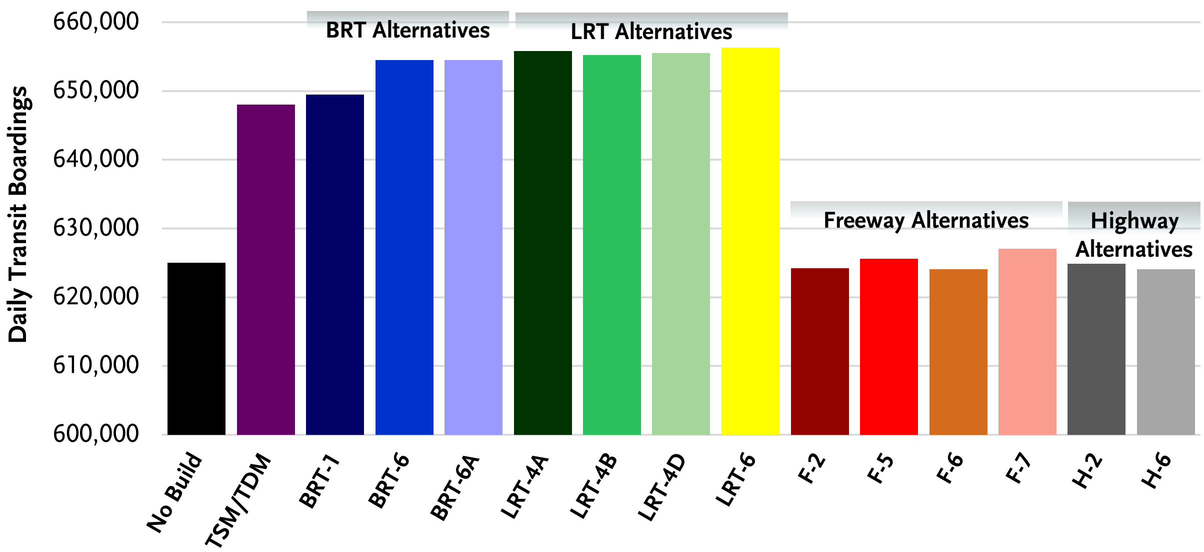
Figure 3-9: Recovery of Lost Job Accessibility



Increase in Transit Boardings

As described in Chapter 1, regional travel on transit routes through the study area is depressed because transit speeds in the study area are slow. The increase in the number of transit boarding on north-south routes through the study area reflects the performance of each alternative in attracting regional trips to transit. Figure 3-10 shows daily transit boardings on north-south routes for each of the alternatives. The No Build Alternative results in 624,946 daily transit boardings on north-south routes. Under the TSM/TDM Alternative, this number is increased by 23,105. Alternative BRT-1 results in 24,482 additional transit boarding, while Alternative BRT-6 and BRT-6A both result in over 29,500 additional transit boarding. All of the LRT alternatives result in over 30,000 additional transit boardings, with Alternative LRT-6 being the highest with 31,373 additional boarding. The freeway alternatives result in little or no change on this measure, with Alternatives F-2 and F-6 resulting in slight decreases in transit boardings because they provide greater travel time savings for automobile trips. Both of the highway alternatives also result in slight decrease in transit boardings.

Figure 3-10: Regional Transit Boardings



Reduction in Arterial Volumes

As described in Section 3.1, this measure reflects the total daily traffic volume crossing a "screenline" on north-south arterials in the study area. In 2008, the modeling analysis indicated that approximately 774,000 vehicle trips crossed the screenline on the north-south arterial system. This number will increase to 941,000 under the No Build Alternative. Figure 3-11 shows the change in north-south arterial volumes for each of the alternatives. Since the performance is relative to the No Build Alternative, that alternative receives a score of zero. The TSM/TDM Alternative slightly increases north-south arterial volumes, since it includes spot intersection improvements and roadway widening that increase roadway capacity. The BRT and LRT alternatives produce no change in north-south arterial volumes. All of the freeway alternatives significantly reduce north-south volumes on the arterial system, with Alternative F-5 being the most effective, removing nearly 100,000 daily trips. Alternative F-7 is the second most effective, removing 80,000 daily trips. The highway alternatives slightly increase north-south volumes on the arterial system in the study area, since their additional capacity attracts trips to the local street system.

Increase in North-South Freeway Throughput

As described in Section 3.1, this measure reflects the total daily traffic volume crossing a "screenline" on freeways in the study area. In 2008, model projections indicate that approximately 781,000 vehicle trips crossed the east-west screenline on north-south freeways. This number will increase to 985,000 under the No Build Alternative. Figure 3-12 shows the change in north-south freeway throughput for each of the alternatives. Since the performance is relative to the No Build Alternative, that alternative receives a score of zero. As shown in Figure 3-12, the TSM/TDM Alternative, the BRT alternatives, and the LRT alternatives result in north-south throughput little changed from the No Build Alternative. All of the freeway alternatives significantly increase north-south freeway throughput, with Alternatives F-5 and F-7 producing the highest throughput. The highway alternatives show a slight decrease in north-south freeway throughput, as they attract trips away from the freeway system.

Figure 3-11: Change in Daily Arterial Volumes (1000s)

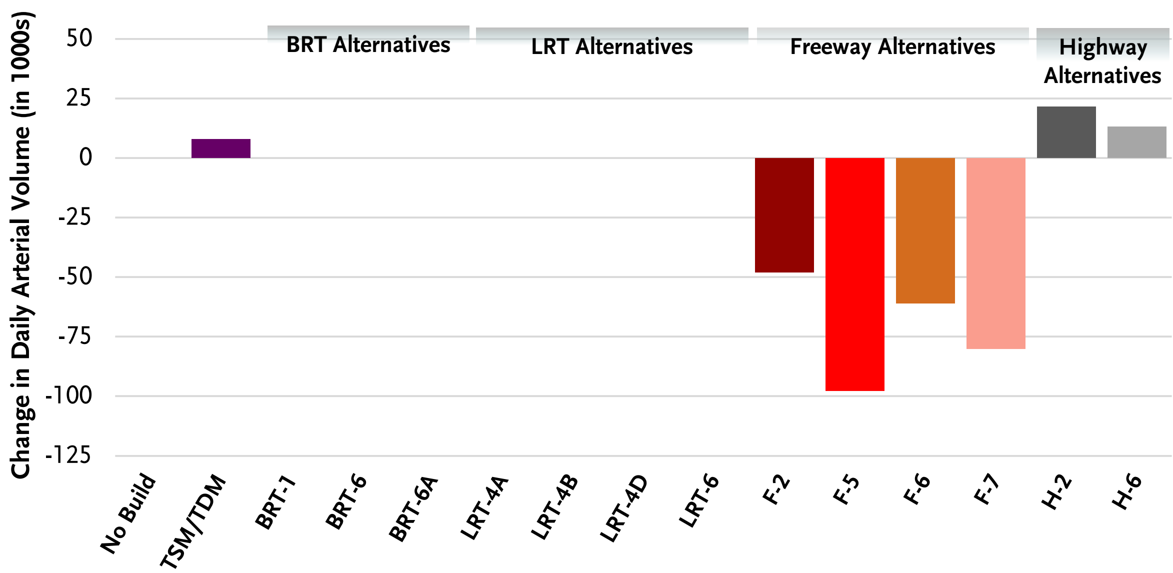
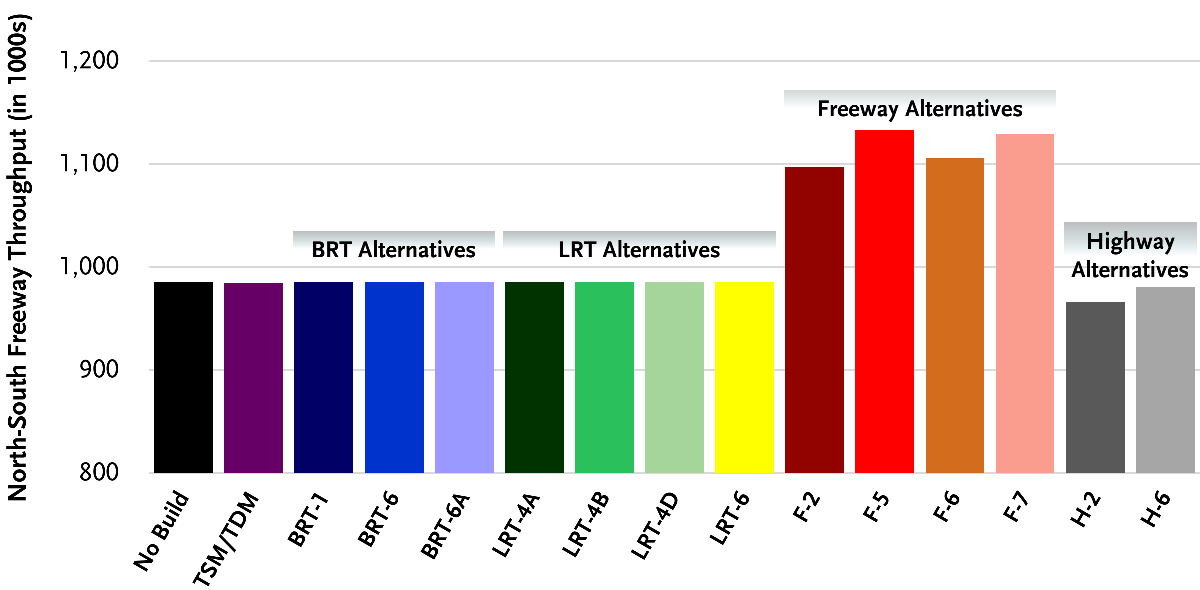


Figure 3-12: North-South Freeway Throughput (1000s)



3.2.2 Freeway System in the Study Area

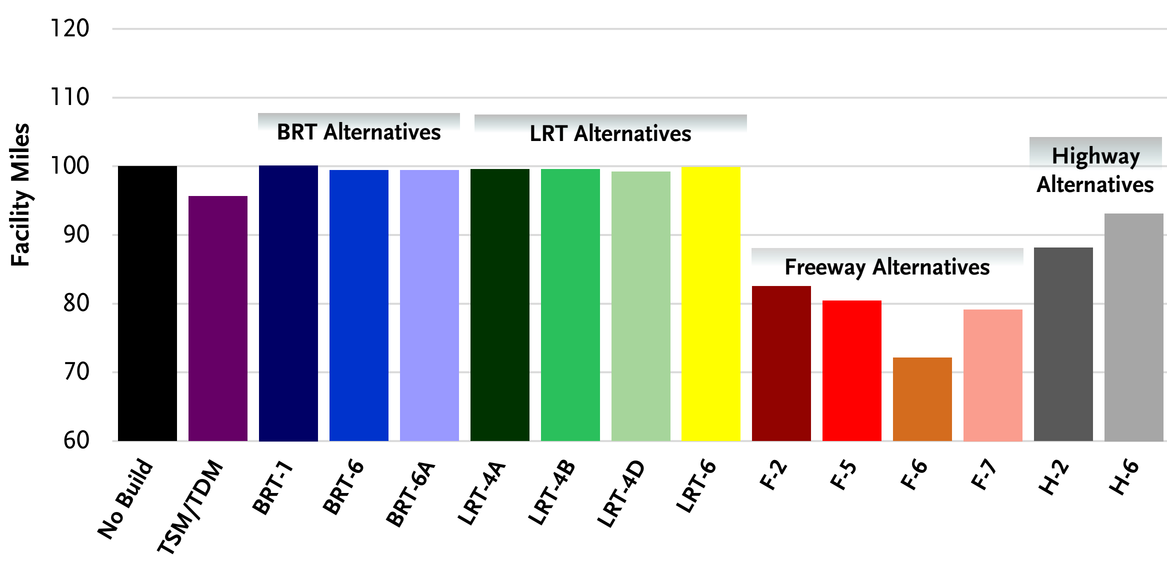
The freeway system in the study area has been identified as being over capacity, with high delays and unpredictable travel times. The project objective of reducing congestion on the freeway system in the study area was evaluated using several measures, including total directional miles of roadway facilities projected to operate at different levels of service and total VMT on congested freeway segments in the study area.

3.2.2.1 Facility Miles Operating at LOS F1

Severely congested facilities were identified by calculating the total directional miles operating at LOS F1 (more than 10 percent over capacity) or worse in 2035 during the a.m. or p.m. peak periods. Figure 3-13 shows total roadway facility miles in the study area operating at LOS F1 during the a.m. or p.m. peak periods for each of the alternatives.

Under the No Build Alternative, the number of facility miles operating at LOS F1 during the a.m. or p.m. peak periods is projected to increase from 64 in 2008 to 100 in 2035. The TSM/TDM Alternative provides only a small benefit on the number of miles of freeway operating at LOS F1, reducing it by less than five percent. None of the BRT or LRT alternatives reduce this measure by more than one percent, as these alternatives do not include any regional freeway improvements, nor do they remove enough vehicles from the freeway system to have an impact on LOS. The freeway alternatives offer major congestion relief as they provide more freeway capacity and allow the opportunity for fewer delays and faster travel times. The freeway alternatives all provide reductions of at least 17 percent, with Alternative F-6 providing a reduction of more than 25 percent.

Figure 3-13: Severely Congested Facility Miles

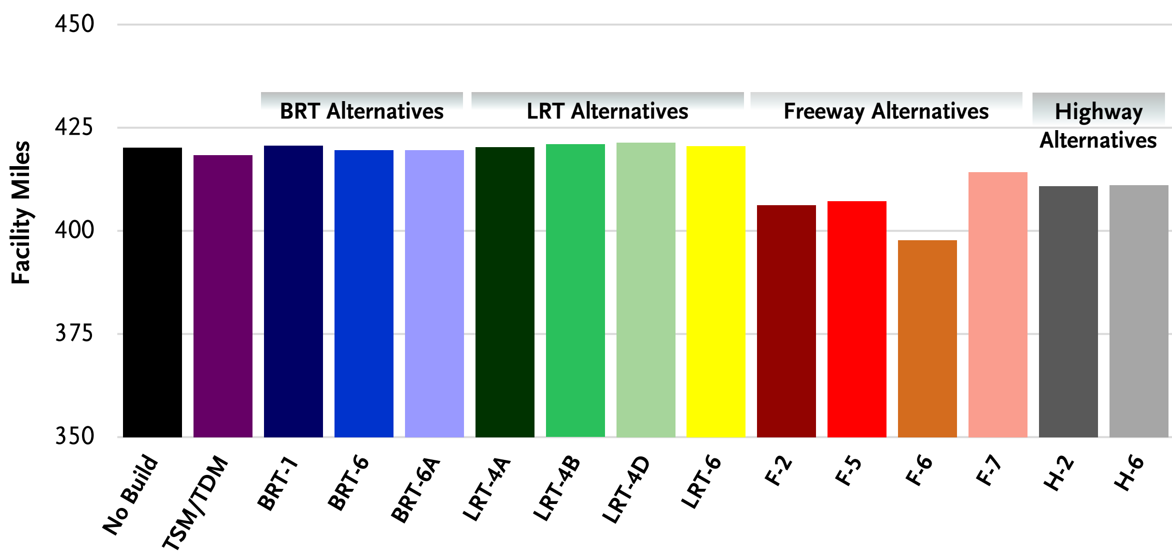


The highway alternatives increase the capacity of the arterials in the study area directly between SR 710 at Valley Boulevard and SR 710 at the terminus of SR 134 at I-120. The improved arterials slightly reduce the congestion on the study area freeways. The highway alternatives provide reductions of up to 12 percent.

3.2.2.2 Facility Miles Operating at LOS E or F0

To provide a more thorough picture of congestion on the study area freeway system, moderate congestion on roadway facilities was also evaluated. Moderately congested facilities are those operating at LOS E or LOS F0 (from 90 percent of capacity to 10 percent over capacity). Figure 3-14 shows total facility miles in the study area operating at LOS E or LOS F0 during the a.m. or p.m. peak periods for each of the alternatives. Under the No Build Alternative, the number of facility miles operating at LOS E or F0 during the a.m. or p.m. peak periods is projected to increase from 316 in 2008 to 420 in 2035. The TSM/TDM Alternative provides only a small benefit on this measure, reducing it by less than one percent. None of the BRT or LRT alternatives reduce this measure by more than one percent. The freeway alternatives reduce this measure by up to five percent. The highway alternatives provide reductions of up to 2 percent. The performance of all alternatives on this measure is relatively modest because those alternatives that perform well on the previous performance measure (reducing severely congested facility miles) shift more facilities into the category of moderately congested, muting the overall benefit on this measure.

Figure 3-14: Moderately Congested Facility Miles



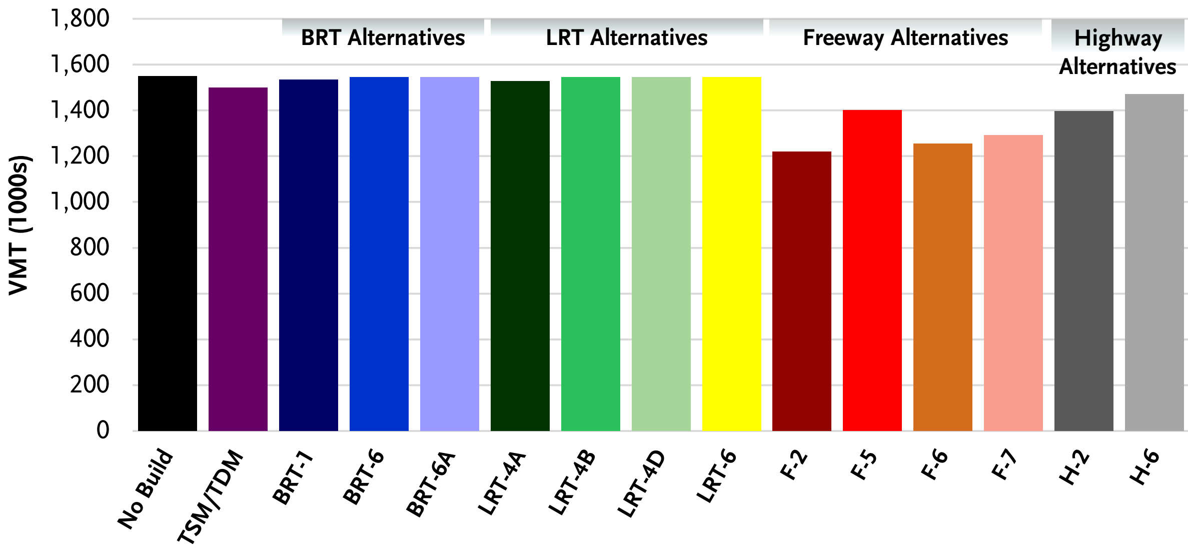
3.2.2.3 VMT on Congested Facilities

Figure 3-15 shows the total daily VMT (automobile and truck) on congested facilities in the study area for each of the alternatives. The TSM/TDM Alternative, the BRT alternatives, and the LRT alternatives reduce this measure by less than four percent. Alternative F-5 reduces this measure by 10 percent, while Alternatives F-2, F-6, and F-7 all reduce this measure by 16 percent or more. Alternatives H-2 and H-6 reduce this measure by 10 and 5 percent, respectively.

3.2.3 Local Street System in the Study Area

The local street system in the study area has been identified as experiencing low speeds, with high congestion, and with out-of-place freeway trips. The objective for the local street system is to reduce congestion. The project objective of reducing congestion on the local street system (arterial and collector roadways) in the study area was evaluated using several different measures, including the percentage of intersection approaches that are over capacity during the p.m. peak period, average v/c ratios on arterials, total daily VMT on local streets, the number of vehicle trips traveling on local streets that have neither an origin nor a destination within the study area ("cut-through traffic"), and north-south travel on local streets.

Figure 3-15: VMT on Congested Facilities



3.2.3.1 Percentage of Congested Intersection Approaches

As described in Section 3.1, the percentage of congested approaches for 55 intersections in the study area was calculated for each of the alternatives. Figure 3-16 shows the percentage of intersection approaches with v/c ratios greater than 1.0 during the p.m. peak period, for each of the alternatives. Under the No Build Alternative, the percentage of congested approaches will increase from 20 percent to 28 percent. Although the TSM/TDM Alternative includes some intersection improvements, it generally performs similarly to the No Build Alternative. The LRT and BRT alternatives do not have any local street capacity or intersection improvements, nor do they reduce traffic volumes enough to alleviate intersection congestion, and they perform similarly to the No Build Alternative. The freeway alternatives draw vehicle trips away from the local streets and onto the freeway system. All of the freeway alternatives reduce the percentage of intersections with congested approaches. Alternatives F-6 and F-7 are the most effective on this measure, compared to the No Build Alternative. Alternative F-6 reduces this percentage to 19 percent, and Alternative F-7 reduces it to 22 percent. Alternative H-2 performs similarly to the No Build Alternative, and Alternative H-6 reduces the percentage of intersections with congested approaches to 23 percent.

3.2.3.2 Average V/C Ratios on Arterials

Figure 3-17 shows the average v/c ratio on north-south arterials within the study area during the peak periods for each of the alternatives. Under the No Build Alternative, the average v/c ratio will increase from 0.70 to 0.77. The TSM/TDM alternative, the LRT alternatives, and the BRT alternatives result in little change from the No Build Alternative. The freeway alternatives reduce the average arterial v/c ratio to 0.71 to 0.73, with Alternative F-6 reducing it the most, to an average v/c ratio of 0.71. Alternatives H-2 and H-6 result in an average arterial v/c ratio of 0.76 and 0.78, respectively.

