Los Angeles County
Metropolitan Transportation Authority

Sepulveda Pass Corridor Systems Planning Study

Final Compendium Report

November 2012

Connecting the San Fernando Valley and the Westside

Interstate 405 Sepulveda Pass

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Sepulveda Pass Corridor
Systems Planning Study

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Metro

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November 2012

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Preface

In January 2012, the Los Angeles County Metropolitan Transportation Authority (Metro) initiated the Sepulveda Pass Corridor Systems Planning Study to evaluate the potential for providing long-term transit and/or highway capacity solutions through the Sepulveda Pass along Interstate 405. This study is the initial phase of project development and precedes an Alternatives Analysis study or Environmental Impact Study (EIS) and/or Environmental Impact Report (EIR). The Systems Planning Study defines broad concepts—from transit modes such as Bus Rapid Transit (BRT), Light Rail Transit (LRT), and Heavy Rail Transit (HRT) to highway improvements including High Occupancy Toll (HOT) lanes, and at-grade, above and/or below grade-separated alignments. The concepts were then evaluated against several performance criteria, including engineering feasibility, travel demand, rough order of magnitude (ROM) costs in current dollars (2012), and environmental issues.

This compendium report includes an Executive Summary along with technical reports and white papers prepared by the transportation planning, demand modeling, civil engineering, and environmental planning discipline teams. Study findings and conclusions can be found beginning on page ES-12 of the Executive Summary.

Note that the technical reports and white papers in the compendium report are working documents that were developed at various stages of the study. As a result, concepts referenced in these documents do vary from the final concepts. The Executive Summary provides the most recent and up to-date maps and exhibits depicting the final planning concepts evaluated.

This compendium is organized in the following sections:

1.0 Executive Summary

The Executive Summary presents a high-level overview of the Sepulveda Pass Corridor Systems Planning Study. It describes existing conditions along the corridor and the methodology used to develop a total of six representative concepts. Each concept was then evaluated against several performance criteria, including costs, ridership and person throughput, and cost-effectiveness. The Executive Summary provides preliminary key findings for each concept based on analysis performed by the four discipline teams involved in the study – Transportation Planning, Demand Modeling, Civil Engineering, and Environmental Planning. Next steps are also presented based on the information that emerged from this process.

2.0 Mobility Problem Definition White Paper

The Mobility Problem Definition Whitepaper documents and assesses existing conditions along the Sepulveda Pass Corridor Study Area and identifies the mobility problem within the Corridor. This document provides a foundation for evaluation of the systems planning concepts in subsequent reports. Specifically, this whitepaper describes the study corridor boundaries, demographic context, travel markets and characteristics, land use patterns, existing and planned infrastructure, as well as quantifies the transportation performance and deficiencies in the corridor.

3.0 Potential Ridership/Usage of Alternative Concepts Report

The Sepulveda Pass Corridor Systems Planning Study evaluates multimodal options and considers both highway and transit improvements. The Potential Ridership/Usage of Alternative Concepts Report (Travel Demand Modeling Report) documents the final travel demand projections for the different systems planning concepts being considered for the Sepulveda Pass. It also evaluates and compares these different concepts through a range of performance indicators, including transit ridership, person throughput, and travel time savings.

4.0 Engineering Issues Report

This report presents refined corridor system concepts, rough-order-of magnitude (ROM) cost estimates, information on key design elements, geotechnical assessments, constructability issues, and issues uncovered during the course of this study that need further investigation and analysis.

5.0 Preliminary Cost Report

This report presents the preliminary cost estimates for the engineering concepts developed and refined as part of the Sepulveda Pass Corridor Systems Planning Study. It provides ROM cost estimates for capital, operating and maintenance cost for each systems planning concept. The cost methodology described in the report is reflective of the conceptual nature of the study and is intended to provide a high level comparison of alternatives.

Appendix

The appendix includes the following reports:

- Environmental Issues Technical Paper
- Geotechnical Evaluation Memorandum
- Summary Notes for Charrettes #1 and #2
- June 20, 2012 Staff Report

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1.0 – EXECUTIVE SUMMARY

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Los Angeles County
Metropolitan Transportation Authority

Sepulveda Pass Corridor Systems Planning Study

Executive Summary

November 2012

Interstate 405 Sepulveda Pass

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Introduction

In early 2012, the Los Angeles County Metropolitan Transportation Authority (Metro) embarked on the *Sepulveda Pass Corridor Systems Planning Study* to evaluate the potential for providing additional transit and/or highway capacity improvements beyond those currently being constructed as a part of the I-405 Sepulveda Pass Improvements Project.

Measure R Corridor. The Sepulveda Pass is one of the 12 transit corridors that were approved in 2008 by the voters of Los Angeles County as a part of the Measure R ballot initiative (Figure 1). The project is included in Metro's adopted 2009 Long Range Transportation Plan (LRTP) with a 2039 delivery date and a funding allocation of $2.4 billion in year of expenditure dollars (YOE).

Extreme Congestion. The I-405 through the Sepulveda Pass is one of the few north-south roadways connecting the Westside area and the San Fernando Valley. Projected growth in travel demand will outpace even the increased capacity provided through the completion of the current I-405 Sepulveda Pass Improvements Project, which will add a 10-mile HOV lane on the northbound I-405 between I-10 and US 101 and improve supporting infrastructure such as ramps, bridges and soundwalls.

Study Objectives. The main objectives of the study were to answer: 1) What could be done quickly, with little environmental impact, and within the Measure R budget, and 2) what longer-term higher capacity solutions are feasible, what are associated potential impacts, and what is needed to implement the improvements? Because the Sepulveda Pass transit corridor is a third decade project in the LRTP, Metro is exploring options to accelerate delivery of this project through a public-private partnership (P3).

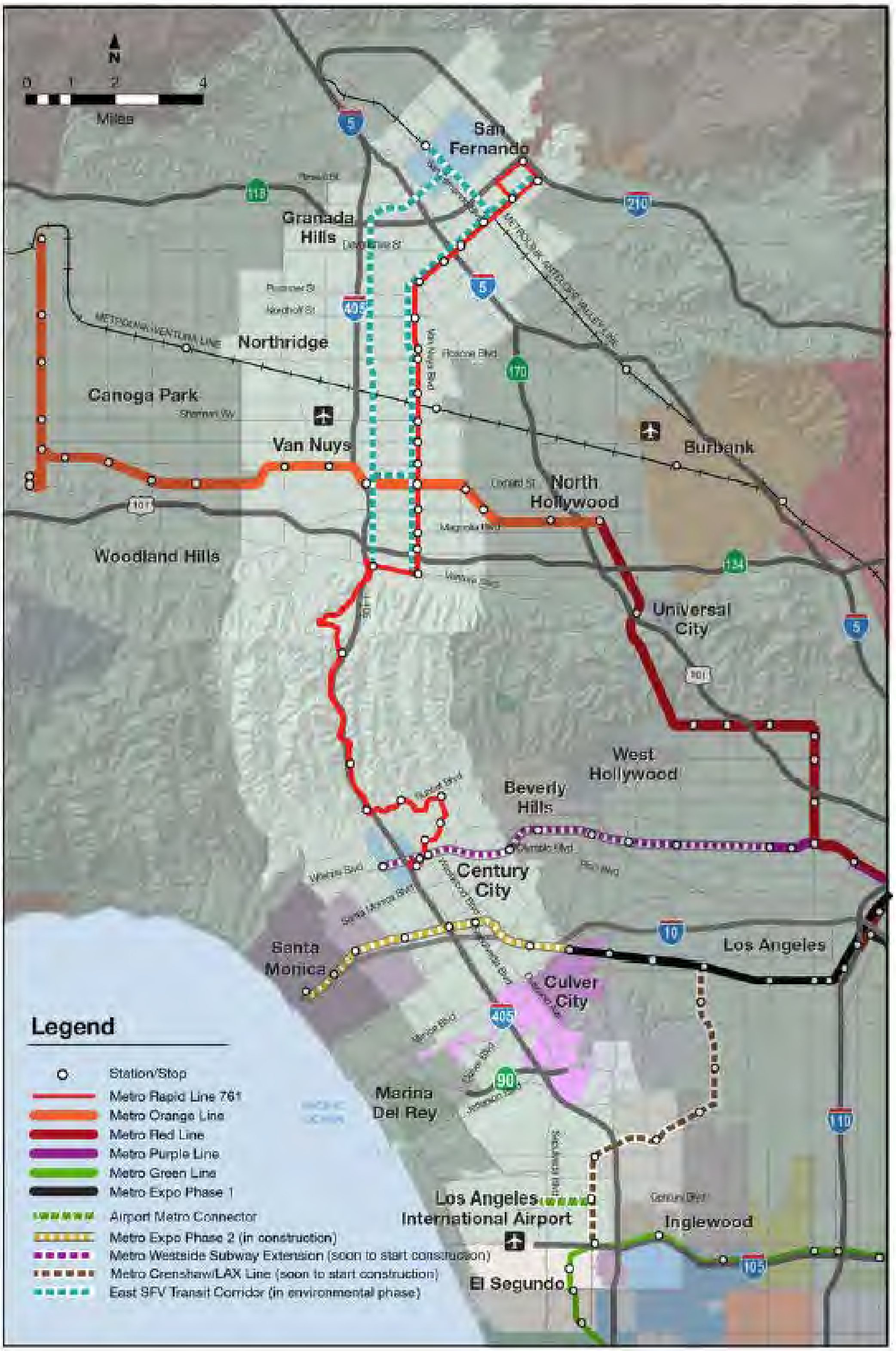
Study Area

The study area, which extends approximately 30 miles from the I-5/I-405 junction in the northern San Fernando Valley to Los Angeles International Airport (LAX), is bisected by the following 10 major existing and planned transportation lines (see Figure 2).

- Metrolink Antelope Valley Line
- Metrolink Ventura Line
- Metro Rapid Line 761
- Metro Orange Line
- Metro Green Line
- East San Fernando Valley Transit Corridor (in environmental phase)
- Metro Westside Subway Extension (soon to start construction)
- Metro Expo Line, Phase 2 (in construction)
- Metro Crenshaw/LAX Line (soon to start construction
- Airport Metro Connector (in environmental phase)

Figure 1. Measure R Map

Figure 2. Sepulveda Pass Study Area



Study Purpose

This study is the earliest phase of project development and precedes an Alternatives Analysis or Environmental Impact Study (EIS). The Systems Planning Study evaluates broad level concepts—from transit modes such as Bus Rapid Transit (BRT), Light Rail Transit (LRT), and Heavy Rail Transit (HRT) to highway improvements including High Occupancy Toll (HOT), and at-grade and above and/or below grade-separated alignments. The study developed initial engineering concepts, travel demand, rough order of magnitude (ROM) costs in current dollars (2012), and a summary of potential environmental issues for each concept.

Project Need

The Sepulveda Pass provides a crucial transportation link across the Santa Monica Mountains between the heavy concentration of households in the San Fernando Valley and major employment and activity centers in Los Angeles County's Westside sub-region. The I-405 Freeway is ranked as one of the most traveled urban highways in the nation by the Federal Highway Administration (FHWA) with an Average Annual Daily Traffic of 374,000 vehicles in 2010. The 13-mile stretch of the freeway, from Getty Center Drive, the core of the Sepulveda Pass, to the I-105 (Century Freeway), was recently ranked as the third most congested freeway segment in the United States.

In addition, the US 101 and I-10 interchanges with the I-405 north and south of the Pass consistently rank among the five most congested freeway interchanges in the country. The I-405 Sepulveda Pass Improvements Project which is currently under construction will address some of these congestion issues when it is completed in about a year. Demand is still expected to exceed capacity as growth in travel demand expands in this corridor and no special provisions have been included in the current construction project for transit improvements.

The I-405 currently varies between four to six general purpose lanes in each direction and includes a continuous High Occupancy Vehicle (HOV) Lane in the southbound direction from the I-5/I-405 split in the north San Fernando Valley to the Orange County Line. The I-405 Sepulveda Pass Improvements Project will add a 10-mile HOV lane in the northbound direction of the I-405 between the I-10 and the US 101 freeways. This will complete the I-405 HOV lanes in both directions between the I-5 in Los Angeles County and the I-5 in Orange County.

Systems Concepts

A set of "concept families" was developed, taking into account travel markets, engineering constraints, and environmental issues. The first two concept families included could be mostly funded with the Measure R funds:

- Concept 1: Shoulder Running BRT

  30 miles between the Sylmar/San Fernando Metrolink Station to Century/Aviation (future Metro station), with a freeway shoulder running Bus Rapid Transit (BRT) during peak periods, and transit signal priority treatments along major arterials.

- Concept 2: At-Grade Managed Lanes with BRT

  29 miles with five general purpose/two High Occupancy Toll (HOT) lanes in each direction at-grade through the Pass, and a single HOT lane north of US 101/south of Santa Monica Blvd.; also includes BRT routes; direct access ramps; and P3 potential.

- Concept 3: Aerial/Viaduct Managed Lanes with BRT

  10 miles of elevated structure above the I-405 from US 101 to I-10 (2 HOT lanes in each direction); BRT for 21 miles from

Sylmar to Expo/Sepulveda Station. Caltrans previously studied this alternative in the I-405 environmental document, however, it was eliminated from further consideration.

- Concept 4: Tolled Highway Tunnel with BRT

  Nine miles of tolled highway tunnel with four toll lanes (two per direction); portals between US 101 and Santa Monica Blvd; direct connectors from eastbound US 101 and southbound I-405; all users, including carpools, pay regular toll; P3 potential.

- Concept 5: LRT Rail Tunnel (5A) or HRT RailTunnel (5B)

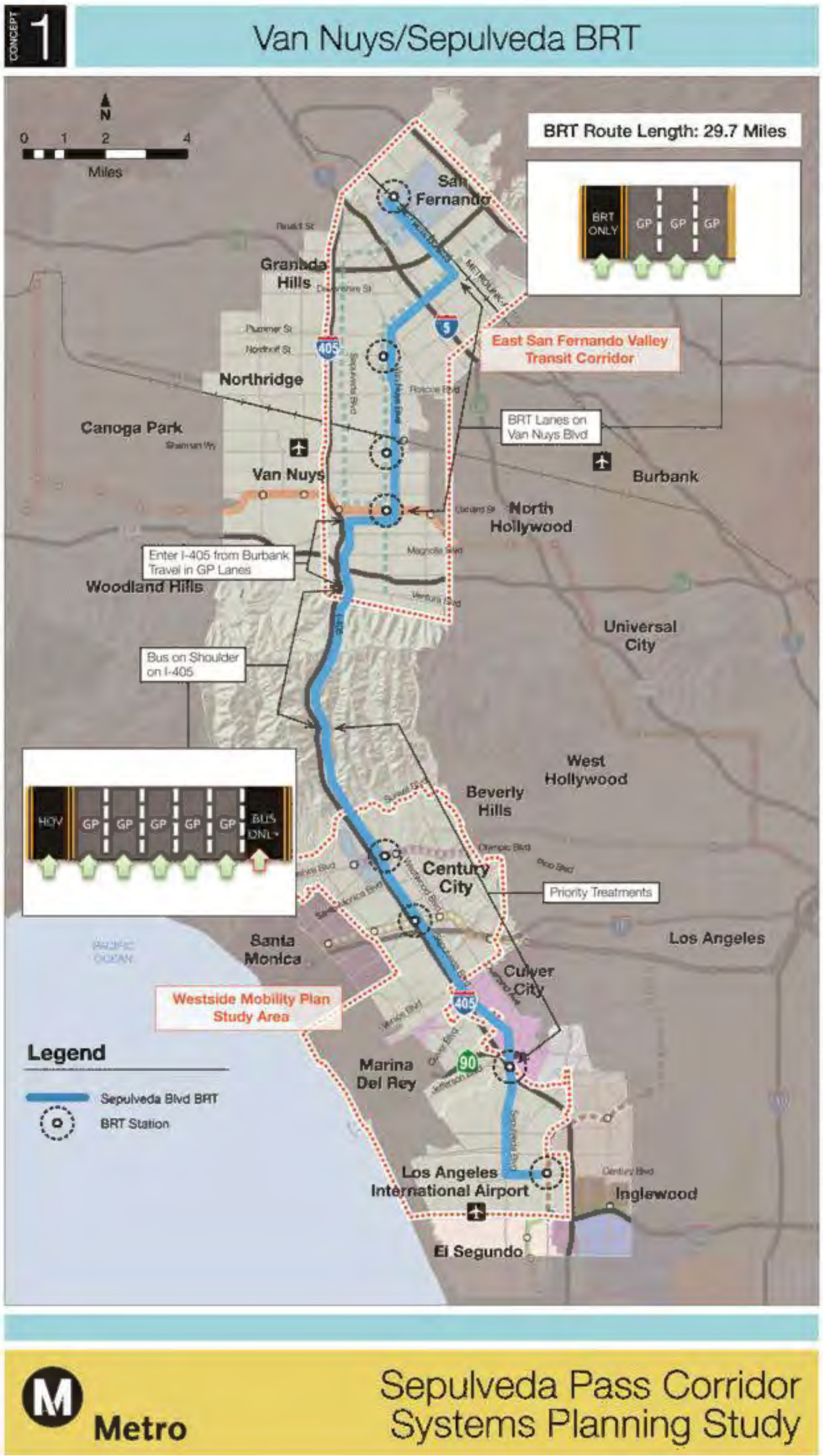
  Twenty-eight miles of Light or Heavy Rail Transit (LRT or HRT) from Sylmar/San Fernando Metrolink Station to Century/Aviation; either at-grade with grade-separated major intersections, or fully grade-separated options; LRT 7.5 miles of tunnel through the Pass or 29.7 miles of HRT subway; 15 stations; portals near Ventura/Van Nuys and just south of Santa Monica Blvd.

- Concept 6: Combined Highway and Rail Tunnels with Demand Pricing

  21 miles of highway tunnel with portals at Roscoe/Van Nuys; direct connectors with eastbound US 101/southbound I-405; three intermediate access points; 21miles of private transit shuttle between Van Nuys Metrolink Station and Century/Aviation; P3 potential.

Concepts were developed at two interactive planning charrettes (May 2, 2012 and July 30, 2012) during which participants from Metro, technical consultants, and Metro's P3 program management consultant provided feedback. Concepts were refined based on technical input from each of the disciplines – transportation planning, engineering, environmental, and demand modeling – and the charrette participants.

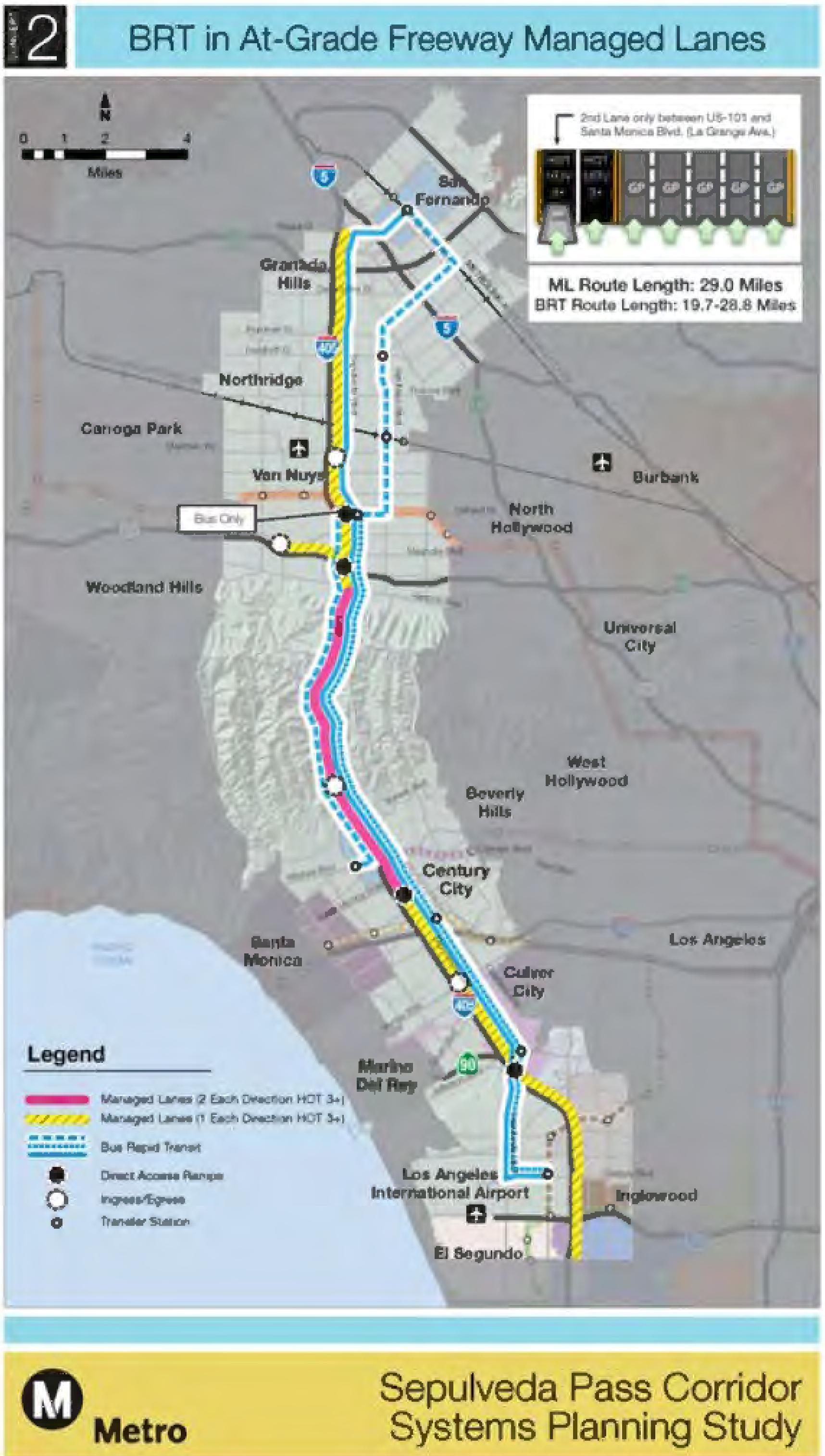
Figure 3. Concept 1 – Shoulder Running BRT