Figure 3-16: Percentage of Congested Intersection Approaches

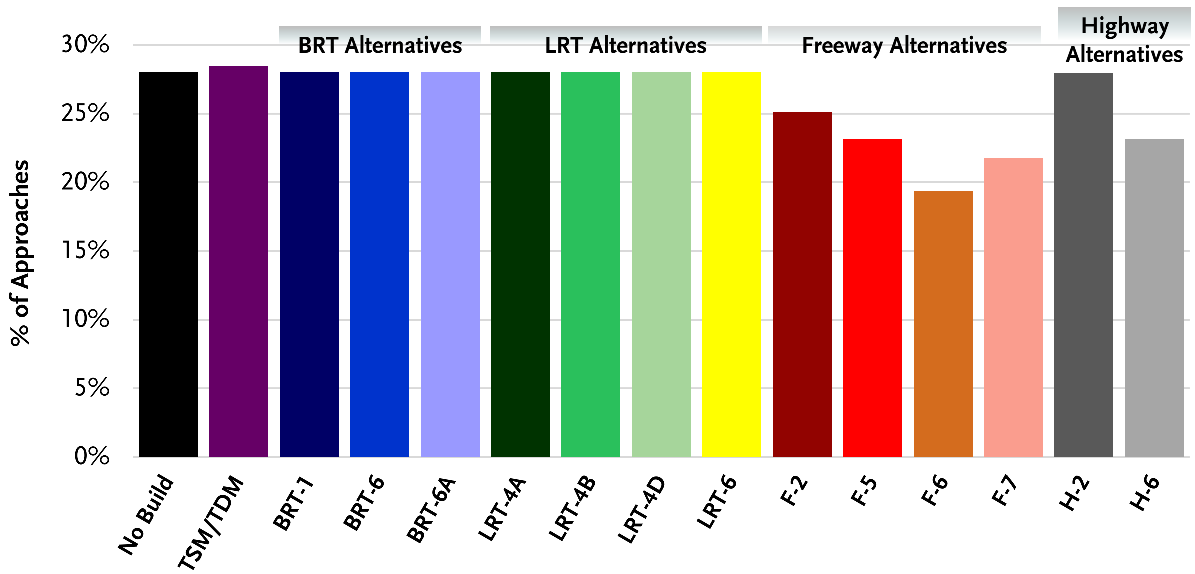
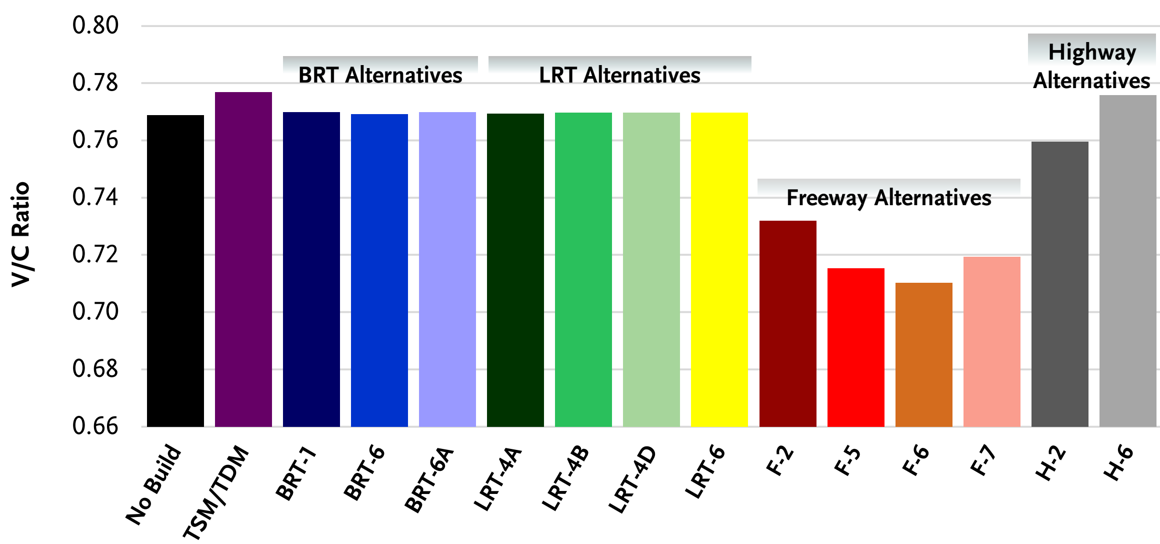


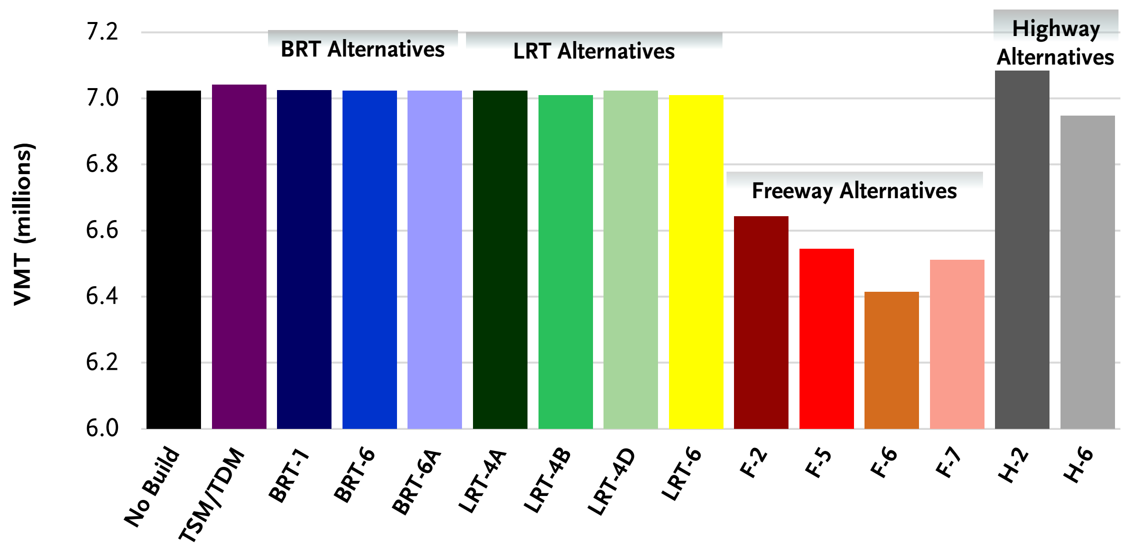
Figure 3-17: Average V/C Ratios on Arterials



3.2.3.3 VMT on Arterials

Figure 3-18 shows total daily VMT on the local street system in the study area for each of the alternatives. Under the No Build Alternative, the daily arterial VMT in the study area will increase from 6 million miles to 7 million miles. The TSM/TDM Alternative, the LRT alternatives, and the BRT alternatives have essentially no effect on arterial VMT, as they do not reduce vehicle volumes on arterials substantially. The freeway alternatives reduce daily arterial VMT by 400,000 to 600,000 miles compared to the No Build Alternative because they shift vehicle trips from arterials to freeways, with Alternative F-6 providing the greatest reduction, followed by Alternative F-7. The highway alternatives add more arterial capacity along certain routes, which draws vehicle trips onto the arterial street network. Alternative H-2 increases daily arterial VMT in the study area by 62,000 miles, while Alternative H-6 decreases daily arterial VMT by 75,000 miles.

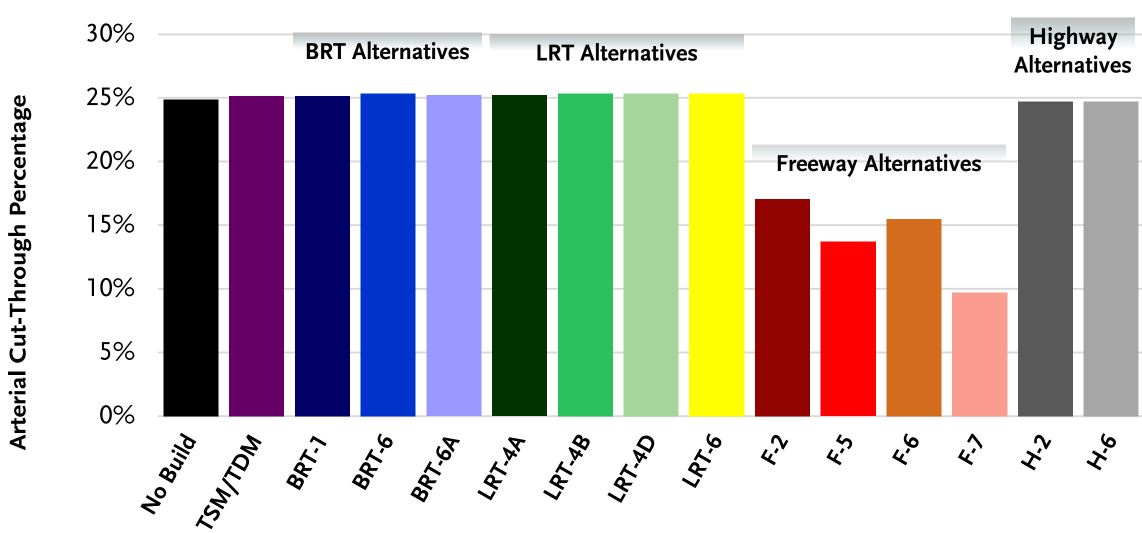
Figure 3-18: Arterial VMT (in millions)



3.2.3.4 Arterial Cut-Through Percentage

Figure 3-19 shows the percentage of arterial cut-through traffic (as defined in Section 3.1) for each of the alternatives. Under the No Build Alternative, the percentage of cut-through traffic will increase from 19 percent to 25 percent. The TSM/TDM Alternative, the LRT alternatives, and the BRT alternatives result in no change in the percentage of cut-through traffic. All of the freeway alternatives reduce cut-through traffic by 30 to 60 percent compared to the No Build Alternative, with Alternative F-7 being the most effective on this measure. The highway alternatives also result in no change in the percentage of cut-through traffic.

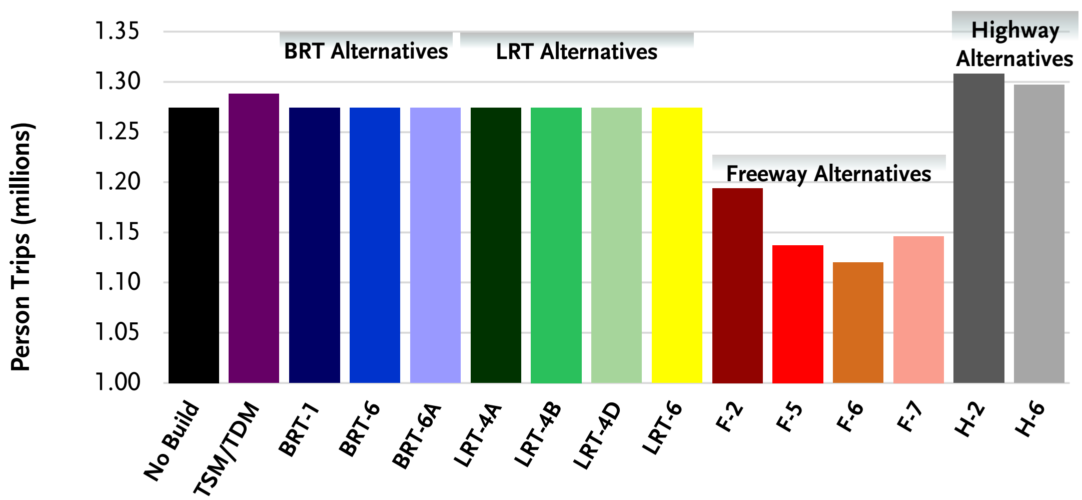
Figure 3-19: Arterial Cut-Through Percentage



North-South Person Travel on Arterials

In 2008, the total number of daily person trips traveling on north-south arterials in the study area was 1.07 million. By 2035, under the No Build Alternative, this number will increase to 1.27 million. Figure 3-20 shows daily north-south person trips on arterials (in millions) for each of the alternatives. The TSM/TDM Alternative will result in slightly more daily arterial person trips than the No Build Alternative because of the spot improvements and roadway widening included in it. The LRT alternatives and the BRT alternatives result in no change on this measure from the No Build Alternative. All of the freeway alternatives will reduce daily north-south arterial person trips by 80,000 to 154,000 because they shift some trips from arterials to the freeway network, with Alternative F-6 being the most effective on this measure. The highway alternatives increase this measure by up to 33,000 trips.

Figure 3-20: North-South Daily Person Trips



3.2.4 Transit System in the Study Area

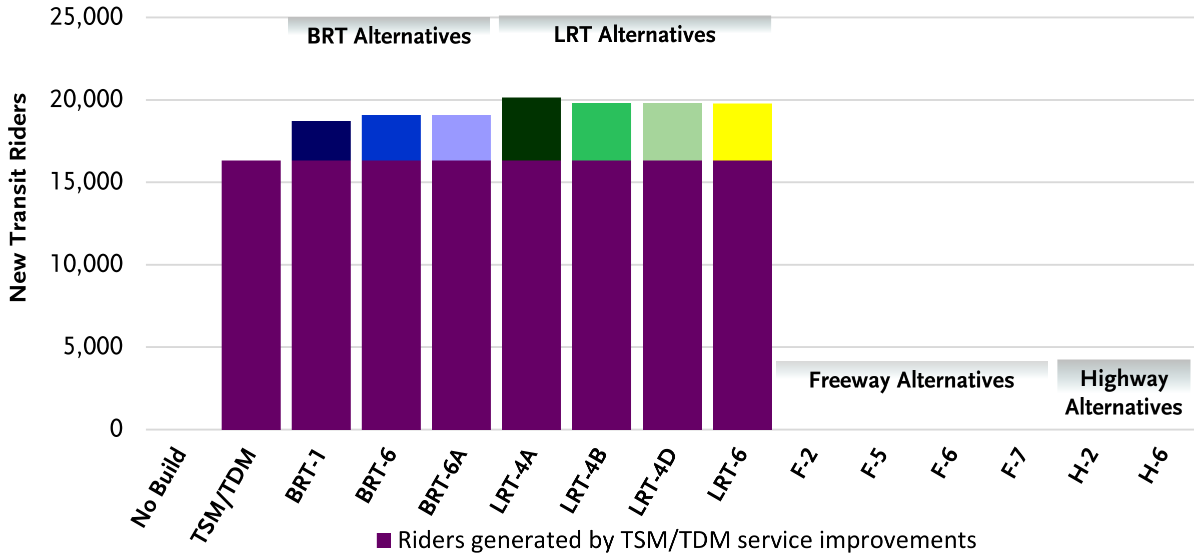
The fourth element of need is operations of the transit system in the study area. The needs identified related to the transit system are operational deficiencies of the roadway system that affect transit service, low travel speeds for buses, increased delay for peak hour trips, and limited north-south routes. The objective for the transit system is to increase transit ridership. The project objective of increasing transit ridership was evaluated using three performance measures: new transit riders, the percentage of the study area population and employment within one-quarter mile of high-frequency transit service (transit accessibility), and the percentage of trips made by transit (mode share).

3.2.4.1 New Transit Riders

This performance measure is reported as the change in daily transit riders (also known as “linked transit trips”) compared to the No Build Alternative. None of the freeway or highway alternatives result in additional transit ridership. Figure 3-21 shows new daily transit riders for the TSM/TDM Alternative, the BRT alternatives, and the LRT alternatives. Since the BRT alternatives and the LRT alternatives include the transit service enhancements from the TSM/TDM Alternative, Figure 3-21 shows the new riders generated by the TSM/TDM service improvements as a component of the total new riders for each transit alternative. The TSM/TDM Alternative by itself attracts over 16,000 new riders.

Alternatives BRT-1, BRT-6 and BRT-6A attract a total of 18,690, 19,058 and 19,058 new riders, respectively. Alternatives LRT-4A, LRT-4B and LRT-4D attract a total of 20,136, 19,806 and 19,804 new riders, respectively, approximately 0.2% of person trips in the study area.

Figure 3-21: New Transit Riders



3.2.4.2 Transit Accessibility

As described in Section 3.1, the percentage of the study area population and employment that is located within one-quarter mile of a transit stop with high frequency service (headways less than 15 minutes) was calculated to measure transit accessibility. In 2006, this percentage was approximately 32 percent. In 2035, under the No Build Alternative, this number is expected to be 29 percent. Figure 3-22 shows this percentage for each of the alternatives.

The TSM/TDM Alternative and all of the LRT and BRT alternatives increase the percentage of the study area population and employment within one-quarter mile of high-frequency transit service from approximately 29 percent under the No Build Alternative to approximately 35 percent. Almost all of this increase is the result of the additional traditional bus service provided by the TSM/TDM Alternative, which is also incorporated into the BRT and LRT alternatives. None of the freeway or highway alternatives increase this percentage.

3.2.4.3 Transit Mode Share

In 2008, the transit mode share, or the ratio of transit trips to total person trips, in the study area was 3.4 percent. Transit mode share for each of the alternatives is shown in Figure 3-23. The TSM/TDM Alternative and all of the LRT and BRT alternatives increase transit mode share from approximately 3.7 percent under the No Build Alternative to approximately 3.9 percent. None of the freeway or highway alternatives increase this percentage.

Figure 3-22: Percentage of Population and Employment within ¼ Mile of Transit

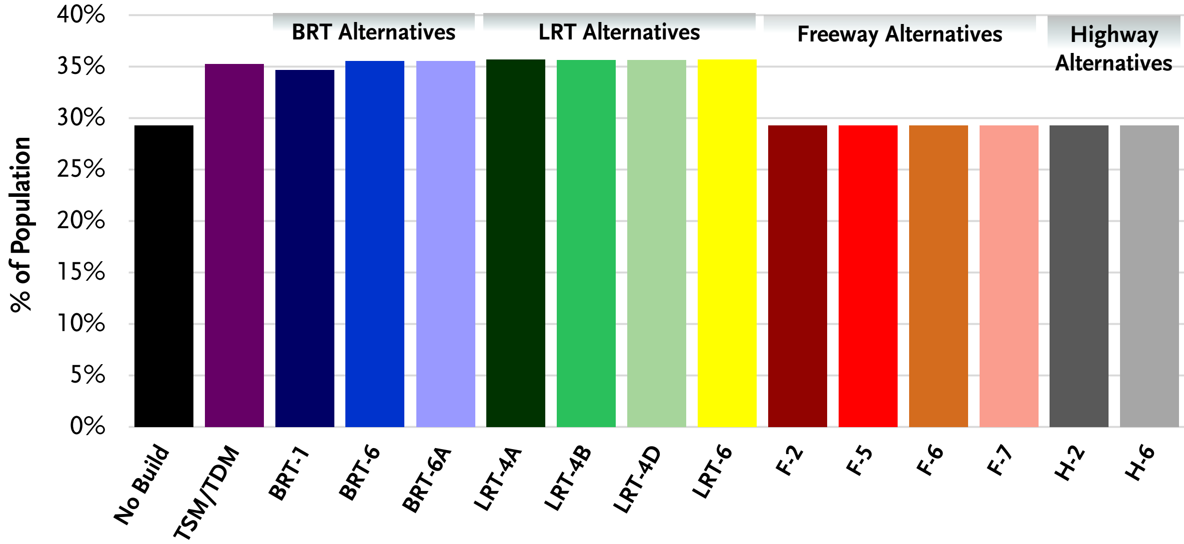
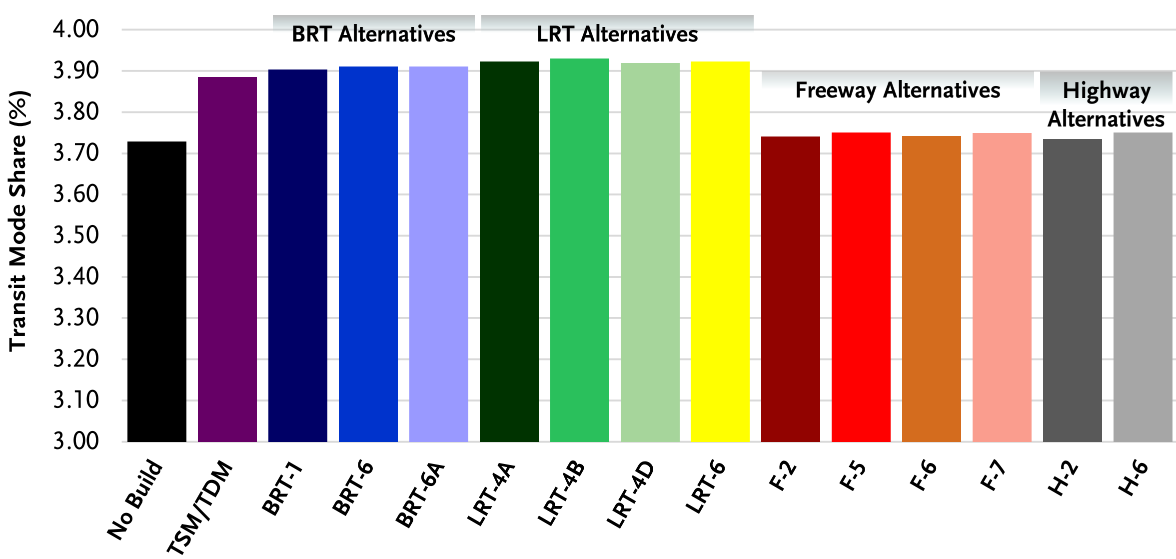


Figure 3-23: Transit Mode Share



4.0 Environmental Impacts and Planning Considerations

In addition to transportation system performance measures described in Chapter 3, the initial set of alternatives was evaluated against the project objectives focused on environmental impacts and planning considerations. For each of these objectives, detailed performance measures were developed. This section describes the performance of each of the alternatives in the initial set of alternatives on the 19 performance measures related to these project objectives.

Table 4-1 presents the performance measures associated with each of these objectives. Because of the wide range of factors included within the objective to "Minimize environmental and community impacts related to transportation," this objective has been separated into three parts in Table 4-1: property acquisitions, impacts on the human environment, and impacts on the natural environment.

Table 4-1: Environmental and Planning Performance Measures

Value or Concern	Objective	Performance Measures
Environment and communities	Minimize environmental and community impacts related to transportation	<u>Property Acquisitions</u> Residential or business acquisitions <u>Human Environment</u> Recreational/community sites impacted Archeological sites impacted Properties over 45 years old impacted Significant historic resources impacted Increase in noise exposure Increase in mobile-source air toxics (MSATs) Increase in regional criteria pollutants Increase in greenhouse gas (GHG) emissions Hazardous waste sites impacted Visual intrusion in communities Scenic corridors impacted <u>Natural Environment</u> Areas of high paleontological sensitivity impacted Exposure to adverse geotechnical conditions Sensitive habitats impacted Drainages impacted
Consistency with plans	Assure consistency with regional plans and strategies	Consistency with RTP/SCS goals Consistency with Measure R goals Consistency with Metro LRTP goals

4.1 Descriptions of Performance Measures

Each of the 19 performance measures related to environmental impacts and planning considerations was developed to meet the values and concerns presented in Table 4-1. The performance measures for each objective are described in the following sections.

4.1.1 Minimize Environmental and Community Impacts Related to Transportation

The objective to "minimize environmental and community impacts related to transportation" has been separated into three parts: property acquisitions, impacts on the human environment, and impacts on the natural environment.

4.1.1.1 Property Acquisitions

Potential property acquisitions were evaluated based on the total number of full residential or business acquisitions required for each alternative. Potential property acquisitions were determined by overlaying the design footprint of each alternative on top of the Los Angeles County Assessor's parcel boundary layer in a Geographic Information System (GIS). Based on the preliminary level of design completed at this phase, it was not always possible to determine conclusively how the conceptual designs would impact each property and whether a partial acquisition could be required instead of a full acquisition. Therefore, for the purposes of this screening, if a property was impacted at all, it was considered to be a full acquisition. However, the acquisition of subterranean and aerial easements was not considered an impact for the purposes of this screening. It should be noted that this is a conservative approach to identifying the number of impacted properties and that the actual number of acquisitions will likely decrease with additional analysis and refinement of the design should an alternative be selected to be further evaluated in the PA/ED phase of the project. The methodology used to evaluate property acquisition impacts is described in detail in the Right of Way Technical Memorandum in Appendix K.

4.1.1.2 Impacts on the Human Environment

The objective of minimizing impacts on the human environment was measured with twelve different performance measures, covering a wide range of aspects of the environment that affect humans.

Recreational and Community Facilities

Potential impacts on recreational and community facilities (e.g., parks, golf courses, schools, places of worship, hospitals, libraries, museums, and auditoriums) were evaluated based on the number of recreational and community facilities located within the disturbance limits of each alternative. The analysis of the potential effects to parks and recreational facilities was focused within each alternative's potential disturbance limit lines (DLL) developed by the engineering team, and the physical location of the existing parks and recreational facilities, either adjacent to or within each alternative's DLL. The reference information for the parks layer was provided from GIS layer files from the following sources: Tele Atlas North America, 2007, Thomas Brothers, 2009, and California State Parks, October, 2009. The methodology used to review the potential effects of the alternatives included using the ArcGIS viewer and the Google Internet aerial map in a side-by side comparison along each of the alternative's alignments. The methodology used to evaluate impacts on recreational and community facilities is described in detail in Appendix L.

Cultural Resources

Potential impacts to cultural resources were evaluated based on three performance measures: the number of known archaeological sites potentially affected, the number of historic (45 years or older) resources potentially affected, and the number of previously identified significant resources (designated historic districts/buildings) potentially affected. Historic resources were considered potentially affected if they were located within or adjacent to the disturbance limit line of an alternative. For archaeological resources, the evaluation was based on the number of known archeological sites within the disturbance limit line of an alternative. The methodology used to evaluate impacts to cultural resources is described in detail in Appendix M.

Noise

Noise impacts were evaluated by using the FHWA Highway Traffic Noise Prediction Model (FHWA RD-77-108) to calculate the change in traffic noise levels adjacent to 15 different freeway segments along I-210, SR 134, SR 710, I-110, I-10, I-710, I-605, SR 2, and I-5, as well as for the non-tunnel sections of the alignments of the freeway and highway alternatives. Based on the noise abatement criteria (NAC), a threshold of 65 dBA L_{eq} was used for this screening analysis. Although the NAC for residential uses is 67 dBA L_{eq}, 65 dBA L_{eq} was used for the screening analysis to provide a more consistent assessment of noise impacts. Land uses located within the 65 dBA L_{eq} noise contours would be potentially exposed to noise levels exceeding the federal and/or State noise standards. As Caltrans considers all land uses, including open space, to be noise sensitive, the potential noise impact areas were calculated by multiplying the length of the roadway segments by the width of the 65 dBA L_{eq} noise contour. The methodology used to evaluate noise impacts is described in detail in Appendix N.

The FHWA Highway Traffic Noise Prediction Model does not have a feature to evaluate additional noise from bus or light rail service along the alignments of the BRT and LRT alternatives, so transit noise was not included in the analysis. Therefore, the noise impacts for the transit alternatives are likely somewhat underestimated, and, as with the impacts of all alternatives, would need to be evaluated in greater detail should these alternatives advance to the PA/ED phase.

Air Quality

Air quality impacts were evaluated using three evaluation criteria: the percent change in regional mobile source air toxics (MSAT) emissions, the percent change in regional criteria pollutants, and the percent change in regional greenhouse gas emissions. Air quality impacts were evaluated by calculating the regional vehicle emissions associated with each alternative compared to the No Build Alternative for 2035 conditions. Emissions were calculated using the EMFAC 2007 emissions model with data on vehicle miles traveled (VMT), vehicle hours traveled (VHT), and vehicle hours of delay (VHD) from the traffic model. MSATs evaluated include diesel particulates, benzene, 1,3-butadiene, acetaldehyde, acrolein, and formaldehyde. The criteria pollutants evaluated include carbon monoxide (CO), reactive organic gases (ROGs), oxides of nitrogen (NO_x), sulfur oxides (SO_x), particulate matter with aerodynamic diameter less than 10 microns (PM_{10}), and particulate matter with aerodynamic diameter less than 2.5 microns ($PM_{2.5}$). The greenhouse gases (GHG) evaluated include carbon dioxide (CO_2) and methane (CH_4). The analysis focused on long-term operational emissions of each alternative and did not consider construction emissions. In addition, no localized analysis of hot-spots or specific sensitive receptors was conducted. The methodology used to evaluate air quality impacts is described in detail in Appendix O.