Transit Components:

- Bus Rapid Transit (BRT) from Sylmar Metrolink Station to Century/Aviation
- Route length: 30 miles (partial exclusive lanes)
- Bus use of freeway shoulders during peak periods
- Priority treatment on Sepulveda Blvd through and south of the Pass
- 2-mile station spacing: Sylmar Metrolink Station, Nordhoff St, Sherman Way, Metro Orange Line, Wilshire (future Metro Purple Line), Metro Expo Line, SR-90/Culver City Transit Mall, Century/Aviation
- 12 min headways peak and 20 min headways off-peak

Figure 4. Concept 2 –At-Grade Managed Lanes with BRT



Highway and Transit Components:

- Managed lane (3+ HOT) - length: 29 miles
  - o Configuration through Sepulveda Pass: 5 general purpose lanes plus 2 HOT lanes in each direction
  - o Single HOT lane north of Sepulveda Pass and south of I-10
- 3 BRT routes, all connecting at Metro Orange Line/I-405 Transfer Station:
  - o Sylmar to LAX via managed lanes
  - o Sylmar to future Metro Purple Line via Van Nuys
  - o Metro Orange Line to Metro Expo Line/Culver City/LAX

Physical Improvements:

- Metro Orange Line direct access ramp for BRT
- Direct connectors from eastbound US 101 to southbound I-405 and from northbound I-405 to westbound US 101
- Direct access ramps south of Santa Monica Blvd (La Grange Ave), and south of SR-90 (Sepulveda Blvd or Howard Hughes Pkwy)

Figure 5. Concept 3 – Aerial/Viaduct Managed Lanes with BRT

Highway and Transit Components:

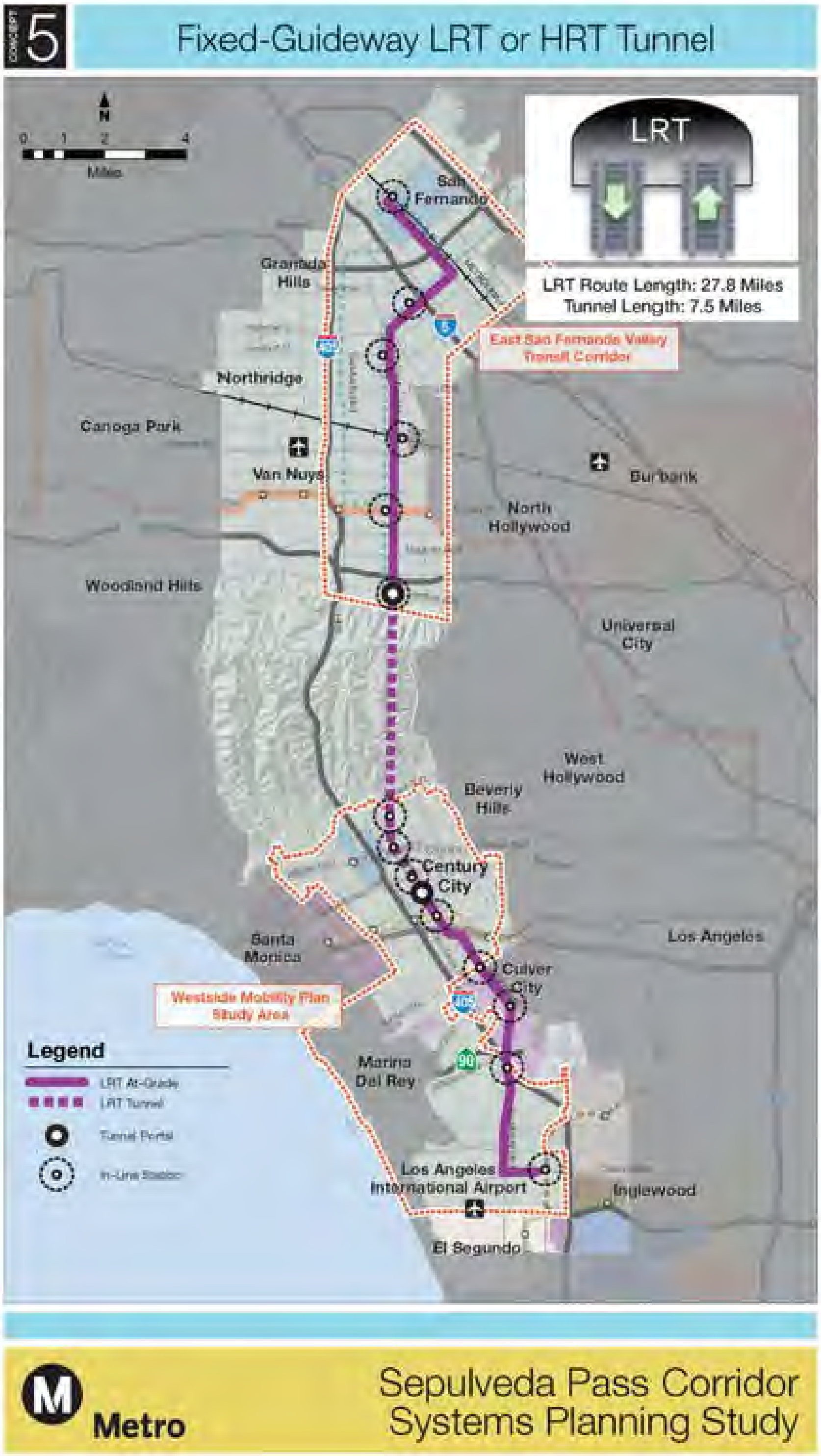
- Highway Viaduct constructed above the I-405 from US 101 to the I-10 Freeways
- Viaduct length: 10 miles
- BRT route length: 21 miles
- BRT service connecting Sylmar/San Fernando Metrolink Station to Metro Expo Sepulveda Station
- 2 HOT lanes in each direction on an elevated structure, freeing existing HOV lanes for dedicated busway beneath viaduct
- Potential south terminus at future Metro Purple Line or Metro Expo Line
- Previously studied by Caltrans
- Viaduct alternative was not recommended in Caltrans/FHWA I-405 Widening EIR/EIS

Figure 6. Concept 4 – Tolled Highway Tunnel with BRT

Highway and Transit Components:

- Tunnel with four toll lanes (two per direction) through Sepulveda Pass
- Tunnel length: 9.2 miles
- Northern portal north of US 101 and a southern portal near Santa Monica Blvd/I-10
- Direct connectors from eastbound US 101 and southbound I-405 freeways
- Buses and private automobiles would be allowed to use the tunnels; trucks would be prohibited
- Carpool users pay regular toll rates
- P3
- Same BRT service plan as in Concept 2

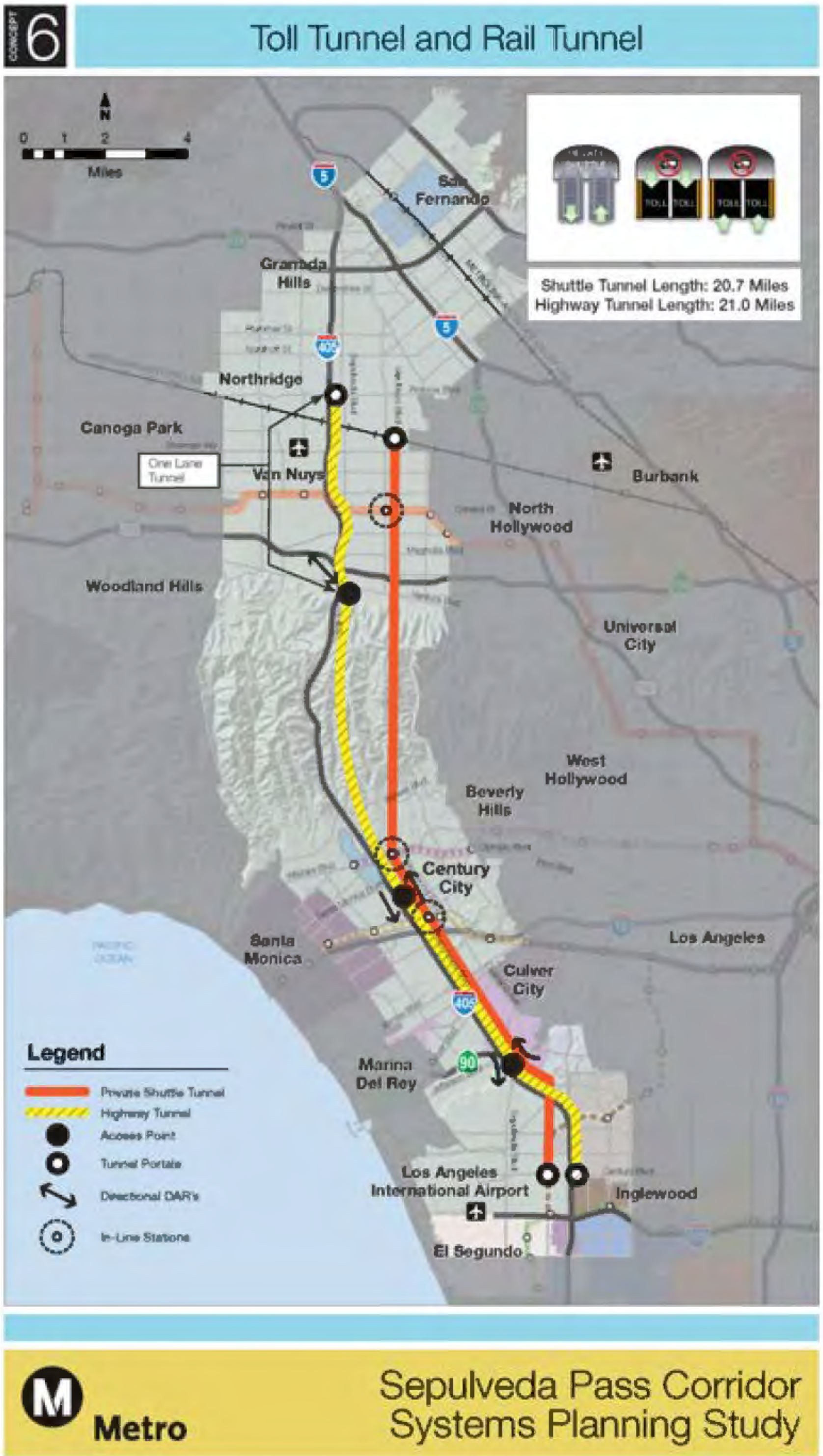
Figure 7. Concept 5 – LRT Rail Tunnel (5A) and HRT Rail Tunnel (5B)