Hazardous Waste

Potential hazardous waste impacts were evaluated by determining the number of hazardous waste sites listed in government hazardous waste databases that would be crossed by each alternative. A records review was conducted using electronic environmental database reports generated by Environmental Data Resources, Inc. (EDR). The EDR database search report was reviewed for sites with recognized environmental conditions within or in close proximity to each of the alignments. In addition, the alignments and their vicinities were screened using data provided by the online database GeoTracker, maintained by the California State Water Resources Control Board, and Envirostor, maintained by the California Department of Toxic Substances Control. The preliminary screening consisted of a corridor-based search of the databases listed above, using search distances listed in Section 8.2.1 of ASTM Standard E1527-05, from the anticipated centerline of each alignments (generally 0.5 to 1.0 miles from alignment centerline).

A rating system was developed to rank the alternatives based on the known environmental conditions encountered within each alignment. Two evaluation criteria (Contamination Impact Score and Area of Impact Score) were established to rate the alignments based on the various environmental conditions. The Contamination Impact Score represents the potential for encountering large areas hazardous waste contamination during construction activities within an alignment based on the limited preliminary environmental assessment. The Area of Impact Score represents the percentage of an alignment impacted by various facilities with environmental issues within or adjacent to the alignment as determined by the limited preliminary environmental assessment. The percentage of each alignment that has impacts was determined for each evaluation criteria and ranked on a scale of 1 to 7, with 1 being the worst case (higher percentage of alignment with environmental impact) and 7 being the best case (lower percentage of alignment with environmental impact). To determine a final environmental screening rating for each alignment, the average of the two evaluation criteria was calculated. The methodology used to evaluate hazardous waste impacts is described in detail in Appendix P.

Visual Resources

Visual impacts were evaluated using two performance measures: visual intrusion into communities and linear feet of an alternative through designated scenic corridors and/or vistas. Visual impacts were assessed by evaluating the alternative's visual intrusion into the surrounding communities as well as impacts to designated scenic corridors or vistas. Potential visual effects of the alternatives were ranked based on standard Caltrans' Visual Impact Analysis screening checklist. The ranking also includes an estimated level of sensitivity the general public may have towards the change in visual context caused by the various alternatives. The methodology used to evaluate visual impacts is described in detail in Appendix Q.

Environmental Justice

A methodology was established to identify the potential for environmental justice impacts based on the number of census tracts meeting three or more environmental justice criteria that would be traversed by the alignment of each alternative. Environmental justice criteria considered include Hispanic populations, non-white populations, below poverty level populations, transit-dependent populations, and median household income. The methodology developed to evaluate environmental justice impacts is described in detail in Appendix R.

While the number of affected census tracts could be identified with reasonable accuracy, there is a limitation to the analysis. Not all effects within a census tract are potentially adverse. For example, the beneficial effects of improved mobility would also be a potential effect of the alternatives, especially for transit dependent populations. As a result, in reviewing the results of the analysis, it was determined that the simple fact that a census tract is traversed by the alignment of an alternative is not necessarily positive or negative. Since the effect on that census tract may not necessarily be adverse, it was not possible to assign an appropriate score using the 1 to 7 rating system employed in this evaluation. For that reason, a performance measure of environmental justice was not included in the secondary screening. During the PA/ED phase of the project, environmental impacts will be evaluated to determine if adverse effects are borne disproportionately by environmental justice populations.

4.1.1.3 Impacts on the Natural Environment

The objective of minimizing impacts on the natural environment was measured with four different performance measures, covering a wide range of aspects of the natural environment.

Paleontological Resources

Potential impacts to paleontological resources were evaluated based on the acreage of disturbance limits for the alignment of each alternative that is within soils with high paleontological sensitivity. The methodology used to evaluate impacts to paleontological resources is described in detail in Appendix S.

Geotechnical Conditions

Geological conditions were evaluated based on the percentage of the alignment of each alternative within potentially liquefiable zones, subsurface material variability, or formational materials known to contain natural gas that could be impacted by an alternative. In addition, the number of active and potentially active faults crossing the alignment of an alternative was considered.

A rating system was developed to rank the alternatives based on the geological/geotechnical conditions encountered within each alignment. Four evaluation criteria (liquefaction, fault, variance in subsurface materials, and natural gas exposure) were established to rate the alignments based on the geological/geotechnical conditions. The liquefaction evaluation criterion represents the approximate percentage of the alignment within potentially liquefiable zones that could impact proposed improvements. The fault evaluation criterion represents the number of active and potentially active faults crossing the alignment that could impact proposed improvements. Variance in subsurface materials represents the approximate percentage of subsurface material variability that could impact the proposed improvements within the alignment. The natural gas evaluation criterion represents the approximate percentage of the alignment constructed within formational materials known to contain natural gas. Each of the alternatives was assigned an overall rating on a scale of 1 to 7 with 1 being the worst case (greatest number of geotechnical conditions that increase the difficulty/complexity of the design/construction) and 7 being the best case (least number of geotechnical conditions that increase the difficulty/complexity of the design/construction). The methodology used to evaluate geotechnical impacts is described in detail in Appendix T.

Biological Resources

Potential impacts to biological resources were evaluated based on the acreage of sensitive biological habitats and linear feet of drainages within the disturbance limits of each alternative. Biological resource information available from federal, state, and local resources was compiled and compared to the alternative alignments to determine what habitats and drainages would have the potential to be impacted. In addition, high resolution aerial photographs were carefully inspected to supplement the data sources and assist with the assessment of existing conditions. The methodology used to evaluate impacts to biological resources is described in detail in Appendix U.

4.1.2 Assure Consistency with Regional Plans and Strategies

The objective to "assure consistency with regional plans and strategies" was measured using three performance measures related to long-range plans for the region: Southern California Association of Government's (SCAG) 2012-2035 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), Measure R, and Metro's Long Range Transportation Plan (LRTP). The alternatives were scored based on a number of goals and objectives of each plan with which the alternative would be consistent. The methodology used to evaluate consistency with regional plans is described in detail in Appendix V.

4.2 Performance of Alternatives

The evaluation of each of the alternatives on each of the performance measures pertaining to environmental impacts and planning considerations is presented below. Detailed performance results for each alternative on each performance measure are included in Appendix J. For alternatives that are evaluated further in the PA/ED phase, designs will be refined to avoid or minimize impacts to the extent possible. In addition, where feasible, mitigation measures will be identified to reduce impacts that cannot be avoided. The performance of each of the alternatives on each performance measure is described below. For each category of impact, impacts common to the alternatives are discussed first, follow by impacts specific to each alternative.

4.2.1 Property Acquisition

This performance measure considers full property acquisitions that would result in the displacement of people or businesses. Descriptions of full acquisitions are detailed by alternative below and summarized in Table 4-2.

Table 4-2: Commercial and Residential Property Full Acquisitions

Alternative	Commercial	Residential
No Build	0	0
TSM/TDM	30	23
BRT-1	19	0
BRT-6	0	0
BRT-6A	0	0
LRT-4A	40	10
LRT-4B	47	8
LRT-4D	61	42
LRT-6	151	63
F-2	9	304
F-5	37	218
F-6	36	440
F-7	2	3
H-2	59	573
H-6	72	112

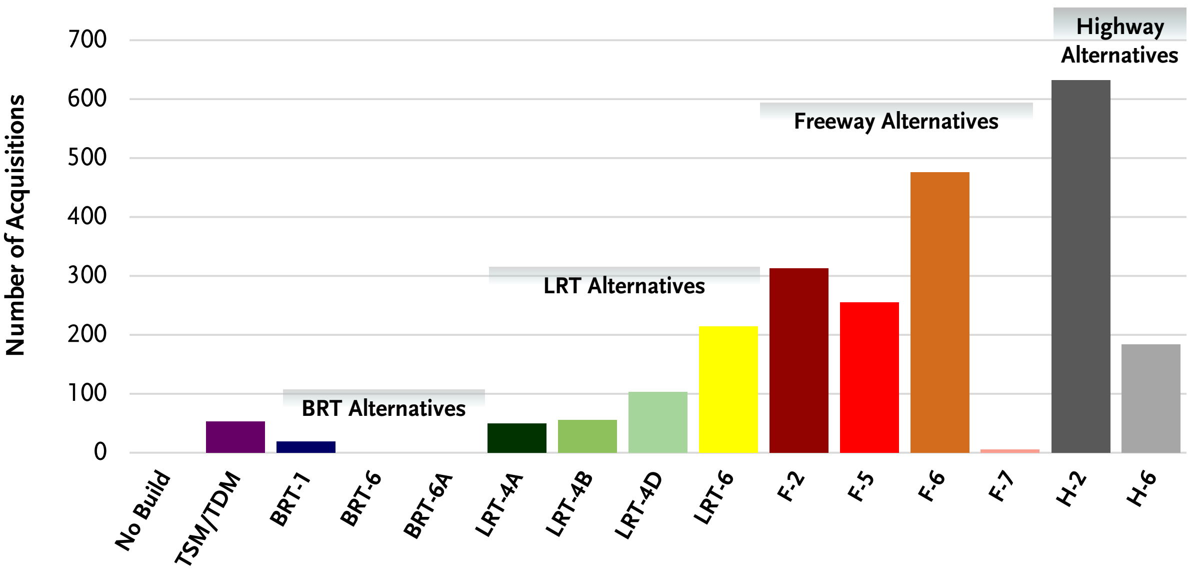
4.2.1.1 General Impacts

Properties that would be acquired include single-family residences, multi-unit dwellings, public recreation sites, places of worship, businesses, and other commercial and industrial buildings.

4.2.1.2 Alternative-Specific Impacts

As shown in Figure 4-1, the No Build Alternative would not require any property acquisitions.

Figure 4-1: Full Property Acquisitions



The largest impacts caused by the various improvements in the TSM/TDM Alternative occur at the intersection of major streets in the region. Because these major intersections are dominated by businesses seeking accessibility to passersby, the majority of acquisitions required for this alternative are commercial properties such as restaurants, drug stores, spas, service stations and other local businesses. Some of the smaller intersections and intersections in more completely residential areas would require acquisitions of some residential properties, including single family residences, condominiums and other multi-unit complexes. There would potentially be a total of 53 properties requiring full acquisitions by the various components of the TSM/TDM Alternative, including as many as 30 commercial properties and 23 residential properties.

For Alternative BRT-1, street widening would be required to create the bus lane along the southerly portion of this alternative and several properties along the alignment would likely need to be acquired. Since the alignment in this area follows Mission Road, the widening would only impact commercial properties that face this street. There are 19 commercial properties that would require full acquisition. There would be no acquisitions of residential property. Although Alternative BRT-1 would require the second least number of property acquisitions, it would have a considerable impact to on-street parking and loading areas that would affect businesses on Mission Road, Huntington Drive, and Fair Oaks Avenue, although the number of the parking spaces affected would be smaller than that under Alternatives BRT-6 and BRT-6A. The methodology used to evaluate parking impacts is described in detail in Appendix W.

For Alternative BRT-6, the proposed bus lanes would fit within the confines of the existing street alignment. As a result, there would be no anticipated property acquisitions. However, Alternative BRT-6 would have a considerable impact to on-street parking and loading areas that would affect businesses on Atlantic Boulevard and Fair Oaks Avenue.

Just as there would be no anticipated property acquisitions required for Alternative BRT-6, there also would not be anticipated property acquisitions required for Alternative BRT-6A. However, Alternative BRT-6A would also have a considerable impact to on-street parking and loading areas that would affect businesses on Atlantic Boulevard and Fair Oaks Avenue.

The majority of Alternative LRT-4A would be either underground or aerial. The aerial segments largely follow existing Caltrans or other public rights-of-way. For this reason, the only properties potentially impacted would be those used for station sites and traction power substations. There would potentially be 50 properties requiring full acquisition for this alternative. As many as 40 commercial properties (including office buildings, restaurants, warehouses, stores, parking lots, and a service station) and 10 residential properties (mostly multi-unit dwellings) would require full acquisition.

Similar to Alternative LRT-4A, Alternative LRT-4B would remain aerial or underground throughout the majority of its route. The exceptions are mostly station areas or areas where the track is transitioning from overhead to underground. There would potentially be 55 properties requiring full acquisition for this alternative. As many as 47 commercial properties (office buildings, restaurants, warehouses, stores, parking lots, and a service station) and 8 residential properties (single family residences and multi-unit dwellings) would require full acquisition.

Alternative LRT-4D also has a large aerial component, but tunnel segments would be cut-and-cover trenches instead of bored tunnels. Because these trenches would need to be excavated during construction and only returned to vacant land after construction, the properties required by these segments are considered full acquisitions. There would potentially be 103 properties requiring full acquisition for this alternative. As many as 61 commercial properties (office buildings, restaurants, warehouses, stores, parking lots, a service station and a medical building) and 42 residential properties (primarily single family residences as well as some duplexes and multi-unit dwellings) would require full acquisition.

Alternative LRT-6 would be primarily at grade along Atlantic Boulevard and Fair Oaks Avenue. These streets would need widening in many places to accommodate the LRT guideway, resulting in a greater number of potential acquisitions of both commercial and residential properties. There would potentially be 214 properties requiring full acquisition for this alternative. As many as 151 commercial properties (office buildings, restaurants, warehouses, stores, parking lots, service stations, medical buildings, a theater, an auto sales lot, an animal hospital, city government buildings and public utilities) and 63 residential properties (single family residences, duplexes, triplexes, quadruplexes and multi-unit dwellings greater than 10 units) would require full acquisition.

Alternative F-2 would be largely underground but does come to the surface in a residential area to make the connection to SR 2. The majority of potential property acquisitions would occur in this portal area. There would potentially be 313 properties requiring full acquisition for this alternative. As many as 9 commercial properties (stores, service stations and a few other commercial and light industrial lots) and 304 residential properties (single family residences with some duplexes, triplexes, quadruplexes and multi-unit dwellings greater than 10 units) would require full acquisition.

Alternative F-5 would be primarily underground but must surface in a residential area near its interchange with SR 134. The majority of potential property acquisitions occur in this area. There would potentially be 255 properties requiring full acquisition for this alternative. As many as 37 commercial properties (restaurants, stores, office buildings, a church, a golf course, public utilities and some light industrial buildings) and 218 residential properties (mostly single family residences and a few multi-unit dwellings) would require full acquisition.

Alternative F-6 would be at grade, but much of the property at the north and south ends of the proposed alignment is owned by Caltrans and would not need to be acquired. The majority of potential property acquisitions occur in the area of South Pasadena. There would potentially be 476 properties requiring full acquisition for this alternative. As many as 36 commercial properties (parking lots, office buildings, service stations, a church, utilities and several industrial buildings) and 440 residential properties (many single family residences, several condominium complexes, duplexes, triplexes, multi-unit dwellings and several vacant residential lots) would require full acquisition.

Alternative F-7 would require the fewest property acquisitions of all build alternatives (5 full acquisitions). The alternative is almost entirely underground from I-10 to SR 210. When it surfaces at these portals, it does so in the existing Caltrans right-of-way. In this way, it minimizes potential impacts. There would potentially be 5 properties requiring full acquisition for this alternative. As many as 2 commercial properties (commercial and light industrial buildings and as well as some vacant commercial lots) and 3 residential properties (mostly single family residences and multi-unit dwellings) would require full acquisition.

Alternative H-2 would be completely at grade and though it attempts to follow existing street rights–of-way, the widening required would result in to the need to acquire numerous commercial and residential properties. Alternative H-2 would require the greatest number of property acquisitions of all alternatives. There would potentially be 632 properties requiring full acquisition for this alternative. As many as 59 commercial properties (stores, restaurants, office buildings, parking lots, a medical building, a church, service stations and a park) and 573 residential properties (single family residences, duplexes, triplexes, quadruplexes, multi-unit dwellings, condominiums and vacant residential lots) would require full acquisition.

Alternative H-6 utilizes largely existing street rights-of-way and properties already owned by Caltrans. In this way, it would be able to reduce potential impacts to residential properties. The alignment does, however, pass through a commercial area along Fair Oaks Avenue, which results in additional potential property acquisitions. There would potentially be 184 properties requiring full acquisition for this alternative. As many as 72 commercial properties (stores, office buildings, service stations, parking lots, restaurants and a medical building) and 112 residential properties would require full acquisition.

4.2.2 Recreational and Community Facilities

4.2.2.1 General Impacts

Recreational and community facilities impacted by the alternative alignments include parks, recreational centers, school sports fields, auditoriums, museums, schools, churches, hospitals, convalescent centers, libraries, and senior centers.

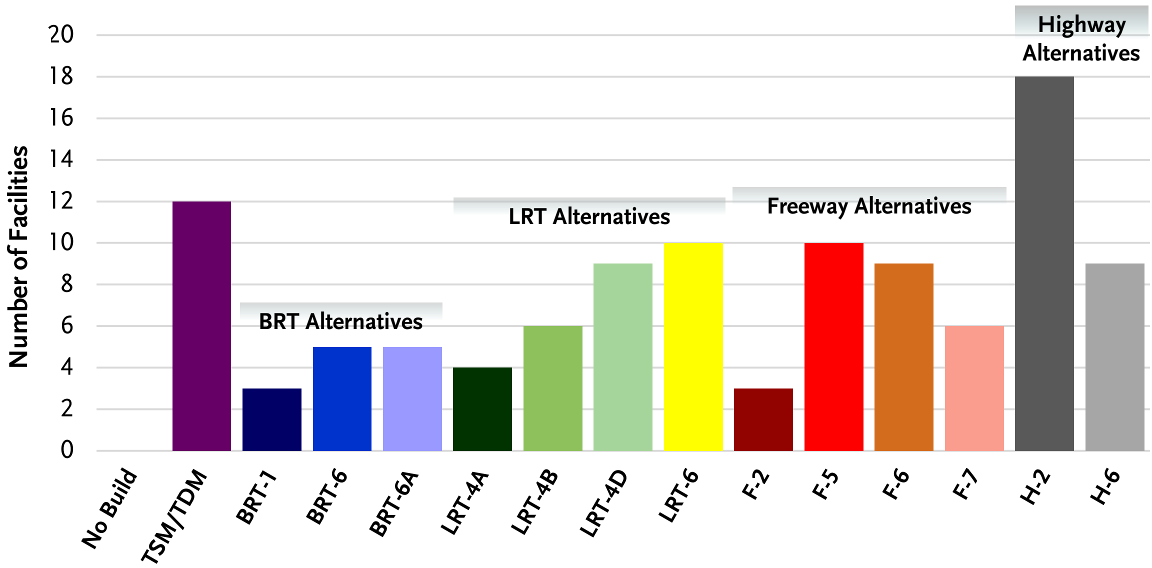
4.2.2.2 Alternative-Specific Impacts

As shown in Figure 4-2, the No Build Alternative would not affect any parks, recreational and/or community facilities in the Study Area.

The TSM/TDM Alternative would potentially impact 12 parks, recreational, and/or community facilities: Jehovah's Witness, Occidental United Presbyterian Churches, Saint James Episcopal, South Pasadena Christian Churches, Gateway Plaza Park at two locations, K.L. Carver School, St. Edmund's Episcopal Church, Saints Felicitas and Perpetua Church and School, Rosemead High School at two locations, and Eagle Rock Recreation Center.

Alternative BRT-1 would potentially affect 3 parks, recreational, and/or community facilities: Lincoln Park, War Memorial Park, and Pasadena Central Park.

Figure 4-2: Recreational/Community Facilities Affected



Alternatives BRT-6 and BRT-6A would potentially affect 5 parks, recreational, and/or community facilities: War Memorial Park, Pasadena Central Park, Atlantic Boulevard County Park, Cascades Park, and Tournament Park.

Alternative LRT-4A would potentially affect 4 parks, recreational, and/or community facilities: Belvedere Community Regional Park (a Los Angeles County park), building and parking lot area of Cal State LA, South Pasadena Middle School, and access to Casa Maravilla Senior Center.

Alternative LRT-4B would potentially affect 6 parks, recreational, and/or community facilities: Belvedere Community Regional Park, Alhambra Medical University, building and parking lot of Cal State LA, Morris K. Hamasaki Elementary School, South Pasadena Middle School, and access to Casa Maravilla Senior Center.

Alternative LRT-4D would potentially affect 9 parks, recreational, and/or community facilities: War Memorial Park, Belvedere Community Regional Park, Alhambra Park, a parking lot adjacent to the baseball field at Park Elementary School, building and parking lot area at Cal State LA, Morris K. Hamasaki Elementary School, South Pasadena Middle School, GEM Transitional Care Center and access to Casa Maravilla Senior Center.

Alternative LRT-6 would potentially affect 10 parks, recreational, and/or community facilities: War Memorial Park, Cascades Park, the American English College, South Pasadena Middle School, Church of Jesus Christ of Latter Day Saints, First Baptist Church, Grace Lutheran/Chinese Life Lutheran Church, Temple Beth Torah, Monterey Park Hospital and Atherton Baptist Homes.

Alternative F-2 would potentially affect 3 parks, recreational, and/or community facilities: A building and parking lot area at Cal State LA, a recreational field at California State University Los Angele, and Eagle Rock Victory Outreach.

Alternative F-5 would potentially affect 10 parks, recreational, and/or community facilities: Eagle Rock Recreation Center, Lower Arroyo Park, San Rafael Park, the Annandale Golf Club, Richard Alatorre

Park, building and parking lot at Cal State LA, Fusion Academy, San Rafael Elementary School, Central Filipino Church of Seventh-day Adventists, and the San Rafael Library.

Alternative F-6 would potentially affect 9 parks, recreational, and/or community facilities: A building and parking lot area at Cal State LA, a recreational field located at Cal State LA, Arlington Garden, a football field and parking lot of Maranatha High School, a baseball field at the corner of Del Mar Blvd. and St. John Ave, the Ambassador Auditorium, the Sequoyah School, Chinese Seventh-day Adventist Church, and the El Sereno Community Garden.

Alternative F-7 would potentially affect 6 parks, recreational, and/or community facilities: A building and parking lot area at Cal State LA, a recreational field located at Cal State LA, a baseball field at the corner of Del Mar Blvd. and St. John Ave, a football field and parking lot of Maranatha High School, and the Ambassador Auditorium, and parking lot of the Norton Simon Museum.

Alternative H-2 would impact the greatest number of parks, recreational, and/or community facilities of all alternatives. Alternative H-2 would potentially affect 18 parks, recreational, and/or community facilities: Lower Arroyo Park, San Rafael Park, Emery Park, Arroyo Seco Golf Course, Arroyo Seco Park, Garzanza Park, Almansor Center, South Pasadena Senior High School, Hillsides Education Center, Church of the Angels, Garvanza Methodist Church/Hansammul Church, Garvanza Foursquare Church, Holy Family Catholic Church and Youth Ministry, Saint James Episcopal Church, South Pasadena Christian Church, South Pasadena United Methodist Church, San Rafael Library and South Pasadena Women's Club.

Alternative H-6 would potentially affect 9 parks, recreational, and/or community facilities: War Memorial Park, Arlington Garden, Singer Park, the Sequoyah School, Sierra Vista Elementary School, South Pasadena Middle School, Westmont Baptist Church, Pasadena Community Church and El Sereno Community Garden.

4.2.3 Cultural Resources

The architectural styles represented in the cities and communities in the study area followed prevailing trends and the gradual development of forms appropriate to the ideals of the California lifestyle. Residential styles transitioned from the Victorian styles of the late 1800s to Revival and Craftsman styles in the 1910s and 1920s followed by the California Ranch, Modern, and Contemporary styles in the post-World War II period. Similarly, non-residential buildings in the Study Area are representative of architectural trends and styles common to the region. Both high-style, architect designed and more modest examples of a wide variety of styles and periods can be found in the Study Area.

Within the study area there are thousands of historic-period (45 years or older) buildings, as well as numerous historic districts and individually significant resources. Most of the historic districts are made up of residential properties, but a few such as the Old Pasadena Landmark District and the Pasadena Civic Center/Civic Center Financial Landmark District are made up primarily of non-residential properties.

4.2.3.1 General Impacts

Impacted cultural resources include historic-period buildings, designated historic districts, National Register eligible or listed resources, and locally eligible or designated resource. Construction and operation of bus, transit and roadways facilities all have the potential to result in direct and indirect effects on cultural resources.

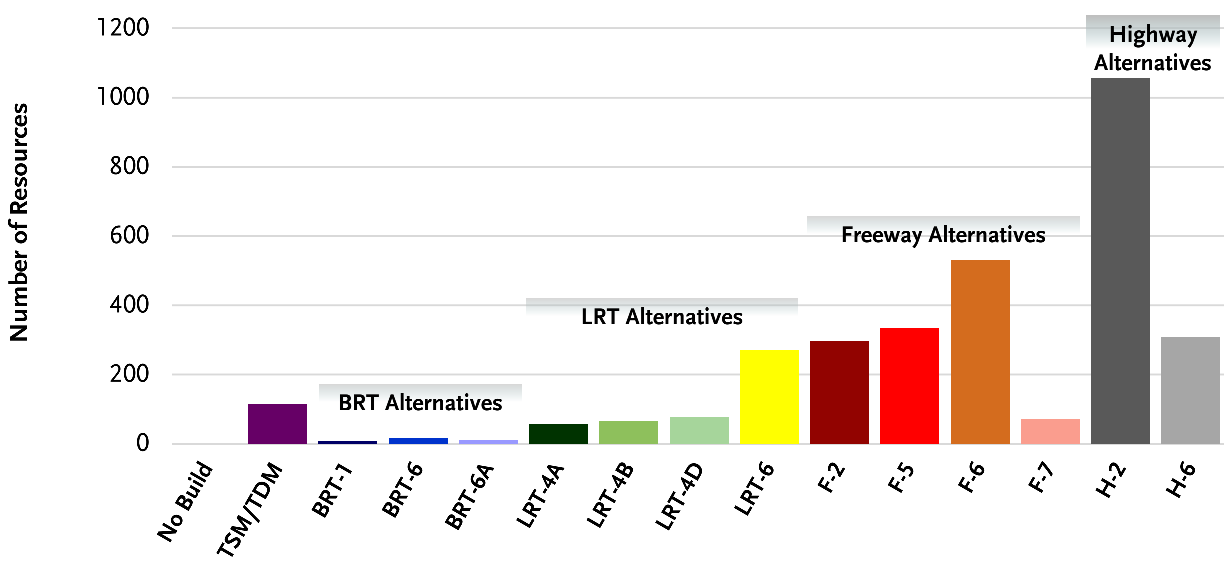
4.2.3.2 Alternative-Specific Impacts

None of the alternatives would impact known archaeological sites. Impacts to historical properties are described below.

The No Build Alternative would not result in any impacts to historic properties.

As shown in Figure 4-3, for the TSM/TDM Alternative, there are approximately 115 parcels with historic-period buildings in the area of direct impacts. It is also anticipated that this alignment may directly impact 2 historic districts (one is only proposed) and 2 National Register eligible or listed resources as shown in Figure 4-4.

Figure 4-3: Historic Period Resources Affected



For Alternative BRT-1, there are approximately 9 parcels with historic-period buildings in the area of direct impact. It is anticipated that that no previously identified significant resources will be directly impacted by this alternative.

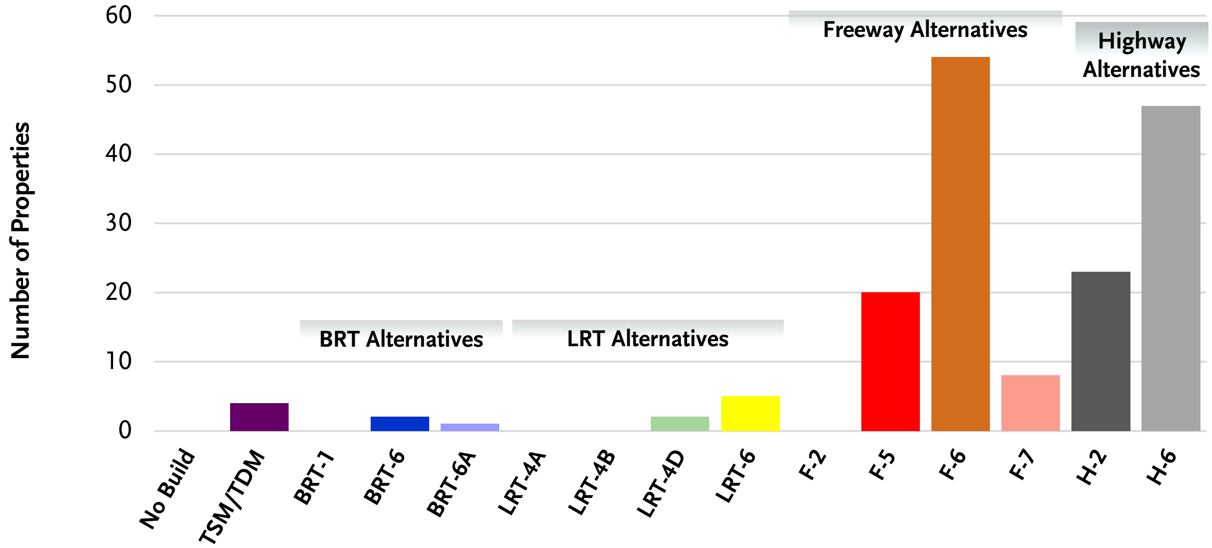
For Alternative BRT-6, there are approximately 15 parcels with historic-period buildings in the area of direct impact. It is anticipated that this alignment may directly impact 2 National Register eligible or listed resources.

For Alternative BRT-6A, there are approximately 12 parcels with historic-period buildings in the area of direct impact. It is anticipated that this alignment may directly impact 1 National Register eligible or listed resource.

For Alternative LRT-4A, there are approximately 56 parcels with historic-period buildings in the area of direct impact. It is anticipated that no previously identified significant resources will be directly impacted by this alternative.

For Alternative LRT-4B, there are approximately 66 parcels with historic-period buildings in the area of direct impact. It is anticipated that no previously identified significant resources will be directly impacted by this alternative.

Figure 4-4: Historic Districts, National Register Eligible/Listed Properties, and Locally Eligible/Listed Properties Affected



For Alternative LRT-4D, there are approximately 78 parcels with historic-period buildings in the area of direct impact. It is anticipated that this alignment may directly impact 2 historic districts (one is only proposed).

For Alternative LRT-6, there are approximately 270 parcels with historic-period buildings in the area of direct impact. It is anticipated that this alignment may directly impact: 2 historic districts, 2 National Register eligible or listed resources, and 1 locally eligible or designated resource.

For Alternative F-2, there are approximately 295 parcels with historic-period buildings in the area of direct impact. It is anticipated that no previously identified significant resources will be directly impacted by this alternative.

For Alternative F-5, there are approximately 335 parcels with historic-period buildings in the area of direct impact. It is anticipated that this alignment may directly impact: 2 historic districts, 1 National Register eligible or listed resource, and 17 locally eligible or designated resources.

For Alternative F-6, there are approximately 530 parcels with historic-period buildings in the area of direct impact. It is anticipated that this alignment may directly impact: 9 historic districts, 40 National Register eligible or listed resources, and 5 locally eligible or designated resources.

For Alternative F-7, there are approximately 72 parcels with historic-period buildings in the area of direct impact. It is anticipated that this alignment may directly impact: 1 historic district, 6 National Register eligible or listed resources, and 1 locally eligible or designated resource.

Alternative H-2 would have the greatest potential impact to historic resources and designated historic districts/buildings. There are approximately 1,055 parcels with historic-period buildings in the area of direct impact for Alternative H-2. It is anticipated that this alignment will directly impact: 4 historic districts, 12 National Register eligible or listed resources, and 7 locally eligible or designated resources.

For Alternative H-6, there are approximately 308 parcels with historic-period buildings in the area of direct impact. It is anticipated that this alignment may directly impact: 4 historic districts, 40 National Register eligible or listed resources, and 3 locally eligible or designated resources.

4.2.4 Noise

4.2.4.1 General Impacts

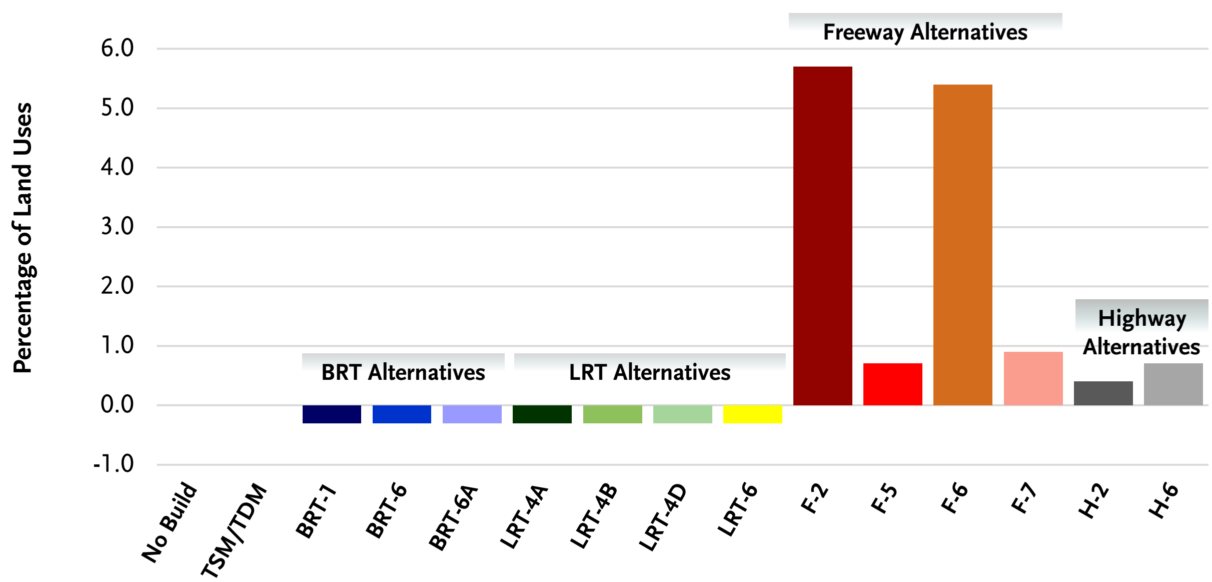
The change in noise level exposure under each alternative would result from the change in traffic patterns and volume associated with each alternative. Land uses considered to be noise sensitive receptors include residences, schools, playgrounds, childcare centers, athletic facilities, hospitals, long-term health care facilities, rehabilitation centers, convalescent centers, and retirement homes.

4.2.4.2 Alternative-Specific Impacts

The No Build Alternative would expose approximately 14,507 acres to traffic noise levels exceeding 65 dBA Leq, within the study area. The majority of the land uses along the roadway segments evaluated as part of this screening analysis are sensitive residential, school, or open space uses.

The TSM/TDM Alternative would expose approximately 14,504 acres to traffic noise levels exceeding 65 dBA Leq, within the study area, a reduction of 3 acres (0 percent) from the No Build Alternative. The majority of the land uses along the roadway segments evaluated as part of this screening analysis are sensitive residential, school, or open space uses. Therefore, this alternative would result in a small reduction in the number of sensitive land uses that would be exposed to noise levels exceeding 65 dBA Leq as shown in Figure 4-5.

Figure 4-5: Percentage Increase in Sensitive Land Uses Exposed to Unacceptable Noise Level



Alternatives BRT-1, BRT-6, BRT-6A, LRT-4A, LRT-4B, LRT-4D, and LRT-6 would expose approximately 13,469 acres to traffic noise levels exceeding 65 dBA Leq, within the study area, a reduction of 38 acres (0.3 percent) from the No Build Alternative. The majority of the land uses along the roadway segments evaluated as part of this screening analysis are sensitive residential, school, or open space uses.

Therefore, these alternatives would result in a small reduction in the number of sensitive land uses that would be exposed to noise levels exceeding 65 dBA Leq.

Alternative F-2 would result in the greatest increase in noise of all alternatives. Within the study area this alternative would expose approximately 15,335 acres to traffic noise levels exceeding 65 dBA Leq, an increase of 828 acres (5.7 percent) from the No Build Alternative. The majority of the land uses along the roadway segments evaluated as part of this screening analysis are sensitive residential, school, or open space uses. Therefore, this alternative would result in an increase in the number of sensitive land uses that would be exposed to noise levels exceeding 65 dBA Leq.

Alternative F-5 would expose approximately 14,615 acres to traffic noise levels exceeding 65 dBA Leq, an increase of 108 acres (0.7 percent) from the No Build Alternative. The majority of the land uses along the roadway segments evaluated as part of this screening analysis are sensitive residential, school, or open space uses. Therefore, this alternative would result in an increase in the number of sensitive land uses that would be exposed to noise levels exceeding 65 dBA Leq.

Alternatives F-6 would result in the second greatest increase in noise of all alternatives. Within the study area this alternative would expose approximately 15,297 acres to traffic noise levels exceeding 65 dBA Leq, an increase of 790 acres (5.4 percent)from the No Build Alternative. The majority of the land uses along the roadway segments evaluated as part of this screening analysis are sensitive residential, school, or open space uses. Therefore, this alternative would result in an increase in the number of sensitive land uses that would be exposed to noise levels exceeding 65 dBA Leq.

Alternative F-7 would expose approximately 14,637 acres to traffic noise levels exceeding 65 dBA Leq, within the study area, an increase of 130 acres (0.9 percent) from the No Build Alternative. The majority of the land uses along the roadway segments evaluated as part of this screening analysis are sensitive residential, school, or open space uses. Therefore, this alternative would result in an increase in the number of sensitive land uses that would be exposed to noise levels exceeding 65 dBA Leq.

Alternative H-2 would expose approximately 14,567 acres to traffic noise levels exceeding 65 dBA Leq, within the study area, an increase of 60 acres (0.4 percent) from the No Build Alternative. The majority of the land uses along the roadway segments evaluated as part of this screening analysis are sensitive residential, school, or open space uses. Therefore, this alternative would result in a small increase in the number of sensitive land uses that would be exposed to noise levels exceeding 65 dBA Leq.

Alternative H-6 would expose approximately 14,602 acres to traffic noise levels exceeding 65 dBA Leq, within the study area, an increase of 95 acres (0.7 percent) from the No Build Alternative. The majority of the land uses along the roadway segments evaluated as part of this screening analysis are sensitive residential, school, or open space uses. Therefore, this alternative would result in a small increase in the number of sensitive land uses that would be exposed to noise levels exceeding 65 dBA Leq.

4.2.5 Air Quality

The project site is in Los Angeles County, an area within the South Coast Air Basin (Basin), which includes Orange County and the non-desert parts of Los Angeles, Riverside, and San Bernardino Counties. Air quality regulation in the Basin is administered by the South Coast Air Quality Management District (SCAQMD).

Air quality monitoring stations are located throughout the nation and maintained by the local air districts and State air quality regulating agencies. Data collected at permanent monitoring stations are used by the Environmental Protection Agency (EPA) to identify regions as attainment, nonattainment, or maintenance, depending on whether the regions meet the requirements stated in the primary national ambient air quality standards (NAAQS). Nonattainment areas are imposed with additional restrictions as required by the EPA. In addition, different classifications of nonattainment, such as marginal, moderate, serious, severe, and extreme, are used to classify each air basin in the State on a pollutant-by-pollutant basis. The classifications are used as a foundation to create air quality management strategies to improve air quality and comply with the NAAQS. Table 4-3 lists the attainment status for each of the criteria pollutants in the Basin.

Table 4-3: Attainment Status of Criteria Pollutants in the South Coast Air Basin

Pollutant	State	Federal
O_3 (1 hour)	Nonattainment	Revoked June 2005
O_3 (8 hour)	Nonattainment	Extreme Nonattainment
PM_{10}	Nonattainment	Serious Nonattainment
$PM_{2.5}$	Nonattainment	Nonattainment
CO	Attainment	Attainment/Maintenance
NO_2	Nonattainment	Unclassifiable/Attainment
Lead	Nonattainment (L.A. County only)	Nonattainment (L.A. County only)
All others	Attainment/Unclassified	Attainment/Unclassified

Source: California Air Resources Board (ARB), 2012 (http://www.arb.ca.gov/desig/desig.htm).
CO = carbon monoxide
EPA = United States Environmental Protection Agency
NO_2 = nitrogen dioxide
O_3 = ozone
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
PM_{10} = particulate matter less than 10 microns in diameter

The SCAQMD operates several air quality monitoring stations within the Basin. The air quality monitoring station closest to the study area is the Pasadena Air Monitoring Station, and its air quality trends are representative of the ambient air quality in the study area. The pollutants monitored at this station are ozone (O_3), $PM_{2.5}$, nitrogen dioxide (NO_2), and CO. The closest air quality monitoring site that monitors PM_{10} and sulfur dioxide (SO_2) is the North Main Street, Los Angeles Station, and its air quality trends are also representative of the ambient air quality in the study area. In the past three years, federal standards for O_3 (1-hour) were exceeded on 5 days in 2009, 1 day in 2010, and 12 days in 2011. Federal standards for O_3 (8-hour) were exceeded on 14 days in 2009, 2 days in 2010, and 5 days in 2011. Federal standards for PM_{10} (24 hour) were exceeded on 4 days in 2009 and 1 day in 2011. Federal standards for $PM_{2.5}$ (annual mean) and PM_{10} (annual mean) were exceeded on 1 day in 2009, 2010, and 2011.

Sensitive populations are more susceptible to the effects of air pollution than the general population. Sensitive populations (sensitive receptors) that are in proximity to localized sources of toxics and CO are of particular concern. Land uses considered to be sensitive receptors for air pollution include residences, schools, playgrounds, childcare centers, athletic facilities, hospitals, long-term health care facilities, rehabilitation centers, convalescent centers, and retirement homes.

4.2.5.1 Criteria Pollutants

The criteria pollutants evaluated in this analysis include carbon monoxide (CO), reactive organic gases (ROGs), oxides of nitrogen (NO_X), sulfur oxides (SO_X), particulate matter with aerodynamic diameter less than 10 microns (PM_{10}), and particulate matter with aerodynamic diameter less than 2.5 microns ($PM_{2.5}$). Emissions of these pollutants result from the combustion of fuels (such as gasoline, diesel, compressed natural gas and electricity) associated within each transportation mode.

4.2.5.2 Mobile Source Air Toxics

The Mobile Source Air Toxics (MSAT) evaluated in this analysis include diesel particulates, benzene, 1,3-butadiene, acetaldehyde, acrolein, and formaldehyde. Emissions of these MSAT result from the combustion of fuels (such as gasoline, diesel, compressed natural gas and electricity) associated within each transportation mode

4.2.5.3 Greenhouse Gas Emissions

The greenhouse gases (GHG) evaluated in this analysis include carbon dioxide (CO_2) and methane (CH_4). Emissions of these MSAT result from the combustion of fuels (such as gasoline, diesel, compressed natural gas and electricity) associated within each transportation mode

4.2.5.4 General Impacts

Air quality impacts to sensitive receptors would occur from regional vehicle emissions primarily due to increases in vehicle hours traveled (VHT). All alternatives, with the exception of Alternatives F-2, F-5, F-6, F-7, H-2 and H-6 would result in minor reductions of regional vehicle emissions primarily due to reductions in VHT. The other alternatives would result in minor increases in the various emissions types; however, it should be noted that the regional-level methodology used in this analysis does not take into account any reductions from the air scrubbers proposed for the tunnel alternatives. The increases noted below are primarily due to increases in VMT associated with the freeway and highway alternatives.

4.2.5.5 Alternative-Specific Impacts

The No Build Alternative would not change the number or type of vehicles operating within the study area. Therefore, there would be no project impact. This alternative provides the basis for comparison of the various project alternatives.

The TSM/TDM Alternative would reduce the VMT, VHT, and VHD within Los Angeles County. As a result, as shown in Figures 4-6, 4-7, and 4-8, when compared to the No Build Alternative this alternative would reduce the MSAT emissions within the County by 0.03 percent, would reduce the average criteria pollutant emissions within the County by 1.17 percent, and would reduce the average greenhouse gas emissions within the County by 1.26 percent.

Alternative BRT-1 would reduce the VMT, VHT, and VHD within Los Angeles County. As a result, this alternative would reduce regional MSAT emissions by 0.04 percent, criteria pollutants by 1.27 percent, and greenhouse gas emissions 1.37 percent.

Alternative BRT-6 would reduce the VMT, VHT, and VHD within Los Angeles County. As a result, this alternative would reduce regional MSAT emissions by 0.04 percent, criteria pollutants by 1.33 percent, and greenhouse gas emissions 1.43 percent.

Figure 4-6: Change in MSAT Emissions Based on Regional VMT/VHT

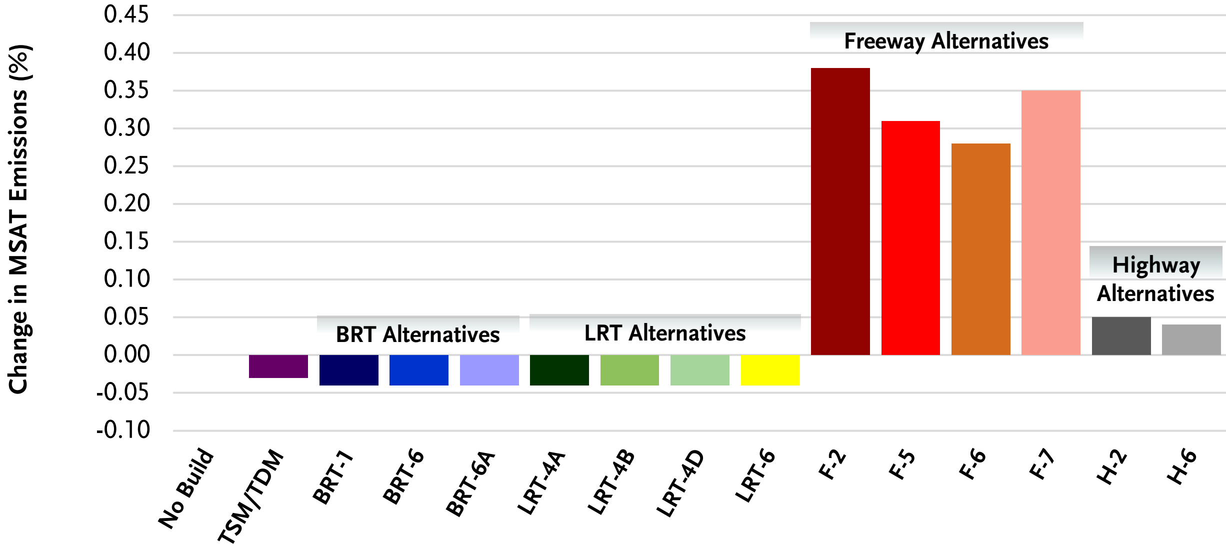


Figure 4-7: Change in Criteria Pollutants Based on Regional VMT/VHT

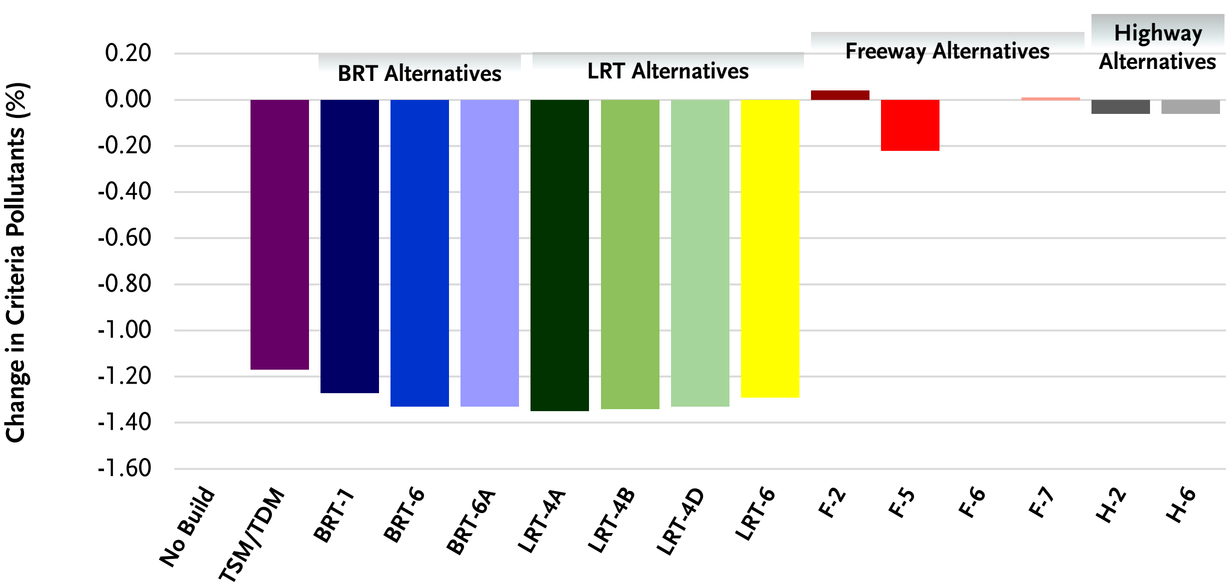
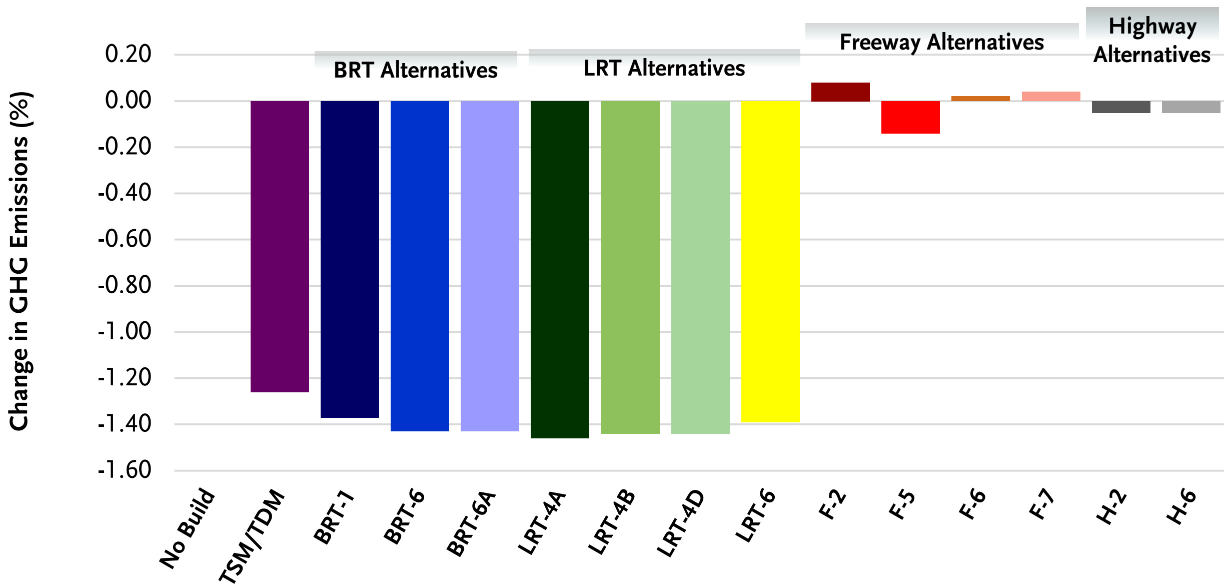


Figure 4-8: Change in GHG Emissions Based on Regional VMT/VHT



Alternative BRT-6A would reduce the VMT, VHT, and VHD within Los Angeles County. As a result, this alternative would reduce regional MSAT emissions by 0.04 percent, criteria pollutants by 1.33 percent, and greenhouse gas emissions 1.43 percent.