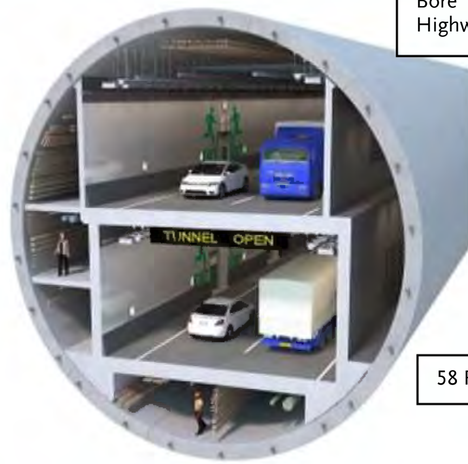
Transit Components

- LRT or HRT Line from Sylmar/San Fernando Metrolink Station to LAX (Century/Aviation)
- Route length: 28 miles
- 14 stations
- Connectivity to Metro Rail system at future Metro Purple Line, Metro Expo Line, and Metro Crenshaw/LAX
- Concept 5A - LRT At-grade
  - Most of LRT alignment at-grade in a dedicated median-running right-of-way, with grade-separated crossings at major intersections
  - Travels underground in transit-only tunnel in the Sepulveda Pass (tunnel length 7.5 miles)
  - Northern portal near Ventura Blvd and Van Nuys Blvd.
  - Southern portal south of Santa Monica Blvd.
- Concept 5B - HRT Tunnel
  - Fully grade-separated in tunnel configuration for full alignment

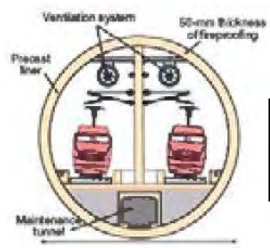
Figure 8. Concept 6 – Combined Highway and Rail Tunnels with Demand Pricing



Typical Large Bore Highway Tunnel



58 Ft. diameter



Typical Single-Bore Transit Tunnel 40' diameter

Highway and Transit Components:

Highway Tunnel to HOT Lanes:

- Highway tunnel length: 21 miles
- Northern portal near Roscoe Blvd, Southern portals at LAX (I-405 and Century Blvd)
- Direct highway connectors from eastbound US 101 and southbound I-405, located at Santa Monica/Olympic and Sepulveda/Howard Hughes Parkway

Private Shuttle Tunnel

- Shuttle tunnel length: 21 miles
- Private shuttle rail tunnel between Van Nuys Metrolink Station and LAX (Century/Aviation)
- P3 sets tolls at proportionate cost to highway tolls

Summary of Study Observations and Findings

The study, having taken into account the analyses and input received during the planning Charrettes, offers the following preliminary observations about the performance of the concepts that were developed:

- Concept 1, though cost-effective and within the LRTP funding commitment, does not serve as a long-term solution to providing a competitive, reliable transit option unimpeded by traffic, which is one of the goals of the project. Also, a technological challenge that needs to be overcome is procuring buses that can operate reliably at high speeds on the steep grades over the Pass.
- Concept 2 is also relatively cost-effective and has a preliminary cost estimate within the ballpark of the LRTP funding commitment, but has the same technological challenge as Concept 1. Concept 2 would be a favorable P3 project, with a total capital cost of $1.7 billion.
- Concept 3, the aerial viaduct, was studied as a part of Caltran's environmental studies for the current I-405 Sepulveda Pass Improvements Project, but was not selected. From a capacity standpoint, a four-lane aerial viaduct would displace two surface lanes for column supports, resulting in a net increase of only two travel lanes at a relatively high capital cost. The cost of an aerial viaduct is estimated to exceed $2 billion for a net increase of only one travel lane in each direction.
- Concept 4 provides added highway capacity with a tolled highway tunnel through the Sepulveda Pass and could accommodate BRT service at virtually no additional transit capital cost.
- Concept 5 provides high-capacity transit service, either LRT with grade-separated service through the Pass and at major intersections elsewhere along the corridor (5A) or HRT in a fully grade-separated alignment (5B). To overcome the high cost of these transit improvements, one option might be to phase the rail service after the implementation of managed lanes and revenue is generated to finance the higher costs of this concept.
- Concept 6 serves as an ultimate build-out solution that includes a new highway tunnel and a new transit tunnel. Due to the extremely high cost of the long tunnels, these improvements would likely need to be developed and phased as a P3 project.

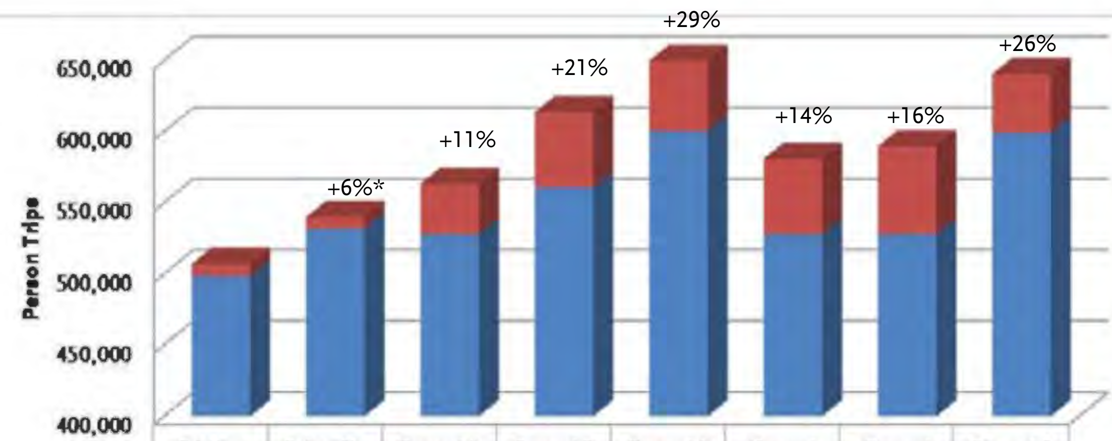
Transit ridership potential is very high for all concepts, due to the strong travel demand between the San Fernando Valley and the Westside. Forecasted average weekday boardings range from 39,500, nearly as many boardings as the current Metro Gold Line, to 106,600, more boardings than the current Metro Blue Line.

- **Study Concepts Could Accommodate Increases in Travel of Between 11 percent and 29 percent.**

  Figure 9 shows person throughput "over the Pass." Today, more than 507,000 people travel over the Pass. The number is expected to increase to 540,100 following completion of the current I-405 Sepulveda Pass Improvements Project (Future No Build scenario).

  The concepts that carry the highest person throughput include: Concept 4 (Tolled Highway Tunnel with BRT), which has a daily throughput of 654,600 persons (29 percent increase in capacity), followed by Concept 6 (Combined Highway and Rail Tunnels with Demand Pricing) with a person throughput of 640,600 (26 percent increase in capacity), and then Concept 2 (At-Grade Managed Lanes with BRT) with a person throughput of 613,800 (21 percent increase in capacity). The concept that

Figure 9. Average Weekday Person Throughput "Over the Pass"



	Existing	Future No Build	Concept 1: Van Nuys/ Sepulveda BRT	Concept 2: BRT in At-Grade Managed Lanes	Concept 4: BRT w/ Tolled Highway Tunnel	Concept 5A: Fixed Guideway LRT	Concept 5B: Fixed Guideway Heavy Rail	Concept 6: Highway/ Private Shuttle Tunnel
Total	507,100	540,100	563,500	613,800	654,600	580,900	589,800	640,600
Change from No Build			23,400	73,700	114,500	40,800	49,700	100,500
Transit	8,500	8,100	35,400	53,100	54,100	52,900	61,800	41,000
Auto	498,600	532,000	528,100	560,700	600,500	528,000	528,000	599,600

* Future No Build assumes completion of current I-405 HOV/Widening Project (2035)

* Future No Build Assumes completion of current I-405 HOV/Widening Project (2035)

carries the least amount of people is Concept 1 (Shoulder Running BRT) with a person throughput of 563,500.

Hence, concepts with the highest person throughput have the combined advantages of managed lanes that encourage ridesharing and additional transit capacity.

Figure 10 shows trip volumes for the AM peak in the southbound direction of the I-405 passing through Moraga Drive. In the AM peak, there are approximately 30,600 vehicles that travel southbound over the Sepulveda Pass via the I-405 into West Los Angeles. The graphic shows where those trips originate. Several key highlights:

- Almost one in every five cars originate in the North County (Santa Clarita, Antelope Valley) (20 percent)
- Two in every five cars originate from the Central San Fernando Valley (41 percent)
- Two in every five cars originate from US 101 or points south of US 101 (39 percent)

Traffic builds up progressively in the southbound direction reaching a point of maximum loading in the Sepulveda Pass.

Of the trips traveling south of the Sepulveda Pass, almost half (49 percent) exit the I-405 by the time they reach the I-10 (Santa Monica) Freeway, a stretch of the I-405 that connects to the jobs-rich area that includes Santa Monica, Westwood and Century City. Another 35 percent exit at Westside destinations south of the I-10 including LAX and approximately 16 percent continue south of the I-405 beyond the airport. This graphic illustrates the very high demand within the Sepulveda Pass between the US 101 and I-10 Freeways, demonstrating the need for additional capacity enhancements within this "bottleneck" area.

Figure 10: 2008 AM Peak Period Select Link Analysis - Southbound

There is a strong potential for transit improvements in the Sepulveda Pass Corridor, particularly for service in the 10-mile segment between the Metro Orange Line and the Metro Expo Line.

- Transit Demand: Current transit service in the Sepulveda Pass is limited to the Metro Rapid 761 and a number of specialized commuter and express services such as the LAX Flyaway Bus and commuter lines operated by Antelope Valley Transit Authority, Santa Clarita Transit and Los Angeles Department of Transportation. Bus speeds are slow with average travel times for the Metro Rapid 761 between Van Nuys Government Center and Westwood of 65 minutes in the AM southbound direction and 74 minutes in the PM northbound direction (9-11 mph).
- Potential transit ridership increases for options considered in the current Systems Planning Study indicate potential future boardings in this corridor that range from 55,000 daily boardings (Concept 2) for an enhanced bus service in at-grade managed lanes to over 106,000 daily boardings for a fully grade-separated fixed-guideway system extending for over 20 miles between the Central San Fernando Valley and LAX.
- The greatest transit demand in the 30-mile study corridor between Sylmar and LAX was found in the 10-mile Sepulveda Pass segment between the Metro Orange Line and the Metro Expo Line. Between 60-80 percent of daily boardings for the full 30-mile corridor were forecasted to occur at stations in this segment.