Alternative LRT-4A would reduce the VMT, VHT, and VHD within Los Angeles County. As a result, this alternative would reduce regional MSAT emissions by 0.04 percent, criteria pollutants by 1.35 percent, and greenhouse gas emissions 1.46 percent.

Alternative LRT-4B would reduce the VMT, VHT, and VHD within Los Angeles County. As a result, this alternative would reduce regional MSAT emissions by 0.04 percent, criteria pollutants by 1.34 percent, and greenhouse gas emissions 1.44 percent.

Alternative LRT-4D would reduce the VMT, VHT, and VHD within Los Angeles County. As a result, this alternative would reduce regional MSAT emissions by 0.04 percent, criteria pollutants by 1.33 percent, and greenhouse gas emissions 1.44 percent.

Alternative LRT-6 would reduce the VMT, VHT, and VHD within Los Angeles County. As a result, this alternative would reduce regional MSAT emissions by 0.04 percent, criteria pollutants by 1.29 percent, and greenhouse gas emissions 1.39 percent.

Alternative F-2 would increase the VMT and reduce the VHT and VHD within Los Angeles County. As a result, this alternative would increase regional MSAT emissions by 0.38 percent, increase criteria pollutant emissions by 0.04 percent and increase greenhouse gas emissions by 0.08 percent.

Alternative F-5 would increase the VMT and reduce the VHT and VHD within Los Angeles County. As a result, this alternative would increase regional MSAT emissions by 0.31 percent, reduce criteria pollutant by 0.22 percent and reduce greenhouse gas emissions by 0.14 percent.

Alternative F-6 would increase the VMT and reduce the VHT and VHD within Los Angeles County. As a result, this alternative would increase regional MSAT emissions by 0.28 percent, have no increase in criteria pollutant and increase greenhouse gas emissions by 0.02 percent.

Alternative F-7 would increase the VMT and reduce the VHT and VHD within Los Angeles County. As a result, this alternative would increase regional MSAT, criteria pollutant, and greenhouse gas emissions by 0.35, 0.01, and 0.04 percent, respectively.

Alternative H-2 would increase the VMT and reduce the VHT and VHD within Los Angeles County. As a result, this alternative would increase regional MSAT emissions by 0.05 percent and reduce criteria pollutant and greenhouse gas emissions by 0.06 and 0.05 percent, respectively.

Alternative H-6 would increase the VMT and reduce the VHT and VHD within Los Angeles County. As a result, this alternative would increase regional MSAT emissions by 0.04 percent and reduce criteria pollutant and greenhouse gas emissions by 0.06 and 0.05 percent, respectively.

4.2.6 Hazardous Waste

4.2.6.1 General Impacts

The build alternatives would have the potential to impact properties with known hazardous waste releases, some of which could have impacted soil or groundwater.

4.2.6.2 Alternative-Specific Impacts

The No Build Alternative would not result in any impacts to hazardous waste sites.

For the TSM/TDM Alternative, detailed environmental screening was not performed as the environmental impacts from the spot improvements are assumed to be minimal. This alternative was ranked as one of the alternatives having the least potential to encounter hazardous waste sites.

For Alternative BRT-1, 23 facilities were identified with environmental impacts from the records review, of which 10 are considered low, 9 medium, and 4 with high impacts. Of these 23 facilities, 11 have impacted groundwater, 4 have impacted soil/soil vapor, and 4 have impacted both soil and groundwater. No specific information regarding media of impact was available for 4 facilities in any of the databases reviewed for this screening. This alternative was ranked as one of the alternatives having the greatest potential to encounter hazardous waste sites.

For Alternatives BRT-6 and BRT-6A, 11 facilities were identified with environmental impacts from the records review, of which 10 are considered low and 1 with medium impact. From the preliminary screening, none of the facilities within or adjacent to the alignment were identified to have high impacts. Of these 11 facilities, 9 have impacted groundwater while 1 has impacted soil/soil vapor. No specific information regarding media of impact was available for 1 facility in any of the databases reviewed for this screening.

For Alternative LRT-4A, 32 facilities were identified with environmental impacts from the records review, of which 25 are considered low, 6 medium, and 1 with high impact. Of these 32 facilities, 24 have impacted groundwater, 3 have impacted soil/soil vapor, and 3 have impacted both soil and groundwater. No specific information regarding media of impact was available for 2 facilities in any of the databases reviewed for this screening. This alternative was ranked as one of the alternatives having the greatest potential to encounter hazardous waste sites.

For Alternative LRT-4B, 9 facilities were identified with environmental impacts from the records review, of which 7 are considered low, 1 medium, and 1 with high impact. Of these 9 facilities, 8 have impacted groundwater and 1 has impacted soil/soil vapor.

For Alternative LRT-4D, 25 facilities were identified with environmental impacts from the records review, of which 13 are considered low, 6 medium, and 6 with high impact. Of these 25 facilities, 18 have impacted groundwater, 1 has impacted soil/soil vapor, and 5 have impacted soil and groundwater. No specific information regarding media of impact was available for 1 facility in any of the databases reviewed for this screening. This alternative was ranked as one of the alternatives having the greatest potential to encounter hazardous waste sites.

For Alternative LRT-6, 12 facilities were identified with environmental impacts from the records review, of which 8 are considered low, 2 medium, and 2 with high impact. Of these 32 facilities, 24 have impacted groundwater while 3 have impacted soil/soil vapor.

For Alternative F-2, 5 facilities were identified with environmental impacts from the records review, of which 3 are considered low and 2 with medium impact. From the preliminary screening, none of the facilities within or adjacent to the alignment were identified to have high impacts. Of these 5 facilities, 2 have impacted groundwater, 1 has impacted soil/soil vapor, and 1 has impacted both soil and groundwater. This alternative was ranked as one of the alternatives having the least potential to encounter hazardous waste sites.

For Alternative F-5, 1 facility that has impacted the soil could result in high environmental impact based on the records review. This alternative was ranked as one of the alternatives having the least potential to encounter hazardous waste sites.

For Alternative F-6, 9 facilities were identified with environmental impacts from the records review, of which 2 are considered low, 4 medium, and 3 with high impact. Of these 9 facilities, 5 have impacted groundwater, 3 have impacted soil/soil vapor, and 1 has impacted both soil and groundwater. This alternative was ranked as one of the alternatives having the least potential to encounter hazardous waste sites.

For Alternative F-7, 11 facilities were identified with environmental impacts from the records review, of which 3 are considered low, 5 medium, and 3 with high impact. Of these 11 facilities, 6 have impacted groundwater, 4 have impacted soil/soil vapor, and 1 has impacted both soil and groundwater.

For Alternative H-2, 28 facilities were identified with environmental impacts from the records review, of which 20 are considered low, 3 medium, and 5 with high impact. Of these 28 facilities, 21 have impacted groundwater, 3 have impacted soil/soil vapor, and 3 have impacted both soil and groundwater. No specific information regarding media of impact was available for one facility in any of the databases reviewed for this screening. This alternative was ranked as one of the alternatives having the greatest potential to encounter hazardous waste sites.

For Alternative H-6, 15 facilities were identified with environmental impacts from the records review, of which 8 are considered low, 4 medium, and 3 with high impact. Of these 15 facilities, 12 have impacted groundwater and 3 have impacted soil/soil vapor.

4.2.7 Visual Resources

The study area includes the San Gabriel Mountains to the north, Santa Monica Mountains to the east, Montebello Hills and Puente Hills to the southeast, Los Angeles plain to the south, Santa Monica Mountains to the west, and Verdugo Mountains/San Rafael Hills to the northwest. The mountainous areas of the San Gabriel and Verdugo Mountains are relatively undeveloped and have extensive natural/native habitats along with non-native grassland areas. Griffith Park in the west has a large area of undeveloped native habitat. The region has areas of pre-existing dense urban and suburban development (residential, commercial, and industrial), along with religious, educational, public institution, recreational park, various open space, rail, and transportation (streets and freeways) uses. The region also has a few significant river and stream courses (Los Angeles River, Arroyo Seco, Rio

Hondo River) within the project study area. Within the study area, partial views of the San Gabriel Mountains and Verdugo Mountains can be seen from a variety of locations within the cities. Views of the significant river and stream courses can be seen from areas adjacent to them. The northern section of the project study area includes a portion of the Arroyo Seco Historic Parkway. A portion of SR 110 has been designated by the National Scenic Byways Program (under jurisdiction of the U.S. Department of Transportation, Federal Highway Administration) as a historic byway based on its archeological, cultural, historic, natural, recreational and scenic qualities.

4.2.7.1 General Impacts

The alternatives would have a visual impact if it would noticeably change the physical characteristics of the existing environment. The TSM/TDM Alternative and the BRT alternatives would result in low visual intrusion into communities because these alternatives include expanded transit service consisting largely of ITS and other improvements, all of which would also have an anticipated low change in overall visual character. The LRT, freeway, and highway alternatives would all result in high visual intrusion into communities, especially at areas of cut and cover construction, tunnel openings, aerial structures, and roadway widenings within communities.

4.2.7.2 Alternative-Specific Impacts

The No Build Alternative would have no change in overall visual character in the Study Area. The No Build Alternative has a visual intrusion rating of 1, which is a low impact.

The TSM/TDM Alternative proposes expanded transit service consisting largely of ITS and other improvements, all of which would also have an anticipated low change in overall visual character. The TSM/TDM Alternatives have a visual intrusion rating of 1, which is a low impact.

Alternative BRT-1 would have a low noticeable change in physical characteristics due to this alternative consisting of modifications to frequency, bus numbers, routing, and schedule. Alternative BRT-1 has a visual intrusion rating of 1, which is a low impact.

Alternative BRT-6 would have a low noticeable change in physical characteristics due to this alternative consisting of modifications to frequency, bus numbers, routing, and schedule. Alternative BRT-6 has a visual intrusion rating of 1, which is a low impact.

Alternative BRT-6A would have a low noticeable change in physical characteristics due to this alternative consisting of modifications to frequency, bus numbers, routing, and schedule. Alternative BRT-6A consists of a different terminal loop in Pasadena. Alternative BRT-6A has a visual intrusion rating of 1, which is a low impact.

Alternative LRT-4A would have a high impact on the overall visual quality of the existing environment due to a high number of physical changes to the existing site to accommodate the aerial segment of this alternative. The aerial segment is comprised of approximately the first 45 percent of the alignment originating at the south end at the commercial center on 3rd Street and Mednik Avenue and ending approximately at Valley Boulevard where the tracks transition from aerial route to a bored tunnel route. The introduction of an aerial segment would add a second story to the commercial center greatly changing the visual as well as the architectural character of the center. Alternative LRT-4A has a visual intrusion rating of 3, which is a high impact.

Alternative LRT-4B would have a high impact on the overall visual quality of the existing environment at 13 locations due to a high number of physical changes to the existing site to accommodate this alternative. Visual impacts begin with the introduction of the aerial station over the commercial center at 3rd Street and Mednik Avenue changing the architectural and visual character of the center.

Continuing northbound along the project route, the elevated route continues to impact the visual quality northbound across from Belvedere Park, along various locations of the route at Floral Drive, and at the crossing of SR 710. The alignment crosses SR 710 and then continues to parallel SR 710 along the natural hillside, greatly changing the hillside's natural character. An additional key area of visual impact is at Cal State LA. The overall visual impact increases further north at the grade portion of the route on Fremont Avenue. Alternative LRT-4B has a visual intrusion rating of 3, which is a high impact.

Alternative LRT-4A would have a high impact on the overall visual quality of the existing environment at 13 locations due to a high number of physical changes to the existing site to accommodate this alternative. Visual impacts begin with the introduction of the aerial station over the commercial center at 3rd Street and Mednik Avenue changing the architectural and visual character of the center. Continuing northbound along the project route, the elevated route continues to impact the visual quality northbound across from Belvedere Park, along various locations of the route at Floral Drive, and at the crossing of SR 710. The route crosses SR 710 and then continues to parallel SR 710 along the natural hillside, greatly changing the hillside's natural character. An additional key area of visual impact is at Cal State Los Angeles. The overall visual impact increases further north at the grade portion of the route on Fremont Avenue. Alternative LRT-4D has a visual intrusion rating of 3, which is a high impact.

Alternative LRT-6 would have a high impact on the overall visual quality of the existing environment at 9 locations due to a high number of physical changes to the existing site to accommodate this alternative. Beginning south of the SR 60 and proceeding north along Atlantic Boulevard the aerial segment will greatly impact the visual character of the area by the addition of the raised segment. Additional areas of high visual impact are along Atlantic Boulevard just past the college where the segment drops down to grade, and further north where the segment alternates from at grade to aerial segments. Alternative LRT-6 has a visual intrusion rating of 3, which is a high impact.

Alternative F-2 would have an impact on the overall visual quality of the existing environment at several locations. Beginning at the southernmost cut and cover segment, then again, north on the segment at the second cut and cover segment where a residential hillside neighborhood will be disturbed for approximately 700 linear feet wide and 3,000 linear feet long section. Continuing further north, the segment transitions from cut and cover to an aerial segment and then meets the grade and ties into SR 2. The aerial segment crosses Eagle Rock Boulevard and will impact the visual quality of the area. Alternative F-2 has a visual intrusion rating of 2, which is a moderate impact. In addition, Alternative F-2 would impact 750 linear feet of the Arroyo Parkway, a designated scenic parkway.

Alternative F-5 would have a high impact on the overall visual quality of the existing environment due to physical changes to the existing site to accommodate this alternative. Beginning at the south end of this alternative it would have a high impact approximately 1,300 linear feet both north and south of west Valley Boulevard and then further impacts the visual quality at the next segment to the north where there is a transition from cut and cover tunnel to a bored tunnel segment. Further northwest, approximately 3,000 linear feet from San Pasqual Avenue, the bored tunnel segment transitions to a cut and cover tunnel for approximately 1,000 linear feet The transition will impact an existing residential neighborhood. This impact will continue north, at grade, through the neighborhood until this alternative ties into SR 134. Alternative F-5 has a visual intrusion rating of 3, which is a high impact. In addition, Alternative F-5 would impact 300 linear feet of the Arroyo Parkway, a designated scenic parkway.

Alternative F-6 has a meandering alignment through residential neighborhoods and will have a high impact in the overall visual quality of the existing environment for approximately 90 percent of the segment. Beginning at the southern end of the segment (the SR 710/I-10 interchange, approximately 900 linear feet south of Paseo Ranchos Castilla), this alternative is at grade then transitions to a depressed segment just north of Norwich Avenue. This alternative segment continues as a depressed segment through residential neighborhoods up to SR 110 where the segment is at grade and then continues further north as a depressed segment. Alternative F-6 has a visual intrusion rating of 3, which is a high impact.

Alternative F-7 would have a high impact in the overall visual quality of the existing environment due to physical changes to the existing site to accommodate this alternative. Beginning at the southern end of the segment, at the SR 710/I-10 interchange, the route transitions from an at grade segment to a cut and cover tunnel approximately 1,300 linear feet south of Valley Boulevard and continues approximately 1,300 linear feet north of Valley Boulevard where the bored tunnel segment begins. The bored tunnel segment transitions to a cut and cover segment approximately 500 linear feet north of west California Boulevard and then transitions to an at grade segment at approximately W. Green Street. Alternative F-7 has a visual intrusion rating of 3, which is a high impact.

Alternative H-2 would have a high impact in the overall visual quality of the existing environment due to physical changes to the existing site to accommodate this alternative. Beginning at the southern end of the segment, the visual impact would stretch the entire length of the segment. Intermittent instances of increased landscaping will add to the visual impact of the alternative. Additionally, this alternative crosses the Arroyo Seco Golf Couse at the golf course's southern edge almost at a perpendicular angle to the I-110 for approximately 1,700 linear feet and has the potential for a large amount of right-of-way acquisition. Alternative H-2 has a visual intrusion rating of 3, which is a high impact. In addition, Alternative H-2 would impact 250 linear feet of the Arroyo Parkway, a designated scenic parkway.

Alternative H-6 would have a moderate impact in the overall visual quality of the existing environment due to low physical changes to the existing site to accommodate this alternative. The overall character of the route would change and there is the potential for a large amount of right-of-way acquisition for the addition of the travel lanes throughout the segment, in addition to the intermittent instances of landscape that would add to the visual impact of the segment. Alternative H-6 has a visual intrusion rating of 2, which is a moderate impact.

4.2.8 Environmental Justice

Environmental justice has been a long-standing concern within the SR 710 study area, and it was a major concern raised by the El Sereno community during the review of the I-710 EIR/EIS in the 1990s. Environmental justice criteria include Hispanic populations, non-white populations, below poverty level populations, transit-dependent populations, and median household income. Census tracts meeting 3 or more Environmental Justice criteria that would potentially be affected by alternatives are located in the cities/communities of Alhambra, East Los Angeles, El Sereno, Los Angeles, Monterey Hills, Monterey Park, Pasadena, Rosemead, and South Pasadena.

4.2.8.1 General Impacts

While the number of affected census tracts could be identified with reasonable accuracy, there is a limitation to the analysis. Not all effects within a census tract are potentially adverse. For example, the beneficial effects of improved mobility would also be a potential effect of the alternatives, especially for transit dependent populations. As a result, in reviewing the results of the analysis, it was determined that the simple fact that a census tract is traversed by the alignment of an alternative is not necessarily positive or negative. Therefore, no performance measure for environmental justice was used in the secondary screening.

4.2.8.2 Alternative-Specific Impacts

Although the analysis methodology did not yield useful results for purposes of the AA, the information developed was helpful in terms of identifying specific areas that will warrant focused analysis for the alternatives that are carried forward into the technical studies for the Draft EIR/EIS prepared during the PA/ED phase. The results of the analysis to identify the number of census tracts traversed by each alternative can be summarized as follows:

The No Build Alternative would not have direct impacts to Environmental Justice populations, but would also not provide any mobility benefits to Environmental Justice populations, especially transit-dependent populations.

The TSM/TDM Alternative would affect a total of 28 Environmental Justice population census tracts.

Alternative BRT-1 would affect 12 Environmental Justice population census tracts in Los Angeles, El Sereno, Alhambra, Pasadena, and Monterey Hills.

Alternative BRT-6 would affect 13 Environmental Justice population census tracts in East Los Angeles, Monterey Park, and Alhambra.

Alternative BRT-6A would affect 13 Environmental Justice population census tracts in East Los Angeles, Monterey Park, and Alhambra.

Alternative LRT-4A would affect five Environmental Justice population census tracts in East Los Angeles, Los Angeles, and El Sereno.

Alternative LRT-4B would affect five Environmental Justice population census tracts in East Los Angeles, Los Angeles, and El Sereno.

Alternative LRT-4D would affect six Environmental Justice population census tracts in East Los Angeles, Los Angeles, and El Sereno.

Alternative LRT-6 would affect ten Environmental Justice population census tracts in East Los Angeles, Monterey Park, and Alhambra.

Alternative F-2 would affect five Environmental Justice population census tracts in Los Angeles and Alhambra.

Alternative F-5 would affect five Environmental Justice population census tracts in Los Angeles and Alhambra.

Alternative F-6 would affect seven Environmental Justice population census tracts in Los Angeles, Monterey Park, Alhambra and El Sereno.

Alternative F-7 would affect seven Environmental Justice population census tracts in Los Angeles, Pasadena, and Alhambra.

Alternative H-2 would affect four Environmental Justice population census tracts in Los Angeles, South Pasadena, and Alhambra.

Alternative H-6 would affect four Environmental Justice population census tracts in El Sereno, Los Angeles, and Alhambra.

4.2.9 Paleontological Resources

The study area is located at the northern end of the Peninsular Range geomorphic province, a 900-mile-long northwest-southeast-trending structural block that extends from the tip of Baja California to the Transverse Ranges and includes the Los Angeles Basin. The total width of the province is approximately 225 miles, with a maximum landbound width of 65 miles. It contains extensive pre-Cretaceous (more than 65 million years ago) igneous and metamorphic rocks covered by limited exposures of post-Cretaceous sedimentary deposits. Geologic mapping indicates that sediments from the middle Miocene through latest Quaternary are mapped as occurring within the study area.

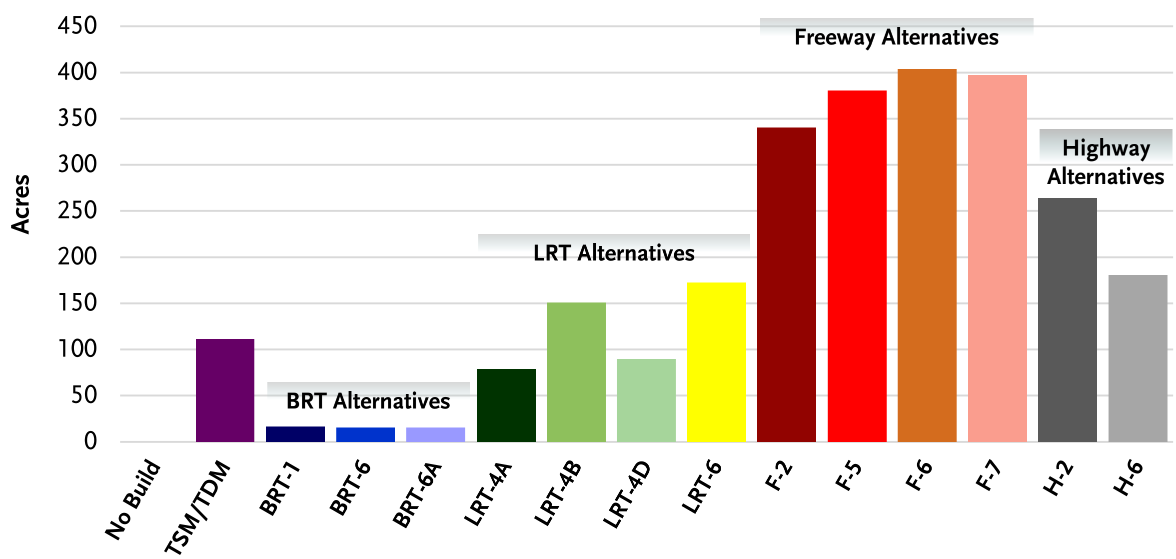
4.2.9.1 General Impacts

Because the majority of the alignments of all of the alternatives (96.4 to 100 percent) are located in areas of high paleontological sensitivities, excavation and ground disturbance activities for all build alternatives would have a high potential to impact paleontological resources.

4.2.9.2 Alternative-Specific Impacts

As shown in Figure 4-9, the No Build Alternative would not impact any paleontological resources.

Figure 4-9: Acres of High Paleontological Sensitivity



For the TSM/TDM Alternative, approximately 111 acres (99.8 percent) of the area within the estimated disturbance limits of the alternative are located within high sensitivity sediments.

For Alternative BRT-1, approximately 16 acres (100 percent) of the area within the estimated disturbance limits of the alternative are located within high sensitivity sediments. Because of the small area of excavation, Alternative BRT-6 would have the third lowest potential of all alternatives to encounter paleontological resources.

For Alternative BRT-6, approximately 15 acres (100 percent) of the area within the estimated disturbance limits of the alternative are located within high sensitivity sediments. Because of the small area of excavation, Alternative BRT-6 would have the lowest potential of all alternatives to encounter paleontological resources.

For Alternative BRT-6A, approximately 16 acres (100 percent) of the area within the estimated disturbance limits of the alternative are located within high sensitivity sediments. Because of the small area of excavation, Alternative BRT-6A would have the second lowest potential of all alternatives to encounter paleontological resources.

For Alternative LRT-4A, approximately 79 acres (100 percent) of the area within the estimated disturbance limits of the alternative are located within high sensitivity sediments.

For Alternative LRT-4B, approximately 151 acres (100 percent) of the area within the estimated disturbance limits of the alternative are located within high sensitivity sediments.

For Alternative LRT-4D, approximately 89 acres (100 percent) of the area within the estimated disturbance limits of the alternative are located within high sensitivity sediments.

For Alternative LRT-6, approximately 172 acres (100 percent) of the area within the estimated disturbance limits of the alternative are located within high sensitivity sediments.

For Alternative F-2, approximately 340 acres (100 percent) of the area within the estimated disturbance limits of the alternative are located within high sensitivity sediments. Because of the large area of excavation, Alternative F-2 would have the fourth highest potential of all alternatives to encounter paleontological resources.

For Alternative F-5, approximately 380 acres (93.8 percent) of the area within the estimated disturbance limits of the alternative are located within high sensitivity sediments. Because of the large area of excavation, Alternative F-5 would have the third highest potential of all alternatives to encounter paleontological resources.

For Alternative F-6, approximately 404 acres (100 percent) of the area within the estimated disturbance limits of the alternative are located within high sensitivity sediments. Because of the large area of excavation, Alternative F-6 would have the highest potential of all alternatives to encounter paleontological resources.

For Alternative F-7, approximately 397 acres (100 percent) of the area within the estimated disturbance limits of the alternative are located within high sensitivity sediments. Because of the large area of excavation, Alternative F-7 would have the second highest potential of all alternatives to encounter paleontological resources.

For Alternative H-2, approximately 264 acres (96.4 percent) of the area within the estimated disturbance limits of the alternative are located within high sensitivity sediments.

For Alternative H-6, approximately 181 acres (100 percent) of the area within the estimated disturbance limits of the alternative are located within high sensitivity sediments.

4.2.10 Geotechnical Conditions

The surface faults of greatest significance to the project include the Raymond fault, the Alhambra Wash fault, the Eagle Rock fault, and the San Rafael fault. The Raymond fault is the major active fault in the study area. It is a left-lateral, reverse-oblique fault that dips steeply (approximately 80 degrees) to the north. It extends southwesterly from the Sierra Madre Fault Zone at the base of the San Gabriel Mountains through the communities of Monrovia, Arcadia, San Marino, and Pasadena to the Raymond Hill area of South Pasadena, where the Raymond fault trends more westerly through the communities of South Pasadena, Highland Park, and possibly into Los Angeles for a length of 12 to 15.5 miles. The Alhambra Wash fault is a short northwest-southeast-trending fault in the southern part of the San Gabriel Valley. The surficial expression of the fault is approximately 1.5 miles long extending from SR 60 on the southeast to San Gabriel Boulevard on the northwest. The San Rafael fault trends along the southerly side of the San Rafael Hills across the Arroyo Seco then along the north sides of Grace and Raymond Hills in southwestern Pasadena. To the northwest, the fault apparently dies out north of the Eagle Rock fault as a series of disjointed strands in the basement complex of the San Rafael Hills. The Eagle Rock fault, mapped as an eastward continuation of the Verdugo fault, lies between the San Rafael and Raymond faults. Southeast of the San Rafael Hills, the fault may be expressed by irregular terrain in a nearly flat surface of overlying terrace deposits. The fault is well exposed where it separates granitic rocks from conglomerate-breccia of the Topanga Formation west of Arroyo Seco.

4.2.10.1 General Impacts

An alternative would have the potential to encounter adverse geotechnical conditions if it crosses areas of potential liquefaction, subsurface soil/ bedrock variability or active faults.

4.2.10.2 Alternative-Specific Impacts

There are two active faults (Raymond and Alhambra Wash), and two potentially active faults (Eagle Rock and San Rafael) present within the study area. Several alluvial areas are zoned as having a liquefaction hazard. The No Build Alternative would not result in any changes to geological conditions in the study area; however, the existing conditions do pose some risk to existing facilities within the study area.

The TSM/TDM Alternative has the lowest potential to encounter adverse geotechnical conditions.

Alternative BRT-1 crosses one active fault (Raymond) and one fault that is potentially active (San Rafael). The potentially active Eagle Rock fault, lying between the Raymond and San Rafael faults, is mapped as ending immediately west of the alignment. Alternative BRT-1 crosses several areas zoned as having a liquefaction hazard. The areas are primarily associated with the Los Angeles River and Arroyo Seco washes. Of the approximately 13.8-mile-long alignment, approximately 3.2 miles cross soil considered to be liquefiable.

Alternative BRT-6 crosses one active fault (Raymond) and one fault that is potentially active (San Rafael). The potentially active Eagle Rock fault, lying between the Raymond and San Rafael faults, is mapped as ending immediately west of the alignments. Alternative BRT-6 crosses no areas zoned as having a liquefaction hazard.

Alternative BRT-6A crosses one active fault (Raymond) and one fault that is potentially active (San Rafael). The potentially active Eagle Rock fault, lying between the Raymond and San Rafael faults, is mapped as ending immediately west of the alignments. Alternative BRT-6A crosses no areas zoned as having a liquefaction hazard.

Alternative LRT-4A crosses one active fault (Raymond) and one fault that is potentially active (San Rafael). The potentially active Eagle Rock fault, lying between the Raymond and San Rafael faults, is mapped as ending immediately west of the alignments. Alternative LRT-4A crosses no areas zoned as having a liquefaction hazard. Because it is partially subterranean, Alternative LRT-4A is one of the alignments ranked with the greatest potential to encounter adverse geotechnical conditions.

Alternative LRT-4B crosses one active fault (Raymond) and one fault that is potentially active (San Rafael). The potentially active Eagle Rock fault, lying between the Raymond and San Rafael faults, is mapped as ending immediately west of the alignments. Alternative LRT-4B crosses no areas zoned as having a liquefaction hazard. Because it is partially subterranean, Alternative LRT-4B is one of the alignments ranked with the greatest potential to encounter adverse geotechnical conditions.

Alternative LRT-4D crosses one active fault (Raymond) and one fault that is potentially active (San Rafael). The potentially active Eagle Rock fault, lying between the Raymond and San Rafael faults, is mapped as ending immediately west of the alignments. Alternative LRT-4D crosses no areas zoned as having a liquefaction hazard. Because it is partially subterranean, Alternative LRT-4D is one of the alignments ranked with the greatest potential to encounter adverse geotechnical conditions.

Alternative LRT-6 crosses one active fault (Raymond) and one fault that is potentially active (San Rafael). The potentially active Eagle Rock fault, lying between the Raymond and San Rafael faults, is mapped as ending immediately west of the alignment. Alternative LRT-6 crosses no areas zoned as having a liquefaction hazard.

Alternative F-2 crosses one active fault (Raymond). However, the alignment trends for almost 2.5 miles within or near the inactive Highland Park fault, which could pose rock quality issues for a tunnel. Alternative F-2 crosses several areas zoned as having a liquefaction hazard by the California Geological Survey (CGS) Seismic Hazard Zonation Program. These areas are associated with Arroyo Seco. The liquefaction impact at tunnel depths greater than 100 feet is unlikely. However, liquefaction at the north tunnel portal will impact this alternative. Because it is partially subterranean, Alternative F-2 is one of the alignments ranked with the greatest potential to encounter adverse geotechnical conditions.

Alternative F-5 crosses one active fault (Raymond) and two faults that are potentially active (Eagle Rock and San Rafael). Alternative F-5 crosses several areas zoned as having a liquefaction hazard. At tunnel depths greater than 100 feet, liquefaction is unlikely to be an issue. However, liquefaction at the north tunnel portal would impact this alternative. Because it is partially subterranean, Alternative F-5 is one of the alignments ranked with the greatest potential to encounter adverse geotechnical conditions.

Alternative F-6 crosses one active fault (Raymond) and one fault that is potentially active (San Rafael). The potentially active Eagle Rock fault, lying between the Raymond and San Rafael faults, is mapped as ending immediately west of the alignment. Alternative F-6 crosses no areas zoned as having a liquefaction hazard.

Alternative F-7 crosses one active fault (Raymond) and one fault that is potentially active (San Rafael). The potentially active Eagle Rock fault, lying between the Raymond and San Rafael faults, is mapped as ending immediately west of the alignment. Alternative F-7 crosses no areas zoned as having a liquefaction hazard. Because it is partially subterranean, Alternative F-7 is one of the alignments ranked with the greatest potential to encounter adverse geotechnical conditions.

Alternative H-2 crosses one active fault (Raymond) and two faults that are potentially active (Eagle Rock and San Rafael). Alternative H-2 crosses several areas zoned as having a liquefaction hazard. These areas are associated with Arroyo Seco Wash. Approximately 1.4 miles of the alignment transects soil considered to be liquefiable.

Alternative H-6 crosses one active fault (Raymond) and one fault that is potentially active (San Rafael). The potentially active Eagle Rock fault, lying between the Raymond and San Rafael faults, is mapped as ending immediately west of the alignment. Alternative H-6 crosses no areas zoned as having a liquefaction hazard.

4.2.11 Biological Resources

Within the study area, the primary drainage is the Arroyo Seco which is mostly concrete-lined. In addition, the concrete-lined portion of the Los Angeles River is on the western edge of the study area. Most of the smaller original drainage courses in this area have been replaced with underground storm drain facilities. However, portions of some of these, such as the Laguna Channel along the northern end of SR 710, remain as above-ground, concrete-lined flood control channels.

Five existing Significant Ecological Areas (SEAs) and seven proposed SEAs designated by Los Angeles County are located in the vicinity of the alternatives. The SEAs within the El Monte area are the Puente Hills SEA and Rio Hondo College Wildlife Sanctuary SEA. Much of the Puente Hills SEA is also designated Critical habitat by the U.S Fish and Wildlife Service for the Coastal California Gnatcatcher (*Polioptila californica californica*). Mount Wilson has two mapped SEAs, San Gabriel Canyon and Altadena Foothills and Arroyos which cross over into Pasadena. Burbank SEAs are the Verdugo Mountains which also cross into Pasadena and Griffith Park. Hollywood has only one SEA, Griffith Park.

Within the study area, there are scattered patches of discontiguous native habitat areas, as well as recreational open spaces that contain substantial native vegetation. Notable areas with native vegetation are in the vicinity of Eagle Rock Reservoir and Annandale Country Club in the San Rafael Hills at the northwestern border of the study area, the Arroyo Seco, and the Mount Washington area north of downtown Los Angeles. Relatively small patches of native vegetation around the Pasadena and Los Angeles quads have potential resources. A walnut forest in the Los Angeles quad located in the Ernest E. Debs Regional Park located west of Monterey hills and the peregrine falcon (*falco peregrinis anatum*) and western mastiff bat (*Eumops perotis californicus*) have been documented at the south end of the Annandale Golf Club in Pasadena. The Pasadena quad has two SEAs, Verdugo Mountain, and Altadena Foothills and Arroyos, which are located at the northern section of the SR 710 study area. The Los Angeles River, Laguna channel, and Arroyo Seco drainage courses are also within the study area

4.2.11.1 General Impacts

Because the study area is primarily developed, impacts of the alternatives would be minimal (less than 4.3 acres of impacts to known sensitive habitats and less than 2,050 linear feet of impacts to drainages). Impacted drainages include the Laguna Channel, Arroyo Seco, and Los Angeles River. Impacted sensitive habitats include the walnut forest in Ernest E. Debs Regional Park in Los Angeles, potential wildlife habitat for Western mastiff bat and peregrine falcon located at the south end of the Annandale Golf Club in Pasadena, trees and shrubs with potential wildlife habitat located in a south Pasadena community, and potential wildlife habitat at the southern section of Arroyo Seco Golf Course.

4.2.11.2 Alternative-Specific Impacts

As shown in Figures 4-10 and 4-11, no biological resources would be impacted by the No Build Alternative.

For the TSM/TDM Alternative, no biological resources were identified; therefore, there would be no impacts to known sensitive habitats or drainages.

For Alternative BRT-1, approximately 247 linear feet of the Los Angeles River located adjacent to Cesar Chavez Avenue would potentially be impacted.

For Alternative BRT-6, no biological resources were identified; therefore, there would be no impacts to known sensitive habitats or drainages.

For Alternative BRT-6A, no biological resources were identified; therefore, there would be no impacts to known sensitive habitats or drainages.

For Alternative LRT-4A, the biological resources with potential to be impacted include 2,050 linear feet of the concrete lined Laguna Channel located at the southern section of the alignment starting 0.2 miles north of the Ford Boulevard on-ramp and ending where the SR 710 ends at Valley Boulevard.

Figure 4-10: Acres of Sensitive Habitats Potentially Affected

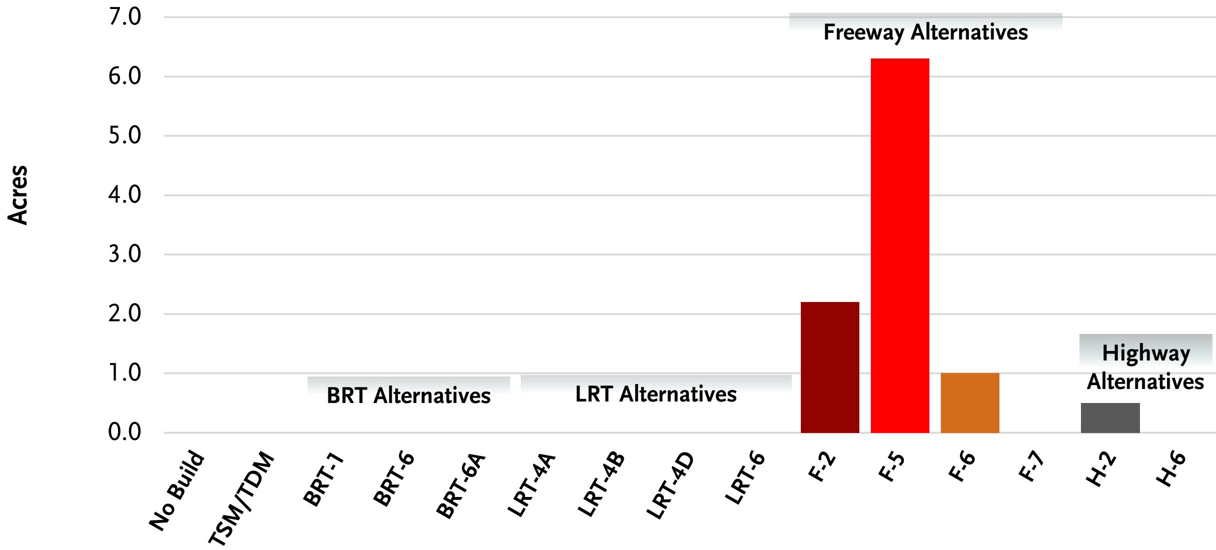
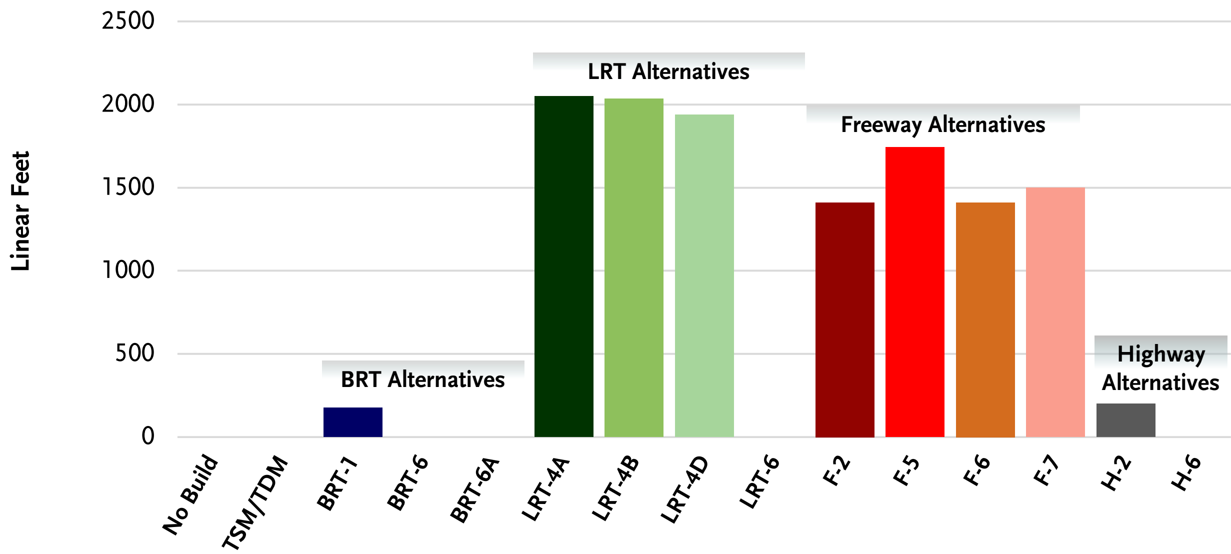


Figure 4-11: Major Drainages Directly Affected (Linear Feet)



For Alternative LRT-4B, the biological resources with potential to be impacted include 2,034 linear feet of the concrete lined Laguna Channel located at the southern section of the alignment starting 0.2 miles north of the Ford Boulevard on-ramp and ending where SR 710 ends at Valley Boulevard.

For Alternative LRT-4D, the biological resources with potential to be impacted include 1,938 linear feet of the concrete lined Laguna Channel located at the southern section of the alignment starting 0.2 miles north of the Ford Boulevard on-ramp and ending where SR 710 ends at Valley Boulevard.

For Alternative LRT-6, no biological resources were identified; therefore, there would be no impacts to known sensitive habitats or drainages.

For Alternative F-2, the biological resources with potential to be impacted include 1,411 linear feet of the concrete lined Laguna Channel located at the southern section of the alignment running parallel to Highbury Avenue and ending where SR 710 ends at Valley Boulevard and 2.2 acres of walnut forest in Ernest E. Debs Regional Park in Los Angeles.

For Alternative F-5, the biological resources with potential to be impacted include 1,744 linear feet of the concrete lined Laguna Channel located at the southern section of the alignment running parallel to Highbury Avenue and ending where SR 710 ends at Valley Boulevard and 6.3 acres of potential wildlife habitat for western mastiff bat and peregrine falcon located at the south end of the Annandale Golf Club in Pasadena.

For Alternative F-6, the biological resources with potential to be impacted include 1,411 linear feet of the concrete lined Laguna Channel located at the southern section of the alignment where SR 710 ends at Valley Boulevard and 1.0 acres of trees and shrubs with potential wildlife habitat located in South Pasadena.

For Alternative F-7, the biological resource within potential to be impacted includes 1,500 linear feet of the concrete lined Laguna Channel located at the southern section of the alignment running parallel to Highbury Avenue and ending where SR 710 ends at Valley Boulevard.

For Alternative H-2, the biological resources with the potential to be impacted include 200 linear feet of the Arroyo Seco drainage that is a tributary to the Los Angeles River and 0.5 acres of potential wildlife habitat at the southern section of Arroyo Seco Golf Course.

For Alternative H-6, no biological resources were identified; therefore, there would be no impacts to known sensitive habitats or drainages.

4.2.12 Consistency with Regional Plans and Strategies

The alternatives were evaluated for consistency with the goals and objectives of SCAG's 2012-2035 RTP/SCS, Measure R, and Metro's LRTP. As shown in the analysis, the No Build Alternative is not consistent with any of the goals/objectives in these three planning documents. The goals and objectives of SCAG's RTP/SCS focus on maximizing mobility and accessibility and ensuring safety, reliability, sustainability, and productivity of the regional transportation system; therefore, the BRT, LRT, and freeway alternatives have the greatest consistency with goals/objectives in SCAG's RTP/SCS, while the highway alternatives have the least consistency. The goals/objectives of Measure R focus on reducing congestion, improving traffic flow, improving mobility, and increasing public transportation; therefore, the BRT and freeway alternatives have consistency with the most goals/objectives of Measure R, followed by the LRT alternatives, while the TSM/TDM and highway alternatives are the least consistent. Of all alternatives, the TSM/TDM Alternative is consistent with the most goals/objectives in Metro's LRTP through implementation of signal synchronization, ITS technologies, bicycle and pedestrian improvements, and bus signal prioritization.

5.0 Cost Efficiency

One of the objectives identified for the SR 710 Study is to optimize the cost-efficiency of public investments. This objective was evaluated through three performance measures: construction and right-of-way costs, available funding, and technical feasibility.

5.1 Descriptions of Performance Measures

Each of the three performance measures related to cost efficiency was developed to address the concern of providing financially feasible transportation solutions. The performance measures are described in the following sections.

5.1.1 Construction and Right-of-Way Costs

The cost of each alternative includes both construction costs and right-of-way costs. The conceptual engineering plans for each alternative served as the basis to identify the quantities of various construction elements required such as roadway, guideway, structures, and earthwork. To account for unknown and minor items, a contingency of 35 percent has been added to construction costs. Details of the construction cost estimating methodology are included in the Cost of Alternatives Technical Memorandum in Appendix X.

Right-of-way costs include residential and commercial acquisitions, permanent easements, and relocation assistance. Details of the right-of-way methodology are included in the Right of Way Technical Memorandum in Appendix K. Right-of-way costs are conservative and assume full property acquisitions if a property is impacted in any way other than a subsurface easement. To account for unknown and minor items, a contingency of 25 percent has been added to right-of-way costs.

Construction and right-of-way costs were summed. Because of the uncertainty inherent in costs estimates at this stage of project development, each alternative was assigned a score from 1 to 7 using the scale shown in Table 5-1

Table 5-1: Cost Performance Measure Scale

Score	Cost Range
1	Over $6B
2	$4.25B - $6B
3	$2.25B - $4.25B
4	$1.25B - $2.25B
5	$0.25B - $1.25B
6	$0.01B - $0.25B
7	Less than $0.01B

5.1.2 Available Funding

This performance measure compared the total cost of an alternative to the funding expected to be available to construct it. Because of the variety of modes represented in the alternatives, different funding sources could be expected to be available for each alternative. The Measure R allocation for the project would be available for all of the alternatives. Transit fare revenues would be available for the TSM/TDM Alternative and the transit alternatives. Although no analysis of tolling was performed as part of this AA study, an independent study conducted by Metro concluded that toll revenues could be available for a freeway tunnel project and therefore it was assumed that tolling could be used to supplement a funding shortfall for a freeway tunnel project. Each alternative was assigned a score from 1 to 5 using the scale shown in Table 5-2.

Table 5-2: Available Funding Performance Measure Scale

Score	Definition
1	Funding not available
2	Large deficit of available funds compared to construction costs
3	Some deficit of available funds compared to construction costs
4	Can be constructed with available Measure R funds plus revenues from users
5	Can be constructed with available Measure R funds

5.1.3 Technical Feasibility

This performance measure was intended to distinguish alternatives that were known to be technically feasible from those that still require technological innovations. All of the alternatives being evaluated in the secondary screening use established technologies, so all were assigned the same score on this measure.

5.2 Performance of Alternatives

A detailed evaluation of the twelve alternatives (plus three design variations) on each of the performance measures pertaining to cost efficiency is presented below. For alternatives that are evaluated further in the PA/ED phase, designs will be refined to reduce construction and right-of-way costs where possible without compromising performance or increasing impacts.

5.2.1 Construction and Right-of-Way Costs

Table 5-3 presents the construction and right-of-way costs of each alternative, along with the score assigned to its cost.