Segments extending north of the Metro Orange Line and south of the Metro Expo Line are forecasted to provide good ridership as well, but at levels that are not nearly as robust as in the high demand bottleneck segment between the Metro Orange Line and the Metro Expo Line. Figure 11 illustrates the stations with the highest levels of travel boardings for both bus and rail transit options. Figure 12 provides the forecasted station to station travel times and transit boardings for each of the six concepts. Highest levels of boardings occur at the following stations:

- San Fernando Valley – The Metro Orange Line Stations at either Van Nuys or Sepulveda offer the highest boardings due to high transfers. Between 14,000 and 25,000 daily boardings are predicted for this station.

- Westside – The future Wilshire/Westwood Metro Purple Line Station would offer the highest ridership for the connecting stations on the Westside with a forecast of 17,000 boardings. The Metro Expo Line Station would be the second highest with between 7,000 and 13,000 daily boardings. The Crenshaw/LAX Century/Aviation Station at LAX would be the third highest with between 6,500 and 9,000 daily boardings.

Figure 11. Proposed Transit Improvements and High Station Boarding Locations

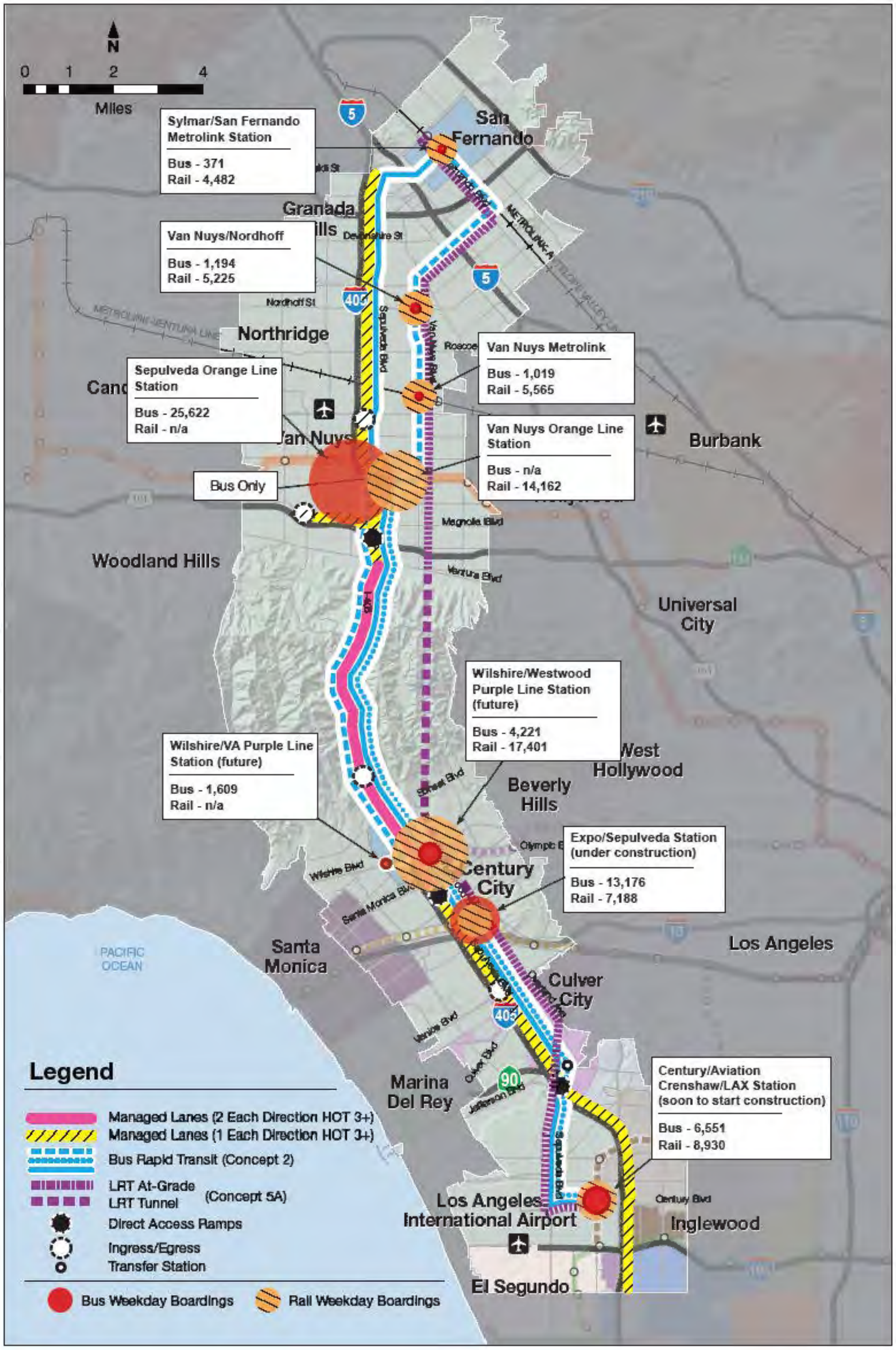


Figure 12. Forecasted Weekday Transit Boardings by Station

Figure 12-1. Concept 1 – Shoulder Running BRT

Station Name	Distance (miles)	TIME		TOTAL BOARDINGS		
		Peak (min)	Off Peak (min)	Peak	Off Peak	Daily
Sylmar/SF Metrolink	-	-	-	844	480	1,323
Van Nuys/Nordhoff	5.1	19.1	15.4	1,516	894	2,410
Van Nuys/Sherman Way	2.4	10.4	7.5	2,594	1,392	3,986
Van Nuys/Orange Line	1.5	4.3	4.4	6,726	5,421	12,147
Westwood/Wilshire	11.1	54.4	32.3	5,805	4,262	10,067
Sepulveda/Expo Line	2.0	7.8	8.7	2,688	1,710	4,398
Culver City TC	4.4	18.2	20	1,235	596	1,831
Century/Aviation	3.8	14.9	18.3	2,115	1,191	3,306
TOTAL	**30.3**	**129.1**	**106.6**	**23,523**	**15,946**	**39,468**

Figure 12-2. Concept 2 – At-Grade Managed Lanes with BRT

Station Name	Distance (miles)	Time		Total Boardings		
		Peak (min)	Off Peak (min)	Peak	Off Peak	Daily
Line 1: Sylmar to LAX						
Sylmar Metrolink	-	-	-	74	14	88
Sepulveda/Orange Line	10.1	53.6	45.2	4,213	1,823	6,036
Century/Aviation	18.1	40.5	44.9	4,286	1,837	6,123
TOTAL	**28.2**	**94.1**	**90.1**	**8,573**	**3,674**	**12,247**
Line 2: Sylmar to VA						
Sylmar Metrolink	-	-	-	178	106	283
Van Nuys/Nordhoff	5.1	28	22.8	829	365	1,194
Van Nuys Metrolink Station	1.9	12.8	8.8	762	257	1,019
Sepulveda/Orange Line	3	12.8	13.6	3,946	1,520	5,466
Sepulveda/Wilshire	10.9	19.4	20.2	2,822	1,400	4,222
Purple Line VA Station	0.7	10.3	8.1	1,249	360	1,609
TOTAL	**21.6**	**83.3**	**73.5**	**9,786**	**4,008**	**13,793**
Line 3: Orange Line to LAX						
Sepulveda/Orange Line	-	-	-	9,314	4,806	14,120
Sepulveda/Expo Line	10.6	17.4	17.8	8,837	4,340	13,176
Culver City TC	4.4	18.2	20.0	993	743	1,735
Century/Aviation	3.8	15.0	18.4	282	146	428
TOTAL	**18.8**	**50.6**	**56.2**	**19,426**	**10,035**	**29,459**
CONCEPT 2 TOTAL				**37,785**	**17,717**	**55,499**

Figure 12-3. Concept 4 – Highway Tunnel with BRT

Station Name	Distance (miles)	Time		Total Boardings		
		Peak (min)	Off Peak (min)	Peak	Off Peak	Daily
Line 1: Sylmar to LAX						
Sylmar Metrolink	-	-	-	531	100	631
Sepulveda/Orange Line	10.1	53.6	45.2	2,031	1,083	3,114
Century/Aviation	18.1	51.4	49.6	1,928	1,074	3,001
TOTAL	**28.2**	**105**	**94.8**	**4,490**	**2,257**	**6,746**
Line 2: Sylmar to VA						
Sylmar Metrolink	-	-	-	73	85	158
Van Nuys/Nordhoff	5.1	28	22.8	787	366	1,153
Van Nuys Metrolink Station	1.9	12.8	8.8	773	268	1,041
Sepulveda/Orange Line	3	12.8	13.6	3,970	1,560	5,530
Sepulveda/Wilshire	9.7	17.8	18.6	2,910	1,462	4,371
Purple Line VA Station	0.7	9.9	8	1,313	376	1,688
TOTAL	**20.4**	**81.3**	**71.8**	**9,826**	**4,117**	**13,941**
Line 3: Orange Line to LAX						
Sepulveda/Orange Line	-	-	-	11,714	5,827	17,541
Sepulveda/Expo Line	9.4	15.8	16.2	9,794	4,881	14,675
Culver City TC	4.4	18.2	20.0	1,148	762	1,910
Century/Aviation	3.8	14.9	18.3	1,566	599	2,164
TOTAL	**17.6**	**48.9**	**54.5**	**24,222**	**12,069**	**36,290**
CONCEPT 2 TOTAL				**38,538**	**18,443**	**56,977**

Figure 12-4. Concept 5A – LRT Rail Tunnel

Station Name	Distance (miles)	Time (min)	Total Boardings		
			Peak	Off Peak	Daily
Sylmar Metrolink	-	-	2,557	1,925	4,482
Van Nuys/Arleta	3.7	11	2,225	978	3,202
Van Nuys/Nordhoff	1.6	4.8	3,829	1,396	5,225
Van Nuys Metrolink Station	1.7	5	3,735	1,831	5,565
Van Nuys/Orange Line	2.2	6.7	10,962	3,200	14,162
Van Nuys/Ventura Blvd.	2.0	5.9	5,987	1,947	7,934
UCLA Ackerman Union	6	7.2	3,307	1,091	4,397
Westwood/Wilshire	0.8	1	14,316	3,085	17,401
Westwood/Santa Monica	0.8	0.9	2,752	1,278	4,030
Westwood/Expo Line	1.1	2.6	5,490	1,698	7,188
Overland/Venice	1.8	5.3	2,504	985	3,488
Overland/Jefferson	1.3	3.8	1,414	619	2,033
Culver City TC	1.7	5	1,566	631	2,197
Century/Aviation	3.5	10.5	6,740	2,190	8,930
TOTAL	**28.2**	**69.7**	**67,384**	**22,854**	**90,234**

Figure 12-5. Concept 5B – HRT Rail Tunnel

Station Name	Distance (miles)	Time (min)	Total Boardings		
			Peak	Off Peak	Daily
Sylmar Metrolink	-	-	3,855	2,581	6,436
Van Nuys/Arleta	3.7	8.1	2,706	1,237	3,943
Van Nuys/Nordhoff	1.6	3.6	4,383	1,647	6,030
Van Nuys Metrolink Station	1.7	3.7	4,228	2,082	6,310
Van Nuys/Orange Line	2.2	5	12,687	3,618	16,305
Van Nuys/Ventura Blvd.	2.0	4.4	5,690	2,154	7,843
UCLA Ackerman Union	6	7.2	3,488	1,195	4,683
Westwood/Wilshire	0.8	1	15,174	3,396	18,570
Westwood/Santa Monica	0.8	0.9	2,880	1,447	4,327
Westwood/Expo Line	1.1	1.5	6,125	2,122	8,246
Overland/Venice	1.8	3.9	2,687	1,078	3,765
Overland/Jefferson	1.3	2.8	1,860	801	2,661
Culver City TC	1.7	3.7	1,845	754	2,599
Century/Aviation	3.5	7.8	11,318	3,590	14,907
TOTAL	**28.2**	**53.6**	**78,926**	**27,702**	**106,625**

Figure 12-6. Concept 6 – Combined Highway and Rail Tunnels with Demand Pricing

Station Name	Distance (miles)	Time (min)	Total Boardings		
			Peak	Off Peak	Daily
Van Nuys Metrolink Station	-	-	6,700	2,240	8,939
Van Nuys/Orange Line	2.2	2.6	13,644	3,200	16,843
Westwood/Wilshire	9	10.8	11,048	1,868	12,915
Sepulveda Blvd/Expo Line	1.7	2	6,283	1,855	8,137
Century/Aviation	7.8	9.4	9,093	2,538	11,631
TOTAL	**20.7**	**24.8**	**46,768**	**11,701**	**58,465**

- **Further At-Grade Improvements are Possible Beyond the Current I-405 Widening Project.**

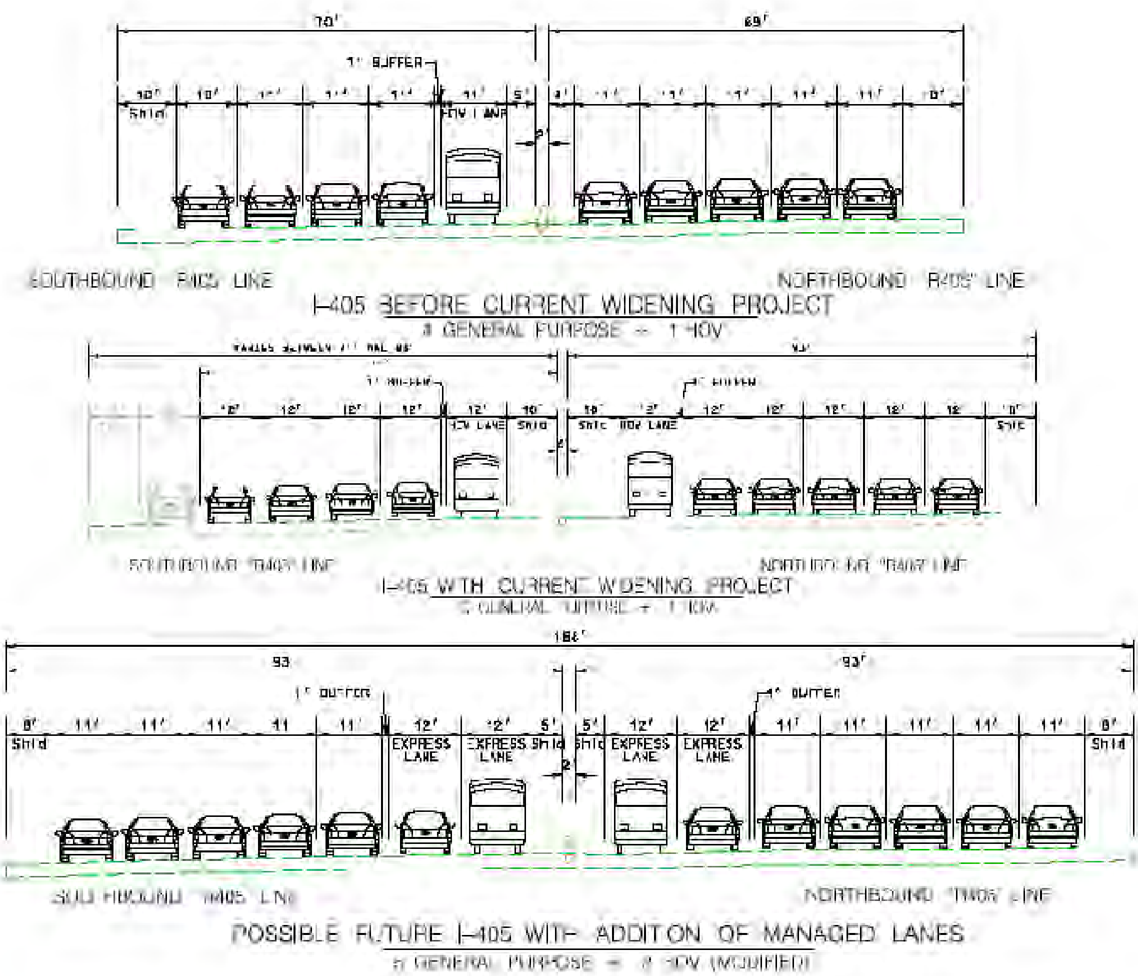
  A project similar to Metro's I-10 and I-110 ExpressLanes would be feasible in the Sepulveda Pass at relatively low cost and with minimal environmental impacts. By restriping lane widths from 12 to 11 feet, a managed lane facility with two High Occupancy Toll (HOT) lanes in each direction could be constructed with only minor spot-widening of the paved surface area and no widening outside of the existing Caltrans right-of-way in the Sepulveda Pass.

  Figure 13 illustrates three current cross sections within the Sepulveda Pass as well as the future changes that are currently being implemented or could be possible with Concept 2.

  - I-405 Before Current Widening Project – The first cross section illustrates existing conditions before completion of the current I-405 Sepulveda Pass Improvements Project. There are 4 to 5 mixed-flow lanes and one southbound HOV Lane (2+).
  - I-405 With Improvement Project – The current widening project will add one northbound HOV lane (2+) and will widen the 4 to 5 mixed-flow lanes from 11 feet to 12 feet as well as widen the median area.
  - Possible Future I-405 with Addition of Managed Lanes – It would be possible to create 4 managed lanes (2 in each direction) by restriping the freeway to restore the prior lane widths to 11 feet and restoring the prior median area widths. With the addition of direct access ramps to the managed lanes in the Valley and the Westside, a free-flow bus lane would be created in the corridor.

Such a project would cut transit travel times nearly in half (approximately from 65 to 74 minutes to 34 to 36 minutes) by providing 45-50 mph speeds through the Pass. With a managed lanes project, virtually all the capital costs to provide free-flow bus lanes are borne by the highway improvement, with only minimal capital costs attributable to transit.

Figure 13. Cross Sections of Before, Current and Future I-405



- **Subway Concepts improve both vehicle and person throughput between US 101 and I-405, but costs will be high due to the length of the corridor.**

  Subway options in the Systems Planning Study include the following:

  - Highway Tunnel – One or two highway tunnels could be constructed under the Sepulveda Pass. A minimum distance for such a tunnel would be 9-10 miles extending from the US 101 (Ventura Freeway) to the I-10 (Santa Monica Freeway). Highway tunnel are larger in cross-section than rail tunnels and recent projects in North America and in other countries have used large-bore tunneling technologies that are currently as large as 58' in diameter.

    An example of such a large-bore tunnel in North America is the Seattle Alaska Highway Viaduct Replacement Tunnel, which is approximately 1.8 miles in length with a fully burdened cost of $2.034 billion ($2013 YOE). A similar 58-foot diameter large bore tunnel could be implemented in the Sepulveda Pass and could meet Caltrans roadway design criteria with two lanes in each direction (4 lanes total). If non-standard designs could be approved, a total of 6-lanes would be possible in such a tunnel, as has been proposed for the I-710 Gap Closure Project.

    Using per mile/fully burdened costs from the Seattle large-bore tunnel this would result in a total project cost of between $10 and $13 billion including the necessary surface roadway ramps and improvements to provide access to and from the subway portals.

    Capacity increases in person throughput would be on the order of 21 percent from 540,100 persons per day to 654,600 persons per day. Such a highway tunnel could accommodate BRT service at virtually no additional transit capital costs.

  - Rail Transit Tunnel – Rail transit tunnels are significantly smaller in cross-section than highway tunnels. Twin bore tunnels such as those for the Metro Westside Subway Extension or the Metro Eastside LRT would cost approximately $500 million per mile in fully burdened costs.

    An LRT line over a 30-mile distance between Sylmar/San Fernando and Century/Aviation (near LAX) with a tunnel through the Pass and limited, above-ground grade separations elsewhere would cost between $7.5 and $8.5 billion (or $85 million per mile at-grade and $504 million per mile for tunnel segment). A HRT option with a full tunnel alignment through the Pass would cost between $13.6 and 17.5 billion (or between $504 million per mile). A rail project between the Metro Orange and the Metro Expo Lines primarily configured in a tunnel would cost between $5 and $6 billion.

Rough Order of Magnitude (ROM) Cost Methodology

Because the Systems Planning Study is at the very earliest stage of project development, the civil engineering task focused on identifying the major engineering constraints/issue for each concept as a means of developing rough order of magnitude cost estimates. High-level conceptual drawings were developed for each concept to identify major elements and features such as:

- Typical cross sections
- Tunnel configuration

Once the major elements and features were identified and drawn on conceptual maps, rough order of magnitude (ROM) cost estimates were developed for each of the system concepts. A survey was conducted of other North American highway and transit projects that could be used for comparative costing purposes. The cost estimates reflect the conceptual nature of the study and were developed to be used as a high-level metric to compare the alternatives.

Figure 14 identifies a group of similar projects that were reviewed with a listing of project lengths, fully-loaded agency costs and resulting cost per mile figures. Unit costs from similar projects—including existing Metro bus and rail projects and the planned Alaskan Way Viaduct freeway tunnel project in Seattle—were used as a basis of the cost estimates. For example, unit costs were identified for the cost per mile of pavement, tunnel, elevated or at-grade concept; or typical number and cost of stations per mile for a BRT, LRT or HRT alternative. These unit costs were then applied to each systems concept to derive an estimated total capital cost.

Figure 14. Comparable Highway and Rail Projects

Historical North America highway and rail projects provided the key source of data for the preparation of these cost estimates. Figure 14 provides a summary of comparable projects. All costs are shown as fully-burdened agency costs which are significantly higher than project bid costs.