Table 5-3: Construction and Right-of-Way Costs

Alternative	Construction Cost (millions $)	ROW Cost (millions $)	Total Cost (millions $)	Score
No Build	0	0	0	7
TSM/TDM	30	90	120	6
BRT-1	50	30	80	6
BRT-6	50	0	50	6
BRT-6A	50	0	50	6
LRT-4A	2,400	200	2,600	3

Alternative	Construction Cost (millions $)	ROW Cost (millions $)	Total Cost (millions $)	Score
LRT-4B	2,200	225	2,425	3
LRT-4D	2,100	300	2,400	3
LRT-6	1,125	700	1,825	4
F-2	6,100	325	6,425	1
F-5	5,750	525	6,275	1
F-6	1,450	675	2,125	4
F-7	5,350	75	5,425	2
H-2	500	850	1,350	4
H-6	325	425	750	5

The lowest cost alternatives include the No Build Alternative, the TSM/TDM Alternative, and Alternatives BRT-1, BRT-6, and BRT-6A. The No Build Alternative is the least expensive since no infrastructure improvements would be constructed. The BRT alternatives are relatively low cost since their infrastructure improvements are primarily designed within existing right-of-way, reducing construction and right-of-way costs, and they include no major structures.

Alternatives with moderate construction and right-of-way costs include Alternatives LRT-6, H-2, H-6 and F-6. These alternatives may require significant right-of-way but have lower construction costs than the tunnel alternatives. Alternative F-6 has a higher right-of-way cost than tunneled freeway alternatives due to the higher number of surface impacts, but its construction costs are significantly lower because its alignment includes only one short tunnel segment.

Light rail and freeway alternatives with tunnels (Alternatives LRT-4A, LRT-4B, LRT-4D, F-2, F-5, and F-7) are the most expensive alternatives. Alternatives F-2 and F-5 have large construction costs associated with lengthy bored tunnel sections and significant residential right-of-way impacts in their respective north portal areas. The construction cost of Alternative F-7 is slightly lower than those of Alternatives F-2 and F-5, because it has a slightly shorter tunnel and it can make use of the existing I-210/SR 134 interchange at the northern terminus. Also, because Alternative F-7 improvements are within the Caltrans right-of-way, its right-of-way costs are lower than those of the other freeway and highway alternatives. Therefore, Alternative F-7 is somewhat less expensive than the other tunneled freeway alternatives.

Alternatives LRT-4A, LRT-4B, and LRT-4D are intended to limit right-of-way costs, but they do include high tunnel construction costs. While most of the tunnel segments of Alternatives LRT-4A and LRT-4B are bored, cut-and-cover techniques would have to be employed at the underground station locations.

5.2.2 Financial Feasibility

The best performing alternatives on this measure include the No Build Alternative, the TSM/TDM Alternative, and Alternatives BRT-1, BRT-6, BRT-6A, H-2 and H-6. The total cost of each of these alternatives is less than the funds available from Measure R.

All freeway alternatives (Alternatives F-2, F-5, F-6, F-7) rank moderately, with a score of 4. This score reflects the conclusions of an independent study conducted by Metro that concludes that freeway tunnel alternatives could be funded by future toll revenues. However, as no analysis of toll revenues has been conducted in the AA, this conclusion will have to be verified in the PA/ED phase.

Alternatives LRT-4A, LRT-4B, and LRT-4D score the lowest, with a score of 2, since transit fare revenues generally do not exceed transit operating costs, so future revenues would not be available to fund construction costs. All have estimated construction costs that are greater than the funds available from Measure R, even with the consideration of potential Federal New Starts funding. Alternative LRT-6 scores a slightly more favorable 3 because of lower construction costs since it has no tunnel sections. Table 5-4 presents the financial feasibility of each alternative.

Table 5-4: Financial Feasibility

Alternative	Score
No Build	5
TSM/TDM	5
BRT-1	5
BRT-6	5
BRT-6A	5
LRT-4A	2
LRT-4B	2
LRT-4D	2
LRT-6	3
F-2	4
F-5	4
F-6	4
F-7	4
H-2	5
H-6	5

5.2.3 Technical Feasibility

The technical feasibility performance measure assesses the constructability of each alternative, given current technologies. The evaluation of each alternative has determined that all alternatives are equally feasible, since the technology, construction methods and construction personnel required are available to construct each alternative. Therefore, each alternative was assigned a score of 5 on this measure.

6.0 Public Participation

This section presents an overview of the public participation process in the Alternatives Analysis process. A complete description of public participation activities will be included in the Public Outreach Documentation Report.

6.1 Project Scoping

The SR 710 project public outreach began in February 2011 with the "SR-710 Conversations," a series of scoping meetings that began with 21 pre-scoping and scoping meetings throughout the study area. The formal scoping period extended from March 3, 2011, through April 14, 2011, during which time Caltrans and Metro accepted comments on the proposed project. Comments were received from a total of 252 different agencies, community groups, members of the public, elected officials and other interested parties via letters, emails, comment cards, and recorded scoping meeting comments. All scoping comments were documented in the *710 North Gap Closure, Scoping Summary Report*, Volumes I and II, dated September 2011. The scoping comments were reviewed and analyzed to develop the project's updated need and purpose, evaluation criteria, performance measures, and preliminary alternatives. This set the foundation for the start of the AA study.

6.2 Technical Advisory Committee

The TAC was created with the purpose of providing technical input to Metro, Caltrans, and the project team. Representatives of each jurisdiction in the Study Area, as well as representatives of other stakeholder agencies, were invited to participate in the TAC. The TAC reviewed technical analyses and methodologies and provided feedback on technical materials and project information. TAC members were also responsible for sharing information with their agencies. The TAC met eight times during the AA process, in January February, March, April, May, July, August, and November, 2012.

6.3 Community/Stakeholder Outreach

Several community outreach groups were formed as part of the SR 710 Study to facilitate stakeholder input as well as to utilize the communication channels to circulate information about community engagement forums, such as the open house events. The community groups that were organized include the Community Liaison Councils (CLC) and the Stakeholder Outreach Advisory Committee (SOAC). A complete description of the activities of the CLC and the SOAC, as well as other public participation in the AA process, is included in the *Public Outreach Report*.

Building on the SR-710 Conversations, after the start of the SR 710 Study, community outreach efforts began with two All Communities Convening (ACC) meetings held in March 2012 with the purpose of gathering communities together in an open house format to discuss the project, share information about the process, and gather feedback. At these meetings, the CLCs were introduced as an option for community members to participate in the councils to generate interest and participation within the various communities of the Study Area and to invite the public to the next series of informational meetings. The individual CLC members were asked to take information about upcoming meetings and events associated with the SR 710 Study into their communities and focus on encouraging other community members to attend SR 710 Study meetings and events. CLCs were formed in 13 different communities, and CLC meetings in April 2012 were attended by over 100 people. CLC meetings were held throughout the month of April to notify the community of the upcoming Open House meetings scheduled for May. In August 2012, seven CLC meetings were held to provide a status update to CLC members and to inform them of Open Houses scheduled for the fall.

The SOAC was created at the direction of the Metro Board and consisted of members of planning commissions, transportation commissions, and elected officials. The SOAC met in May, July, August, and November 2012, to be briefed on the progress of the SR 710 Study. SOAC members were responsible for providing updates to their respective jurisdictions on the progress of the study and in turn recommend items to the project team to place on the agenda for subsequent SOAC meetings.

Open House Meetings. A series of seven Open House meetings was held in May 2012 to share the project progress and to gather input from community members and other stakeholders on the Initial Set of Alternatives and on the screening process. Meetings were held in El Sereno, Eagle Rock, La Cañada Flintridge, El Monte, South Pasadena, Alhambra, and Pasadena. At the Open Houses, seven stations were set up covering the following topics: welcome and introduction, study overview, environmental study review process, scoping process review, alternative concepts overview, feedback, and next steps in the study.

Each station presented information in English and Spanish on large presentation boards, allowing members of the community to proceed at their own pace. Each station was also staffed by members of the project team, who were available to answer questions and provide clarifications. Attendees were encouraged to provide their feedback on "Post-It®" notes that could be affixed to the boards. All feedback was documented and shared with the project team. A total of 357 attendees signed in at the Open Houses, and 890 items of feedback were received.

7.0 Evaluation Summary and Recommendations

This Chapter summarizes the results of the secondary evaluation of the 12 alternatives and three design variations that were included in the initial set of alternatives. As described in previous chapters, the alternatives were evaluated using 42 performance measures: 20 related to the five objectives pertaining to the project need and 22 related to the three objectives related to environmental impacts, planning considerations, and cost efficiency.

As the 42 performance measures used a wide variety of units and scale, a method was required to simplify comparisons across alternatives. In addition, the sheer number of performance measures complicates comparisons across alternatives. Therefore, the overall performance of the alternatives was compared using standardized scales ranging from 1 (worst) to 7 (best) that represented each alternative's performance on the project objectives, rather than the individual performance measures. Because the objective related to minimizing environmental impacts include a wide variety of impacts, three scores were assigned for this objective: right-of-way impacts, impacts to the human environment, and impacts to the natural environment. The following sections describe how the standardized scores were developed for each objective for each alternative.

7.1 Evaluation Approach

A six-step process was used to convert the performance on each of the 42 performance measures to a one-to-seven scale for each objective. The steps are listed and described below:

Step 1: For each performance measure, identify the best and worst values, and normalize on a 0 to 100 scale for the range of alternatives.

Step 2: Combine the performance measures within each objective, using a factoring approach.

Step 3: Calculate the combined measures for each alternative within the objective (0 to 100 scale).

Step 4: Convert the 0 to 100 scale to a 1 to 7 rating for each objective and alternative.

Step 5: Repeat steps 2 to 4 for the five other "Factor Focus" groups.

Step 6: Average the six "Factor Focus" group scores and convert to a 1 to 7 scale.

7.1.1 Step 1: Normalize Each Performance Measure

The first step was to convert the scores on each performance measure to a common scale (0 to 100). The individual performance measures were reported with various technical values, using different units. In some cases, higher values are better, and in some cases, lower values are better. Therefore, this step was needed to convert to a common scale, with 100 as the best value for each performance measure, and 0 as the worst value.

Figure 7-1 presents an example for the performance measure of the number of vehicle-miles traveled (VMT) on arterials in the study area each day. This measure is a component of the objective to reduce congestion on the local street system, shown as measure 2.4.3 in Figure 7-1. In this case, the Alternative F-6 has the lowest (best) value: 6.415 million VMT. Alternative H-2 has the highest (worst) value: 7.084 million VMT. Using these data, the normalized values were 100 for Alternative F-6 and 0 for Alternative H-2. The values for the other alternatives were calculated on the scale of 0-100 using the following formula:

$$\frac{\text{Alternative Value (X)} - \text{Worst Value (7.084)}}{\text{Best Value (6.415)} - \text{Worst Value (7.084)}} \times 100$$

For example, Alternative F-2 has a value of 6.642, so the calculated normalized value is (6.642-7.084)/(6.415-7.084) x 100, or 66.0. This process was repeated for all of the alternatives and all of the performance measures.

7.1.2 Step 2: Combine Performance Measures in Each Objective

In this step, the normalized values for each performance measure were combined to create a single score for each alternative for each of the project objectives. As discussed earlier, three scores were calculated for the objective of minimizing environmental impacts, so there were actually ten scores calculated rather than eight.

Except for the objective of minimizing right-of-way impacts, there were multiple performance measures for each objective. In Step 2, within each objective, the performance measure assessments were combined. For example, for the objective to reduce local street system congestion, there are five separate performance measures. From Step 1, each alternative had a set of five performance measure assessments on the 0-100 scale for this objective.

For this step, an approach for combining the assessments was needed. A factor approach was used, where the multiple performance measures were each assigned a value, with a total value of 100 for each objective. The value for each measure represented the relative importance of each performance measure. For example, with five performance measures, a set of factors of 25, 20, 15, 10, and 30 might be used. These five values total 100.

Two rules were implemented in developing the factors:

- Only multiples of 5 were used, because there was not sufficient precision to warrant a more detailed set of factors.
- A minimum value of 5 and a maximum value of 60 were used for each factor. The minimum was used to ensure that each performance measure was considered. If a measure did not merit a factor of at least 5, then it should not have been included. Similarly, if a factor of greater than 60 was applied, the other performance measures in that objective group would be rendered nearly meaningless, which was not the intent of the comprehensive performance evaluation.

As described in Step 4, multiple sets of factors were used. The first set of factors tested was a set of equal factors for each objective group. For example, for an objective that has five performance measures, equal factors of 20 were used. This was called the “Balanced” factor focus group.

7.1.3 Step 3: Calculate the Combined Performance Measures

Step 3 is an arithmetic step to combine the measures. The weighted average of the performance measure values (on the 0-100 scale) was determined using the factors from Step 2. The approach is illustrated in Figure 7-2, where the balanced factor focus group is shown on the left, and the values for the five component measures are shown on the right for Alternative F-6. In this case, the normalized performance measures for Alternative F-6 have values of 71.2, 89.7, 100.0, 63.0, and 78.7. The calculation is the sum of the products of the factors and the normalized scores on the performance measures, or:

$$(20 \times 71.2) + (20 \times 89.7) + (20 \times 100.0) + (20 \times 63.0) + (20 \times 78.7) = 8052/100 = 81$$

Figure 7-1: Performance Measure Normalization Example

Objective Statements	L2 Measure Number	Description	Higher or Lower is Better?	Value Corresponding to Worst 1	Value Corresponding to Best 7	No Build	TSM/TDM	BRT-1	BRT-6	BRT-6A	LRT-4A	LRT-4B	LRT-4D	LRT-6	Freeway-2	Freeway-5	Freeway-6	Freeway-7	Highway/Arterial Improvements-2	Highway/Arterial Improvements-6
4) Reduce congestion on local street system	2.4.1	% of congested intersections	Lower	30.0	15.0	28.0	28.5	28.0	28.0	28.0	28.0	28.0	28.0	28.0	25.1	23.2	19.3	21.7	27.9	23.2
						13.2	10.0	13.3	13.2	13.2	13.2	13.2	13.3	13.2	32.5	45.4	71.2	55.1	13.8	45.6
	2.4.2	Average v/c on arterials	Lower	0.80	0.70	0.77	0.78	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.73	0.72	0.71	0.72	0.76	0.78
						31.3	23.2	30.1	30.8	30.1	30.8	30.3	30.4	30.4	68.0	84.7	[illegible]	80.7	[illegible]	24.2
	2.4.3	VMT on arterial	Lower	7.1	6.4	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.6	6.5	6.4	6.5	7.1	6.9
						9.2	6.5	8.9	9.1	9.2	9.2	11.1	9.1	11.2	66.0	80.6	100.0	85.8	0.0	20.4
	2.4.4	Arterial cut-through percentage	Lower	25.3	9.7	24.9	25.2	25.2	25.3	25.2	25.2	25.3	25.3	25.3	17.1	13.7	[illegible]	9.7	[illegible]	24.7
						2.9	1.1	1.1	0.0	0.8	0.8	0.0	0.0	0.0	52.8	74.5	63.0	100.0	4.0	4.0
	2.4.5	North-south travel served	Lower	1.3	1.1	1.27	1.29	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.19	1.14	1.12	1.15	1.31	1.30
						14.1	8.3	14.2	14.2	14.2	14.1	14.1	14.1	14.2	47.7	71.5	78.7	67.8	0.0	4.5

Figure 7-2: Combined Performance Measures (Balanced Factor Focus Group)

Objective Statements	L2 Measure Number	Description	Higher or Lower is Better?	Balanced	Value Corresponding to Worst 1	Value Corresponding to Best 7	No Build	TSM/TDM	BRT-1	BRT-6	BRT-6A	LRT-4A	LRT-4B	LRT-4D	LRT-6	Freeway-2	Freeway-5	Freeway-6	Freeway-7	Highway/Arterial Improvements-2	Highway/Arterial Improvements-6
4) Reduce congestion on local street system	2.4.1	% of congested intersections	Lower	20	30.0	15.0	28.0	28.5	28.0	28.0	28.0	28.0	28.0	28.0	28.0	25.1	23.2	19.3	21.7	27.9	23.2
							13.2	10.0	13.3	13.2	13.2	13.2	13.2	13.3	13.2	32.5	45.4	71.2	55.1	13.8	45.6
	2.4.2	Average v/c on arterials	Lower	20	0.80	0.70	0.77	0.78	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.73	0.72	0.71	0.72	0.76	0.78
							31.3	23.2	30.1	30.8	30.1	30.8	30.3	30.4	30.4	68.0	84.7	89.7	80.7	40.4	24.2
	2.4.3	VMT on arterial	Lower	20	7.1	6.4	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.6	6.5	6.4	6.5	7.1	6.9
							9.2	6.5	8.9	9.1	9.2	9.2	11.1	9.1	11.2	66.0	80.6	100.0	85.8	0.0	20.4
	2.4.4	Arterial cut-through percentage	Lower	20	25.3	9.7	24.9	25.2	25.2	25.3	25.2	25.2	25.3	25.3	25.3	17.1	13.7	15.5	9.7	24.7	24.7
							2.9	1.1	1.1	0.0	0.8	0.8	0.0	0.0	0.0	52.8	74.5	63.0	100.0	4.0	4.0
	2.4.5	North-south travel served	Lower	20	1.3	1.1	1.27	1.29	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.19	1.14	1.12	1.15	1.31	1.30
							14.1	8.3	14.2	14.2	14.2	14.1	14.1	14.1	14.2	47.7	71.5	78.7	67.8	0.0	4.5
Balanced Factor Focus					Percentile Score		14	10	14	13	13	14	14	13	14	53	71	81	78	12	20

7.1.4 Step 4: Convert to a 1 to 7 Rating

After Step 3, performance of each alternative on each of the objectives had been assigned a normalized score on a 0-100 scale. To simplify comparisons, these values were converted to a 1-7 score. That calculation was a simple conversion:

- Values between 0 and 14.3 were assigned a rating of 1
- Values between 14.3 and 28.6 were assigned a rating of 2
- Values between 28.6 and 42.9 were assigned a rating of 3
- Values between 42.9 and 57.1 were assigned a rating of 4
- Values between 47.1 and 71.4 were assigned a rating of 5
- Values between 71.4 and 85.7 were assigned a rating of 6
- Values between 85.7 and 100 were assigned a rating of 7

In the example from Section 7.1.3, the calculated performance measure of 81 would be converted to a rating of 6.

7.1.5 Step 5: Consider Other Factor Focus Groups

The "Balanced" factor focus group used in Step 3 was a reasonable first step, but did not necessarily represent the best approach for combining performance measures. The performance measures used were different, and the results from each varied. On some performance measures, there was a lot of variation among alternatives, while others had a relatively small range. Also, some measures might be considered more or less important by some stakeholders. Therefore, six different factor focus groups were developed:

- Balanced: equal values for all performance measures
- Freeway Operations: higher values for those measures that will improve the regional freeway system
- Arterial Operations: higher values for those measures that will improve the arterial and local street system
- Transit: higher values for those measures that will improve the regional and local transit system
- Environmental: higher values for those measures that will minimize impacts or encourage transportation that reduces impacts on the natural or built environment
- Economic/Right-of-Way: higher values for those measures that improve cost efficiency and/or minimize right-of-way impacts

Table 7-1 presents a summary of the values applied for each factor focus group and each objective.

Figure 7-3 presents an example calculation for Alternative F-6 using the six different factor focus groups. The combined performance measure was 81 using the balanced factor focus group. With the other five groups, the values are 75, 76, 75, 79, and 74.

Table 7-1: Factor Focus Group Values

Objective Statements	Description	Balanced	Freeway Operations Focus	Arterial Operations Focus	Transit Focus	Environmental Focus	Economic/ROW Focus
1) Minimize travel time	Travel time - vehicular	25	60	60	15	15	60
	Travel time - transit	25	5	10	50	25	5
	Reduction in VHT	25	10	20	15	50	10
	Percentage on managed	25	25	10	20	10	25
2) Improve connectivity and mobility	New interchanges/transit pts.	20	30	20	15	5	10
	Jobs reachable	20	15	20	10	20	60
	Transit boardings	20	5	5	60	60	5
	Arterial throughput	20	5	50	10	10	5
	Freeway throughput	20	45	5	5	5	20
3) Reduce congestion on freeway system	LOS F1 or worse	35	50	60	20	60	60
	LOS E or F0	35	30	10	40	30	10
	VMT on congested facilities	30	20	30	40	10	30
4) Reduce congestion on local street system	% of congested intersections	20	20	20	35	40	50
	Average v/c on arterials	20	10	10	5	5	5
	VMT on arterial	20	15	15	15	30	10
	Arterial cut-through percentage	20	40	35	30	20	25
	North-south travel served	20	15	20	15	5	10
5) Increase transit ridership	Increase in transit ridership	35	50	50	60	40	40
	% within 1/4 mile of transit	35	20	20	10	25	30
	Mode split - transit	30	30	30	30	35	30
6A) Minimize R/W	Residential R/W acquisitions	100	100	100	100	100	100
6B) Minimize environmental and community impacts related to transportation on the human environment	Recreational sites	10	5	5	5	5	5
	Archaeological sites	10	5	5	5	5	5
	Historic sites	5	10	10	10	10	5
	Previously id'd sig. resources	5	10	10	10	10	5
	% change in sensitive noise	10	15	15	15	15	20
	MSATs	10	10	10	10	10	15
	Regional criteria pollutants	10	10	10	10	10	15
	GHG emissions	10	10	10	10	10	10
	Hazardous waste sites	10	5	5	5	5	10
	Visual intrusion	10	10	10	10	10	5
	Scenic corridors	10	10	10	10	10	5
	Environmental justice	0	0	0	0	0	0
6C) Minimize environmental and community impacts on the natural environment	Acres of high paleo sensitivity	25	5	10	10	10	5
	Geotechnical	25	30	40	40	40	60
	Sensitive habitats	25	30	40	40	40	30
	Drainages	25	35	10	10	10	5
7) Assure consistency with regional plans and strategies	RTP/SCS goals	35	50	50	30	60	50
	Measure R goals	35	25	25	25	20	25
	Metro LRTP goals	30	25	25	45	20	25
8) Maximize cost-efficiency of public investments	Construction and ROW costs	35	10	10	10	10	30
	Available funding	35	60	60	60	60	60
	Technical feasibility	30	30	30	30	30	10

Figure 7-3: Combined Performance Measures (Multiple Factor Focus Group)

Objective Statements	L2 Measure Number	Description	Higher or Lower is Better?	Balanced	Freeway Operations Focus	Arterial Operations Focus	Transit Focus	Environmental Focus	Economic/ROW Focus	Value Corresponding to Worst 1	Value Corresponding to Best 7
4) Reduce congestion on local street system	2.4.1	% of congested intersections	Lower	20	20	20	35	40	50	30.0	15.0
	2.4.2	Average v/c on arterials	Lower	20	10	10	5	5	5	0.80	0.70
	2.4.3	VMT on arterial	Lower	20	15	15	15	30	10	7.1	6.4
	2.4.4	Arterial cut-through percentage	Lower	20	40	35	30	20	25	25.3	9.7
	2.4.5	North-south travel served	Lower	20	15	20	15	5	10	1.3	1.1
Balanced Factor Focus										Percentile Score	
Freeway Operations Factor Focus										Percentile Score	
Arterial Operations Factor Focus										Percentile Score	
Transit Factor Focus										Percentile Score	
Environmental Factor Focus										Percentile Score	
Economic/ROW Factor Focus										Percentile Score	

Measure	No Build	TSM/TDM	BRT-1	BRT-6	BRT-6A	LRT-4A	LRT-4B	LRT-4D	LRT-6	Freeway-2	Freeway-5	Freeway-6	Freeway-7	Highway/Arterial Improvements-2	Highway/Arterial Improvements-6
2.4.1	28.0	28.5	28.0	28.0	28.0	28.0	28.0	28.0	28.0	25.1	23.2	19.3	21.7	27.9	23.2
2.4.2	0.77	0.78	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.73	0.72	0.71	0.72	0.76	0.78
2.4.3	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.6	6.5	6.4	6.5	7.1	6.9
2.4.4	24.9	25.2	25.2	25.3	25.2	25.2	25.3	25.3	25.3	17.1	13.7	15.5	9.7	24.7	24.7
2.4.5	1.27	1.29	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.19	1.14	[illegible]	1.15	1.31	1.30
Balanced Factor Focus – Percentile Score	14	10	14	13	13	14	14	13	14	53	71	81	78	12	20
Freeway Operations Factor Focus – Percentile Score	10	7	10	9	9	10	9	9	9	52	70	75	82	8	17
Arterial Operations Factor Focus – Percentile Score	11	7	10	10	10	10	10	10	10	51	70	76	81	8	17
Transit Factor Focus – Percentile Score	11	7	10	10	10	10	10	10	10	48	65	75	76	8	22
Environmental Factor Focus – Percentile Score	11	8	10	10	10	10	11	10	11	49	65	79	75	8	27
Economic/ROW Factor Focus – Percentile Score	11	8	11	10	11	11	11	11	11	44	61	74	72	10	28

7.1.6 Step 6: Average the Results from the Factor Focus Groups and Convert to a 1 to 7 Rating

In this step, the six scores from the factor focus groups were averaged. In the example in Figure 7-3, the six values (81, 75, 76, 75, 79, and 74) were averaged to 76.7, which was converted to a single rating of 6. This process was repeated for all alternatives, and all objectives. The end result was the performance measure summaries used for comparing alternatives, illustrated in Table 7-2.