Highway/Rail Project	Length (Miles)	Number of Transit Stations	Technology	Construction Completion	Budget (Millions)	Adjusted for Inflation (Millions) 2012	Cost Per Mile (Millions) 2012	Footnote
Metro ExpressLanes I-110 and I-10	25.0	9	At-Grade Managed Lanes	2012/2013	$290	$290	$18-$30	1
Selmon Expressway Florida	14.1	0	Managed Lanes	2007	$420	$475	$33	2
Alaska Highway Viaduct Replacement Tunnel	1.8	0	58' Single Bore Highway Tunnel	2013	$2,034	$2,034	$1,044	3
Metro Purple Line Extension Twin Bore Tunnels	9.0	7	20' Heavy Rail Twin Bore Tunnels	2022-2036	$4,536	$4,536	$504	4
Metro Blue Line	22	22	LRT At-Grade	1990	$877	$1,870	$85	5
Miami Tunnel Project	0.75	0	43' Dual Bore Highway Tunnels	2014	$1,000	$1,000	$1,333	6

Footnotes:
1. Metro ExpressLanes Average Bid Prices for 2 Express Lanes (mid point of construction 2012) = $12M per mile. Construction cost has been increased to cover management and programmatic costs.
2. Derived from Published Reports
3. Derived from Published Reports
4. Metro Westside Subway Extension Project (2012)
5. Metro Estimating historic cost escalated to 2012
6. Port of Miami Tunnel Project estimate (midpoint of construction - 2012), increased to account for Agency and overall Program costs.

The major engineering issues and cost factors identified for each systems concept and the high-level capital cost derived from application of the unit cost for these elements appear below.

- **Concept 1: Shoulder Running BRT**

  Full Corridor (30 miles) $162 million
  Sepulveda Pass (10 miles) $146 million

  This concept would restripe approximately 8.5 miles of the I-405 Freeway to allow shoulder running buses during peak periods. The concept assumes a fleet of higher performance buses to handle the steep grades in the Sepulveda Pass. The full project length would extend from Sylmar/San Fernando Metrolink Station in the northern San Fernando Valley to the LAX Transit Center over a distance of 30 miles. An initial project length was estimated to run from the Metro Orange Line Sepulveda Station to the Metro Expo Line Station over a distance of 12 miles.

- **Concept 2: At-Grade Managed Lanes with BRT**

  Full Corridor – (28 miles) $1.7 billion
  Sepulveda Pass – (10 miles) $1.1 billion

  This concept would restripe the I-405 Freeway to provide 4 managed lanes between the US 101 (Ventura) Freeway and just north of the I-10 Freeway over a distance of approximately nine miles.

  Direct access ramps would be provided at the Metro Orange Line near Victory Boulevard and between Santa Monica and Olympic Boulevards on the Westside. North and south of the 4-lane managed lane segment, the 2 HOV lanes in each direction would be converted to a 2-lane managed lane segment. The full project length would extend from the I-5/I-405 Interchange in the northern San Fernando Valley to the LAX Transit Center and the I-105 (Century) Freeway over a distance of 30 miles.

  An initial project length was estimated to run from the Metro Orange Line Sepulveda Station to the Metro Expo Line Station over a distance of 12 miles. Transit buses would gain access to the facility via the above direct access connectors from local streets in the San Fernando Valley and the Westside, but express buses could travel for all or portions of the full corridor.

- **Concept 3: Aerial/Viaduct Managed Lanes with BRT**

  Full Corridor – (30 miles) $2.3 billion
  Sepulveda Pass – (10 miles) $1.4 billion

  The highway viaduct considered for this concept would be configured above the median of the I-405 Freeway between the US 101 and the I-10 Freeway. The aerial viaduct would consist of four managed lanes (two in each direction) and would be constructed in the median area. The structure was conceived as being supported by 10 foot wide center running columns, utilizing the inside shoulder area from the north and south bound directions.

  Access to the highway viaduct would be at three locations, north of the US 101 at Burbank Boulevard, at US 101 and a southern access point between Santa Monica and Olympic Boulevards. North and south of the viaduct section, the existing, surface running HOV lanes would be retained and could be converted to managed lanes in their current configuration of one lane in each direction.

- **Concept 4: Tolled Highway Tunnel with BRT**

  Full Corridor – (28 miles) $13 billion
  Sepulveda Pass – (10 miles) $10 billion

  This concept would construct a large bore tunnel under the Santa Monica Mountains that would carry 2 lanes of highway traffic in each direction. The large bore tunnel (58' diameter) would accommodate two lanes on the upper level and two lanes on the lower level. Traffic in the tunnel would include both autos and buses. The tunnel would begin near the I-405/US 101 Interchange and would extend south for approximately nine miles generally following under the I-405 roadway. The southern portal of the tunnel would be located within the I-405 right of way just south of Santa Monica Boulevard.

- **Concept 5: Rail Tunnel**

  Light Rail (LRT)
  Full Corridor – (28 miles) $7-8 billion
  Sepulveda Pass – (10 miles) $5 billion

  Heavy Rail (HRT)
  Full Corridor – (28 miles) $ 13-17 billion
  Sepulveda Pass – (10 miles) $ 6 billion

  This concept would provide a rail transit project ultimately extending from the Sylmar/San Fernando Station in the northern San Fernando Valley to the LAX Transit Center/Century/Aviation Station. Fifteen stations were assumed.

  There are two options associated with this concept. Concept 5a is a light rail alignment that would run predominantly at-grade in the San Fernando Valley, travel in a tunnel configuration under the Santa Monica Mountains, and then run in a predominantly at-grade configuration through West Los Angeles to the Crenshaw/LAX Century/Aviation Station at LAX. Concept 5b is a heavy rail (HRT) alignment that has been assumed to run entirely in a tunnel configuration, following the same alignment as the LRT.

- **Concept 6: Combined Highway and Rail Tunnels with Demand Pricing**

  Full Corridor – (21 miles) $30-38 billion
  Sepulveda Pass – (10 miles) $20 billion

  This concept combines both a highway tunnel and a separate rail transit tunnel that would extend from the mid-San Fernando Valley all the way to the vicinity of LAX near the I-105 Freeway. This concept was included to evaluate a potential ultimate build out of the corridor.

  The highway tunnel would be served by entry portals near Roscoe Boulevard on the I-405, at the US 101 Freeway in the San Fernando Valley and near Santa Monica/Olympic and Sepulveda/Howard Hughes Parkway on the Westside.

  The rail tunnel would extend from the Van Nuys Metrolink Station to the planned Crenshaw/LAX Century/Aviation Station at LAX.

Figure 15. Rough Order of Magnitude Costs (30-mile ultimate corridor)

Summary of Capital Cost Estimates - Full Length Project [1]				
		Capital Cost Estimate [2]		Total
		Transit	Highway	
Concept 1	At-Grade Sepulveda BRT	$ 162,542,500	$ -	$ 162,542,500
Concept 2	At-Grade Freeway Managed Lanes	$ 552,542,500	$ 1,127,880,000	$ 1,680,422,500
Concept 3	Highway Viaduct Managed Lanes	$ 134,495,000	$ 2,194,140,000	$ 2,328,635,000
Concept 4	Tolled Highway Tunnel (Low Range)	$ 78,400,000	$ 10,378,992,000	$ 10,457,392,000
Concept 4	Tolled Highway Tunnel (High Range)	$ 78,400,000	$ 12,876,240,000	$ 12,954,640,000
Concept 5A	Fixed-Guideway At-Grade Light Rail Transit (Low Range)	$ 7,523,230,000	$ -	$ 7,523,230,000
Concept 5A	Fixed-Guideway At-Grade Light Rail Transit (High Range)	$ 8,506,030,000	$ -	$ 8,506,030,000
Concept 5B	Fixed-Guideway Heavy Rail Tunnel (Low Range)	$ 13,617,552,000	$ -	$ 13,617,552,000
Concept 5B	Fixed-Guideway Heavy Rail Tunnel (High Range)	$ 17,509,440,000	$ -	$ 17,509,440,000
Concept 6	Highway/Private Shuttle Tunnels (Low Range)	$ 8,705,112,000	$ 22,049,560,000	$ 30,754,672,000
Concept 6	Highway/Private Shuttle Tunnels (High Range)	$ 11,417,640,000	$ 27,318,200,000	$ 38,735,840,000

Assumptions:

1. Costs reflect full development of a 30-mile corridor. Initial project costs for a Sepulveda Pass only segment are less.
2. Capital Cost Estimate includes construction and vehicle cost estimates.

- **The Sepulveda Pass Corridor Project identifies several potential direct access ramp locations that will be needed to direct auto and transit vehicles bound for the enhanced travel facility (express lanes, highway tunnel portals or aerial viaduct ramps). The Systems Planning Study identified several possible locations in the San Fernando Valley and the Westside for further engineering and environmental evaluation.**

  The addition of additional highway lanes and/or transit through the Sepulveda Pass will increase the number of vehicles travelling through the Pass and will therefore require extremely careful and detailed traffic studies to distribute this new traffic onto the local arterial and street network near the project access points in the San Fernando Valley and on the Westside.

  Several locations have been identified for further study. Three that have particularly high potential include the following:

  - Metro Orange Line/Victory Boulevard Direct Connector Ramps- As shown in Figures 16 and 17, it would be possible to provide direct access ramps from the Metro Orange Line where the busway runs parallel to the I-405 Freeway near Victory Boulevard. The freeway is elevated on fill in this section and could be widened in this area with modest property impacts to provide direct access to HOV and/or new lanes in the freeway median. This direct access facility could be used by transit buses as well as auto traffic that would access the facility from Victory Boulevard.

  - US 101/I-405 Direct Connector Ramps- As shown in Figure 18, it may be possible to locate new freeway access ramps within the I-405/US 101 Freeway Interchange to connect to subway portals under the Sepulveda Pass. This configuration would feed traffic into the highway tunnel(s) from the I-405 as well as from the US 101 (Ventura Freeway) segment located west of the I-405. Similar concepts to these ramps would be possible to feed traffic into at-grade managed lanes or an aerial viaduct.

  - Santa Monica Boulevard/Olympic Boulevard Direct Connector Ramps- Locations where new ramps can be connected to the I-405 Freeway on the Westside are extremely limited due to sensitive adjacent land uses (hospitals, cemeteries, schools, homes) and limited available right-of-way. Figure 19 illustrates a location just south of the Santa Monica Boulevard Interchange where the freeway is elevated and additional Caltrans right-of-way could be used to provide direct freeway ramps and a parallel frontage roadway to distribute traffic from the freeway to several local arterials including Santa Monica, Olympic and Pico Boulevards. Such a configuration would allow traffic travelling to and from the freeway to be distributed to several east-west streets rather than a single street, thereby spreading the area of traffic impact. Transit buses accessing the freeway in this location would be located near the Metro Expo Line and future Metro Purple Line rail transit stations.