Table 7-2: Combined Performance Measures (Multiple Factor Focus Group)

Element of Need	Objective	No Build	TSM/TDM	BRT-1	BRT-6	BRT-6A	LRT-4A	LRT-4B	LRT-4D	LRT-6	F-2	F-5	F-6	F-7	H-2	H-6
Regional Transportation System	1) Minimize travel time	1	2	3	2	2	3	3	3	3	4	3	4	5	1	2
	2) Improve connectivity and mobility	1	1	1	2	2	2	2	2	2	3	4	5	4	2	2
Freeway System in the Study Area	3) Reduce congestion on freeway system	1	2	1	1	1	1	1	1	1	6	5	7	5	4	3
Local Street System	4) Reduce congestion on local street system	1	1	1	1	1	1	1	1	1	4	5	6	6	1	2
Transit System in the Study Area	5) Increase transit ridership	1	4	6	6	6	7	7	7	7	1	1	1	1	1	1
Environmental & Communities	6A) Right of way	7	7	7	7	7	7	7	6	5	3	4	1	7	1	5
	6B) Human environment	6	6	7	6	6	6	6	6	5	4	4	3	5	4	5
	6C) Natural environment	7	7	6	7	7	5	5	5	7	5	4	5	5	6	7
Consistency with Plans	7) Consistency with regional plans and strategies	1	6	6	6	6	6	6	6	6	6	6	6	6	3	3
Provide Financially Feasible Transportation Solutions	8) Maximize cost-efficiency of public investments	7	7	7	7	7	4	4	4	5	5	5	6	6	7	7

7.1.7 Factor Focus Check

An integral element of the evaluation was the application of the factor focus groups. Using the different factor focus values was a key step to capture the relative importance of the performance measures. However, there was some judgment involved in developing the factors. Therefore, a sensitivity analysis was conducted to determine how much variation in the results (shown in Table 7-2) might be attributed to the factor focus group values.

To conduct the sensitivity check, a complex matrix was prepared, as shown in Table 7-3.

Table 7-3: Factor Focus Sensitivity Check

Primary Element of Need (see Elements of Need Technical Memorandum, dated February 2, 2012)/ Additional Values and Concerns	Objective Statements	No Build	TSM/TDM	BRT-1	BRT-6	BRT-6A	LRT-4A	LRT-4B	LRT-4D
1) Regional Transportation System (regional travel speeds low; regional travel delays high; regional travel times are unpredictable)	1) Minimize travel time	1,1,1 **1** 1,1,1 — 8.0	2,2,2 **2** 3,2,2 — 24.2	3,2,2 **3** 5,3,2 — 37.9	2,2,2 **2** 3,2,2 — 25.8	2,2,2 **2** 3,2,2 — 25.8	3,2,2 **3** 5,3,2 — 36.1	3,2,2 **3** 5,3,2 — 36.4	3,2,2 **3** 5,3,2 — 36.5
	2) Improve connectivity and mobility	1,1,1 **1** 1,1,1 — 5.2	1,1,1 **1** 2,2,1 — 10.3	1,1,1 **1** 2,2,1 — 12.9	1,1,1 **2** 2,2,1 — 14.3	2,1,1 **2** 2,2,1 — 15.4	2,1,2 **2** 2,2,1 — 17.1	2,1,2 **2** 2,2,1 — 16.8	2,1,2 **2** 2,2,1 — 16.9
2) Freeway system in study area (over-capacity north/south travel demand affects mobility; high delays and unpredictable travel times; freeway system users take longer trips; high accident rates due to congestion)	3) Reduce congestion on freeway system	1,1,1 **1** 1,1,1 — 1.5	2,2,2 **2** 2,2,2 — 15.1	1,1,1 **1** 1,1,1 — 2.2	1,1,1 **1** 1,1,1 — 3.5	1,1,1 **1** 1,1,1 — 3.5	1,1,1 **1** 1,1,1 — 3.9	1,1,1 **1** 1,1,1 — 1.7	1,1,1 **1** 1,1,1 — 2.0
3) Local Street system (affected by excess freeway traffic; operates at low speeds; out-of-place freeway trips cause high levels of congestion)	4) Reduce congestion on local street system	1,1,1 **1** 1,1,1 — 11.4	1,1,1 **1** 1,1,1 — 7.8	1,1,1 **1** 1,1,1 — 10.8	1,1,1 **1** 1,1,1 — 10.5	1,1,1 **1** 1,1,1 — 10.7	1,1,1 **1** 1,1,1 — 10.7	1,1,1 **1** 1,1,1 — 10.8	1,1,1 **1** 1,1,1 — 10.5
4) Transit system in study area (operational deficiencies of the highway system affects transit; low travel speeds for buses and increased delay for peak hour trips; north/south transit network is constrained by slow speeds on the arterial network)	5) Increase transit ridership	1,1,1 **1** 1,1,1 — 0.0	4,3,3 **4** 3,4,4 — 45.6	6,6,6 **6** 6,6,6 — 74.7	7,6,6 **6** 6,6,6 — 83.4	7,6,6 **6** 6,6,6 — 83.4	7,7,7 **7** 7,7,7 — 99.0	7,7,7 **7** 7,7,7 — 95.8	7,7,7 **7** 7,7,7 — 94.2
Other Issues - Environmental & Communities (improve environmental conditions related to transportation sources within local communities within the study area)	6A) Minimize environmental and community impacts related to transportation: right-of-way (1, 2)	7,7,7 **7** 7,7,7 — 100.0	7,7,7 **7** 7,7,7 — 89.4	7,7,7 **7** 7,7,7 — 96.2	7,7,7 **7** 7,7,7 — 100.0	7,7,7 **7** 7,7,7 — 100.0	7,7,7 **7** 7,7,7 — 90.0	7,7,7 **7** 7,7,7 — 89.0	6,6,6 **6** 6,6,6 — 79.4
	6B) Minimize environmental and community impacts related to transportation: human environment (3, 4, 5, 10, 11, 12, 13, 16, 14, 15, 17)	6,6,6 **6** 6,6,5 — 76.7	6,6,6 **6** 6,6,6 — 76.7	7,7,7 **7** 7,7,6 — 87.8	6,6,6 **6** 6,7,7 — 83.4	6,7,7 **6** 7,7,6 — 83.9	6,6,6 **6** 6,6,6 — 78.0	5,6,6 **6** 6,6,6 — 73.7	6,6,6 **6** 6,6,6 — 75.8
	6C) Minimize environmental and community impacts related to transportation: natural environment (6, 7, 8, 9)	7,7,7 **7** 7,7,7 — 93.5	7,7,7 **7** 7,7,7 — 97.0	7,6,6 **6** 6,6,6 — 83.7	7,7,7 **7** 7,7,7 — 93.1	7,7,7 **7** 7,7,7 — 93.1	5,4,5 **5** 5,5,5 — 62.5	4,4,5 **5** 5,5,5 — 60.7	5,4,5 **5** 5,5,5 — 63.0
Other Issues - Consistency with Plans (implement the goals and objectives of the Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS) and LRTP relating to this study area)	7) Assure consistency with regional plans and strategies	1,1,1 **1** 1,1,1 — 0.0	6,6,6 **6** 6,6,6 — 75.6	6,6,6 **6** 5,7,6 — 81.1	6,6,6 **6** 5,7,6 — 81.1	6,6,6 **6** 5,7,6 — 81.1	5,6,6 **6** 5,6,6 — 74.7	5,6,6 **6** 5,6,6 — 74.7	5,6,6 **6** 5,6,6 — 74.7
Other Issues - Provide Financially Feasible Transportation Solutions	8) Maximize cost-efficiency of public investments	7,7,7 **7** 7,7,7 — 100.0	7,7,7 **7** 7,7,7 — 97.1	7,7,7 **7** 7,7,7 — 97.1	7,7,7 **7** 7,7,7 — 97.1	7,7,7 **7** 7,7,7 — 97.1	4,4,4 **4** 4,4,3 — 46.5	4,4,4 **4** 4,4,3 — 46.5	4,4,4 **4** 4,4,3 — 46.5

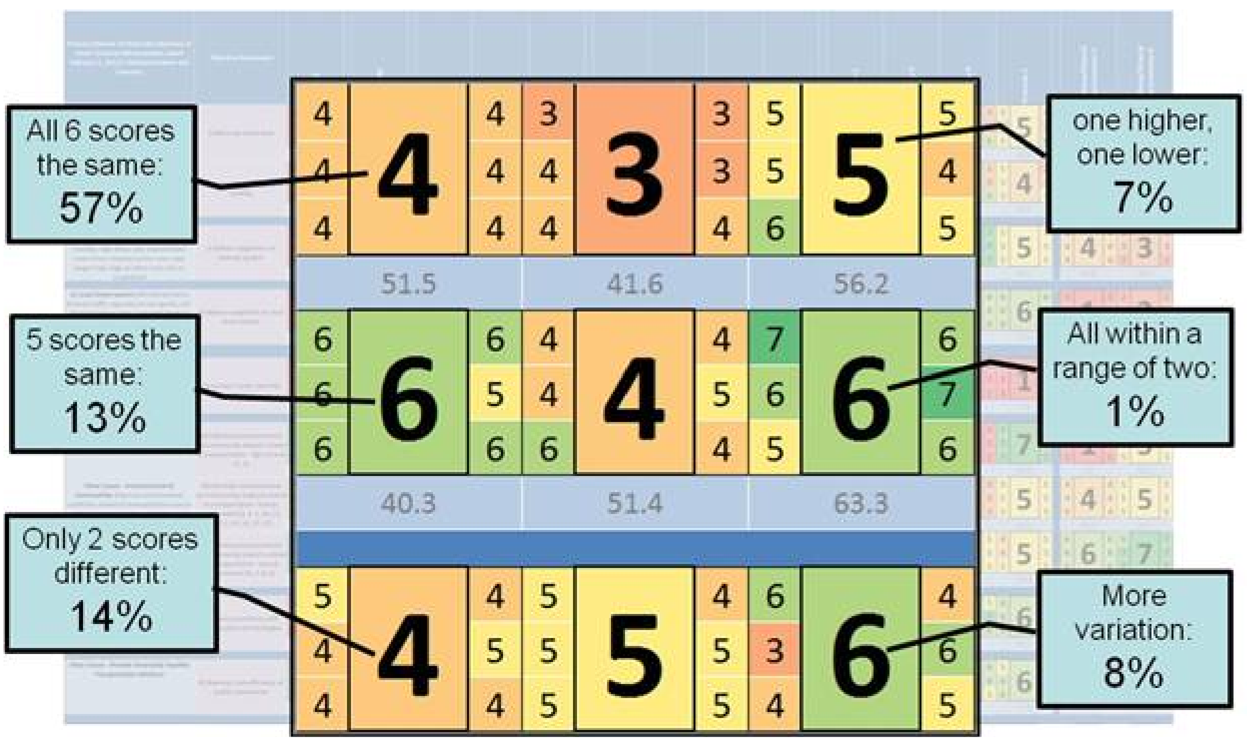
Primary Element of Need	Objective Statements	LRT-6	Freeway-2	Freeway-5	Freeway-6	Freeway-7	Highway/Arterial Improvements-2	Highway/Arterial Improvements-6
1) Regional Transportation System	1) Minimize travel time	3,2,2 **3** 4,3,2 — 31.1	4,5,5 **4** 3,2,5 — 51.5	3,4,4 **3** 3,2,4 — 41.6	4,6,5 **4** 3,2,6 — 56.2	5,6,5 **5** 4,3,6 — 57.4	1,2,1 **1** 1,1,2 — 12.3	2,2,2 **2** 3,2,2 — 20.9
	2) Improve connectivity and mobility	2,1,1 **2** 2,2,1 — 15.9	4,4,4 **3** 2,2,4 — 40.3	5,5,6 **4** 2,2,4 — 51.4	5,6,6 **5** 3,3,6 — 63.3	5,5,5 **4** 2,3,5 — 53.7	2,2,2 **2** 1,1,2 — 14.5	2,2,2 **2** 1,1,2 — 19.7
2) Freeway system in study area	3) Reduce congestion on freeway system	1,1,1 **1** 1,1,1 — 1.6	6,5,6 **6** 6,5,6 — 73.0	5,5,5 **5** 4,5,5 — 61.0	7,7,7 **7** 7,7,7 — 97.1	5,5,5 **5** 5,5,5 — 64.2	4,4,4 **4** 4,4,4 — 44.0	3,3,2 **3** 3,3,2 — 29.4
3) Local Street system	4) Reduce congestion on local street system	1,1,1 **1** 1,1,1 — 10.8	4,4,4 **4** 4,4,4 — 49.6	5,5,5 **5** 5,5,5 — 67.1	6,6,6 **6** 6,6,6 — 76.7	6,6,6 **6** 6,6,6 — 77.3	1,1,1 **1** 1,1,1 — 9.1	2,2,2 **2** 2,2,2 — 21.7
4) Transit system in study area	5) Increase transit ridership	7,7,7 **7** 7,7,7 — 94.5	1,1,1 **1** 1,1,1 — 1.7	1,1,1 **1** 1,1,1 — 3.2	1,1,1 **1** 1,1,1 — 1.9	1,1,1 **1** 1,1,1 — 3.0	1,1,1 **1** 1,1,1 — 0.8	1,1,1 **1** 1,1,1 — 3.3
Other Issues - Environmental & Communities	6A) Minimize environmental and community impacts related to transportation: right-of-way (1, 2)	5,5,5 **5** 5,5,5 — 57.2	3,3,3 **3** 3,3,3 — 37.4	4,4,4 **4** 4,4,4 — 49.0	1,1,1 **1** 1,1,1 — 4.8	7,7,7 **7** 7,7,7 — 99.0	1,1,1 **1** 1,1,1 — 0.0	5,5,5 **5** 5,5,5 — 63.2
	6B) Minimize environmental and community impacts related to transportation: human environment (3, 4, 5, 10, 11, 12, 13, 16, 14, 15, 17)	5,5,5 **5** 5,5,5 — 68.0	4,4,4 **4** 4,4,4 — 50.8	4,4,4 **4** 4,4,4 — 54.5	3,3,3 **3** 3,3,3 — 32.9	5,5,5 **5** 5,5,5 — 63.1	4,4,4 **4** 4,4,4 — 52.7	5,5,5 **5** 5,5,5 — 57.7
	6C) Minimize environmental and community impacts related to transportation: natural environment (6, 7, 8, 9)	6,7,7 **7** 7,7,7 — 88.9	4,4,5 **5** 5,5,5 — 59.6	3,4,5 **4** 5,5,5 — 54.6	4,5,5 **5** 5,5,5 — 64.9	4,4,5 **5** 5,5,5 — 58.2	6,6,6 **6** 6,6,6 — 78.1	6,7,7 **7** 7,7,7 — 88.6
Other Issues - Consistency with Plans	7) Assure consistency with regional plans and strategies	5,6,6 **6** 5,6,6 — 74.7	6,6,6 **6** 5,7,6 — 81.1	6,6,6 **6** 5,7,6 — 81.1	6,6,6 **6** 5,7,6 — 81.1	6,6,6 **6** 5,7,6 — 81.1	3,3,3 **3** 3,3,3 — 33.8	3,3,3 **3** 3,3,3 — 33.8
Other Issues - Provide Financially Feasible Transportation Solutions	8) Maximize cost-efficiency of public investments	5,5,5 **5** 5,5,5 — 66.3	4,6,6 **5** 6,6,4 — 68.5	4,6,6 **5** 6,6,4 — 68.3	6,6,6 **6** 6,6,5 — 77.3	5,6,5 **6** 6,6,5 — 71.5	7,7,7 **7** 7,7,7 — 94.2	7,7,7 **7** 7,7,7 — 94.2

Figure 7-4 is an expanded (generic) view of part of the table. The large numbers are the ratings from the results of the averages of the six factor focus groups, as reported in Table 7-2. The smaller numbers are the ratings for each of the factor focus groups. For example, at the bottom left, the overall rating is a "4". The ratings are different when considering each of the six factor focus groups. Four of the factor focus groups result in a rating of "4", while the other two result in a rating of "5". In contrast, the result at top left has the same rating ("4") for all six factor focus groups.

This sensitivity analysis was conducted for all of the ratings. Then the ratings resulting from each of the six sets of factors were compared to see how well they matched. The blue boxes in Figure 7-4 provide that information.

The majority (84 percent) of the evaluations are in the left three groups. Over half of the evaluations had the exact same score for all six factor focus groups. Another seven percent had scores that were off by only one for all factor focus groups. Based on the narrow range of ratings, and close correlation between the factor focus groups, there is a high level of confidence in the validity of the performance assessments.

Figure 7-4: Details from Factor Focus Sensitivity Check



7.2 Evaluation Results and Recommendations

7.2.1 Performance Comparisons

To reach recommendations concerning which alternatives should be evaluated further in the PA/ED phase, the performance measures of alternatives within each mode were compared in a pairwise fashion to identify the alternatives within each mode that best meet the project need and also address the other values and concerns identified as objectives of the study. Because addressing the project need is of primary importance, alternatives were compared first on their performance on the objectives related to the transportation system. If alternatives within a mode performed similarly, they were then compared on their performance on the measures related to other values and concerns. Table 7-4 summarizes the performance of each of the alternatives on the five project objectives pertaining to the performance of the transportation system.

Table 7-4: Summary of Transportation System Performance Measures

Element of Need	Objective	No Build	TSM/TDM	BRT-1	BRT-6	BRT-6A	LRT-4A	LRT-4B	LRT-4D	LRT-6	F-2	F-5	F-6	F-7	H-2	H-6
Regional Transportation System	1: Minimize travel time	1	2	3	2	2	3	3	3	3	4	3	4	5	1	2
	2: Improve connectivity and mobility	1	1	1	2	2	2	2	2	2	3	4	5	4	2	2
Freeway system in study area	3: Reduce congestion on freeway system	1	2	1	1	1	1	1	1	1	6	5	7	5	4	3
Local Street system in study area	4: Reduce congestion on local street system	1	1	1	1	1	1	1	1	1	4	5	6	6	1	2
Transit system in study area	5: Increase transit ridership	1	4	6	6	6	7	7	7	7	1	1	1	1	1	1

Note: 1 indicates least favorable performance, 7 indicates most favorable performance

Table 7-5 summarizes the performance of each of the alternatives on the three project objectives pertaining to environmental and other concerns.

Table 7-5: Summary of Environmental and Other Performance Measures

Value or Concern	Objective	No Build	TSM/TDM	BRT-1	BRT-6	BRT-6A	LRT-4A	LRT-4B	LRT-4D	LRT-6	F-2	F-5	F-6	F-7	H-2	H-6
Environmental & Communities	6A: Right of way	7	7	7	7	7	7	7	6	5	3	4	1	7	1	5
	6B: Human environment	6	6	7	6	6	6	6	6	5	4	4	3	5	4	5
	6C: Natural environment	7	7	6	7	7	5	5	5	7	5	4	5	5	6	7
Consistency with Plans	7: Consistency with regional plans and strategies	1	6	6	6	6	6	6	6	6	6	6	6	6	3	3
Provide Financially Feasible Transportation Solutions	8: Maximize cost-efficiency of public investments	7	7	7	7	7	4	4	4	5	5	5	6	6	7	7

Note: 1 indicates least favorable performance, 7 indicates most favorable performance

7.2.2 Recommended Alternatives for Further Evaluation

The **No Build Alternative** and the **TSM/TDM Alternative** are required to be evaluated in the PA/ED phase. Therefore, they should be evaluated further.

Among the **BRT alternatives**, the measures for the objectives related to transportation system performance were similar to one another, with Alternative BRT-1 performing slightly better at reducing transit travel times, but Alternatives BRT-6 and BRT-6A performing slightly better at increasing access to high-frequency transit service and increasing north-south transit patronage. Therefore, performance on the transportation objectives does not clearly favor one alternative over the others. However, Alternatives BRT-6 and BRT-6A could be implemented with no right-of-way acquisition and would also have a smaller potential impact on sensitive habitat. Therefore, Alternatives BRT-6, along with the design variation Alternative BRT-6A, should be evaluated further in the PA/ED phase.

Among the **LRT alternatives**, the measures for the objectives related to transportation system performance were similar to one another. However, on the measures for the objectives related to environmental and other concerns, Alternative LRT-6 was clearly inferior to Alternatives LRT-4A/B/D. Alternative LRT-6 would require the acquisition of hundreds of properties, impact more historic period properties, and impact more community facilities. Similarly, compared to Alternatives LRT-4A and LRT-4B, Alternative LRT-4D would have greater property impacts. Therefore, Alternatives LRT-4A and LRT-4B should be evaluated further in the PA/ED phase.

Among the **freeway alternatives**, Alternatives F-6 and F-7 are superior to Alternatives F-2 and F-5 on the measures for the objectives related to the transportation system performance. Alternatives F-6 and F-7 each performed best on either minimizing travel times or improving connectivity and mobility, and they both performed best on the objective of reducing congestion on local streets. The performance on the objectives related to environmental and other concerns distinguished Alternatives F-6 and F-7 from one another. Alternative F-7 would require only a small number of property acquisitions (fewer than 10), compared to the over 400 required for Alternative F-6 in addition to properties that Caltrans already owns. Alternative F-7 would also impact fewer historic period properties and community facilities. Therefore, Alternative F-7 should be evaluated further in the PA/ED phase.

None of the **highway alternatives** perform well on the measures for objectives related to transportation system performance. They also performed poorly on the measures for objectives related to environmental and other concerns, especially Alternative H-2. Therefore, neither of the highway alternatives should be evaluated further in the PA/ED phase.

Thus, the alternatives recommended for further evaluation in the PA/ED phase are as follows:

- The No Build Alternative
- The TSM/TDM Alternative
- Alternative BRT-6, with possible refinements as described below
- Alternative LRT-4A/B, with possible refinements as described below
- Alternative F-7, with possible refinements, as described below

7.2.3 Recommended Refinements of Alternatives

No single alternative performs most favorably on all eight project objectives. Therefore, as the alternatives are further evaluated in the PA/ED phase, refinements of these alternatives that improve their performance and reduce their impacts should be developed and considered, as well as alternatives that combine elements of alternatives whose performance complements each other.

7.2.3.1 Recommended Refinements of Alternatives

In the PA/ED phase, alternatives will be refined first to avoid and then to minimize potential impacts to the extent possible. Where impacts cannot be avoided or minimized, feasible mitigation measures will be identified to reduce impacts. Additional refinements of alternatives that should be investigated in the PA/ED phase include the following:

- The **No Build Alternative** should be updated to reflect the financially constrained project list in the 2012 Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS). This plan was adopted by SCAG after the initiation of the AA, but it would be appropriate to update the No Build Alternative in the PA/ED phase to be consistent with the newly adopted plan. The ridership and travel demand forecasting in the PA/ED phase will be based on the 2012 RTP/SCS.
- The **TSM/TDM Alternative** was found to have potential right-of-way impacts, primarily resulting from the spot intersection and roadway segment improvements included in the alternative. These spot improvements should be refined in coordination with the local jurisdictions to maximize the alternative's benefits and to minimize its impacts. In addition, these improvements should be refined to identify opportunities to create "complete streets" that enhance the pedestrian and bicycle environment and to ensure that they do not detract from it. The other components of the TSM/TDM Alternative should also be reviewed and refined to look for additional opportunities to improve the performance of the alternative.
- **Alternative BRT-6**, like all of the BRT alternatives, would displace a large amount of on-street parking. Therefore, refinements should be considered to its design, alignment, and/or operational characteristics to minimize their impact to on-street parking. Refinements should also be considered to maximize ridership and productivity (passengers per bus).
- **Alternative LRT-4A/B** station locations should be refined to maximize ridership, minimize property impacts, and to facilitate transfers to the Metro Gold line at its northern and southern termini.

  Alternative LRT-4A/B could be combined with **enhanced bus service**, including feeder routes to its stations. By making Alternative LRT-4A/B the spine of a transit network that serves destinations to its east and west, and not solely along its alignment, it may be possible to attract additional transit ridership and improve the performance of this alternative.
- **Alternative F-7** should incorporate refinements to its design and alignment to minimize its impact. Potential tolled operations to improve its financial feasibility should also be evaluated. Restriction on use by trucks should be evaluated to determine if they are effective at reducing impacts.

  Alternative F-7 could be combined with a **BRT or other enhanced bus service** to improve the performance of this alternative on the performance measures related to the transit system. Alternative F-7 was found to not increase transit ridership or transit mode share. By introducing a well-designed BRT or other enhanced bus service into Alternative F-7, it may be possible to diminish north-south transit travel times through the study area and attract additional transit ridership.

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