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Figure 16. Orange Line Direct Access Ramp Layout

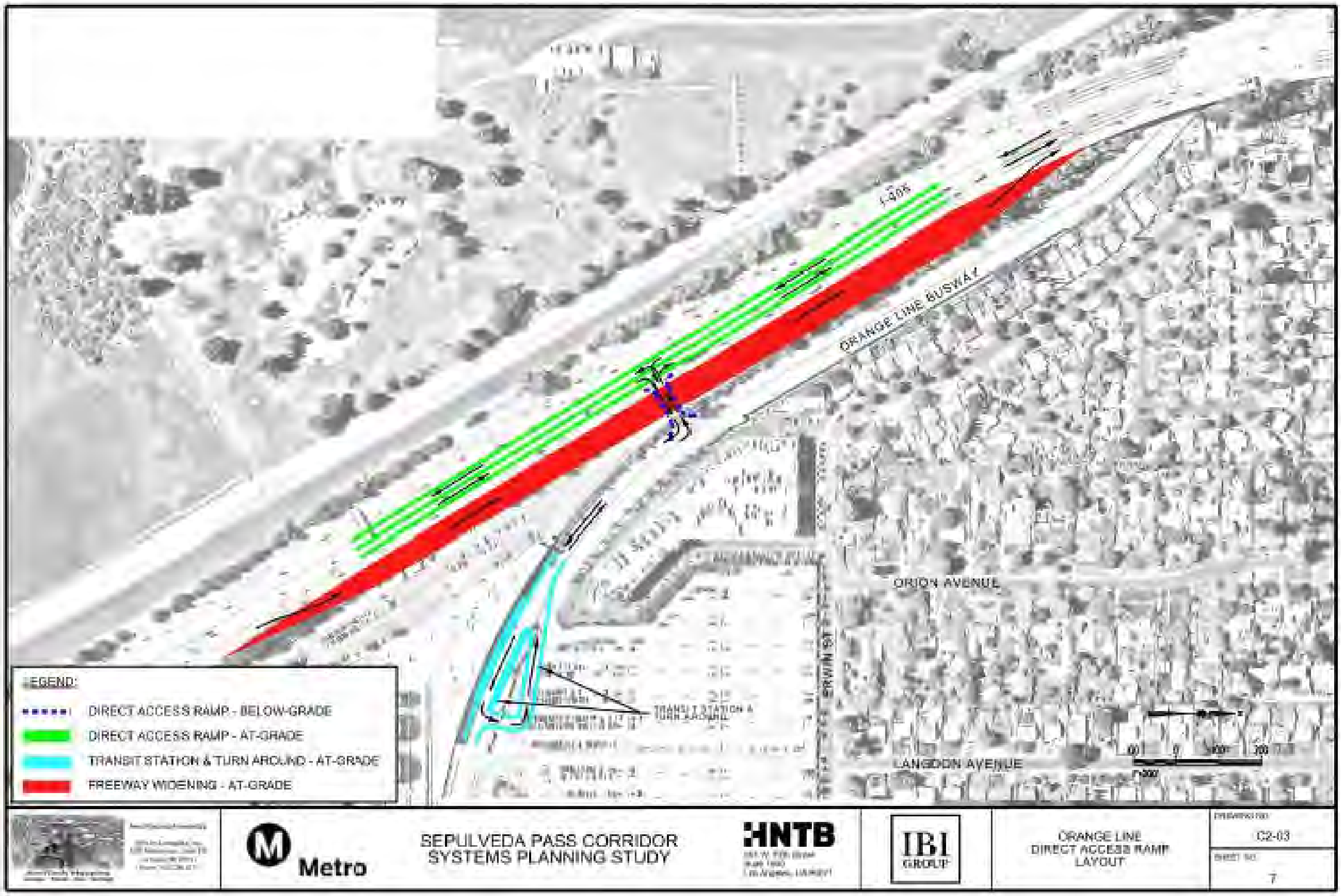


Figure 17. Orange Line Direct Access Ramp Cross Section

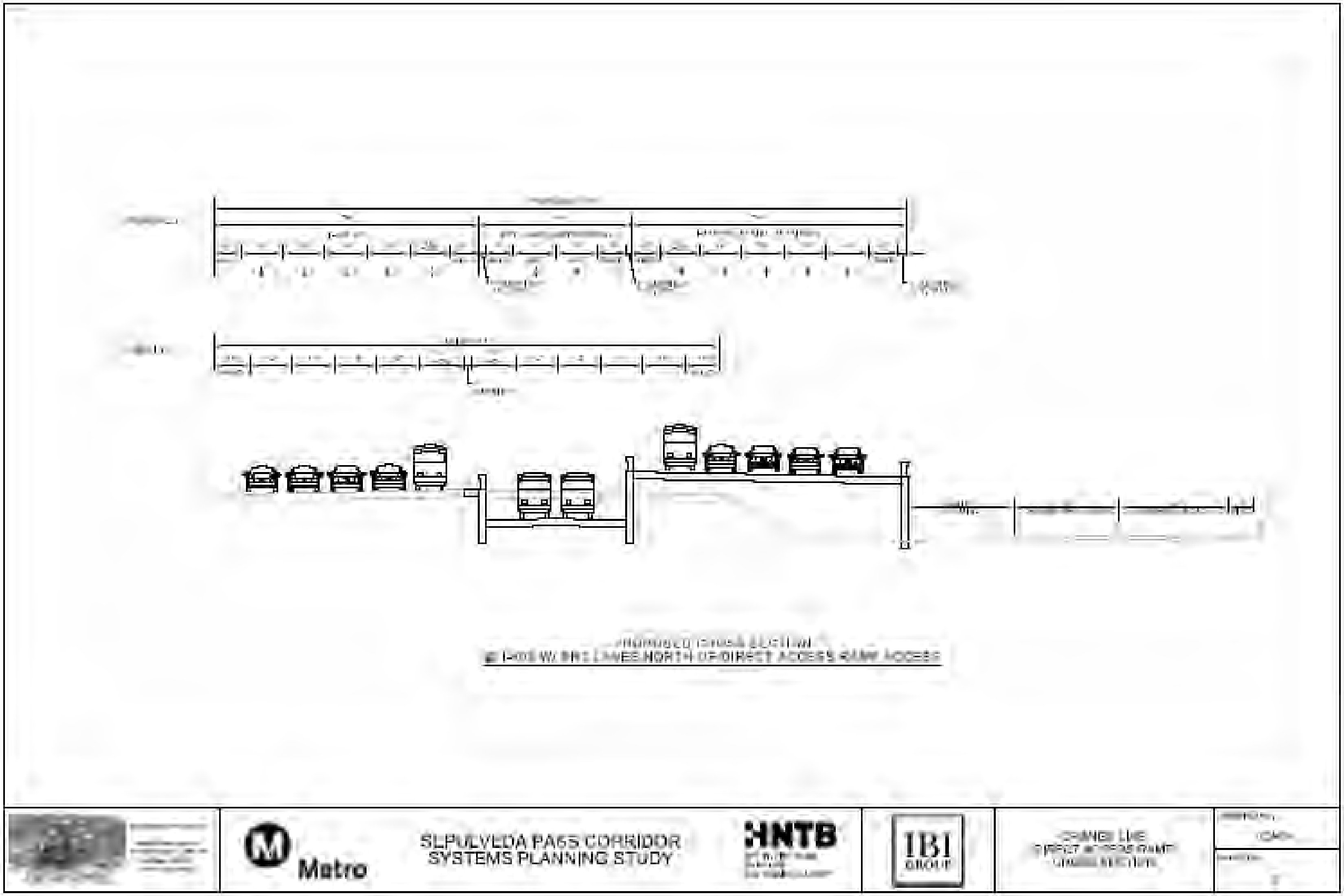


Figure 18. US 101 Direct Access Ramps and Tunnel Portal

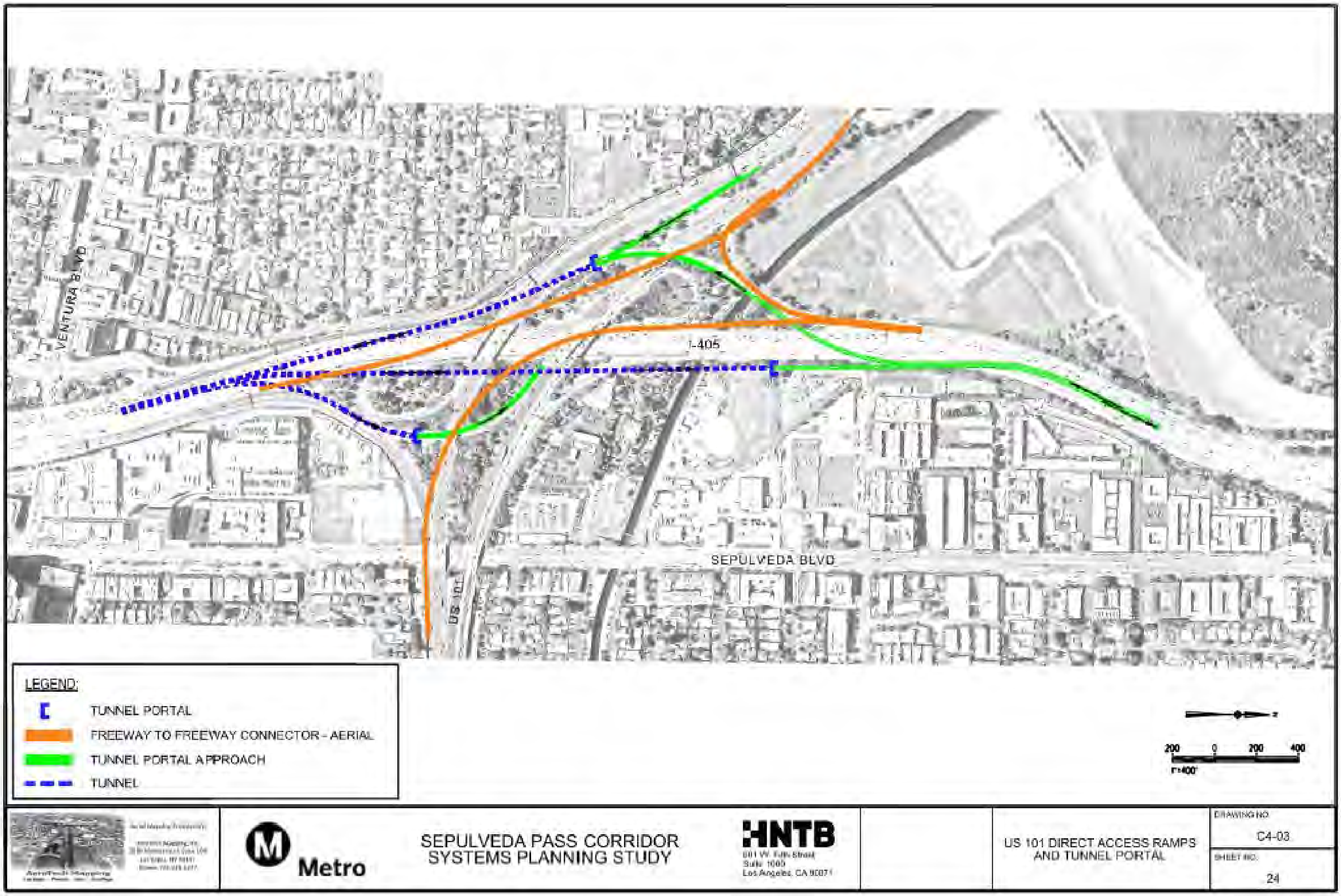


Figure 19. La Grange Direct Access Ramps

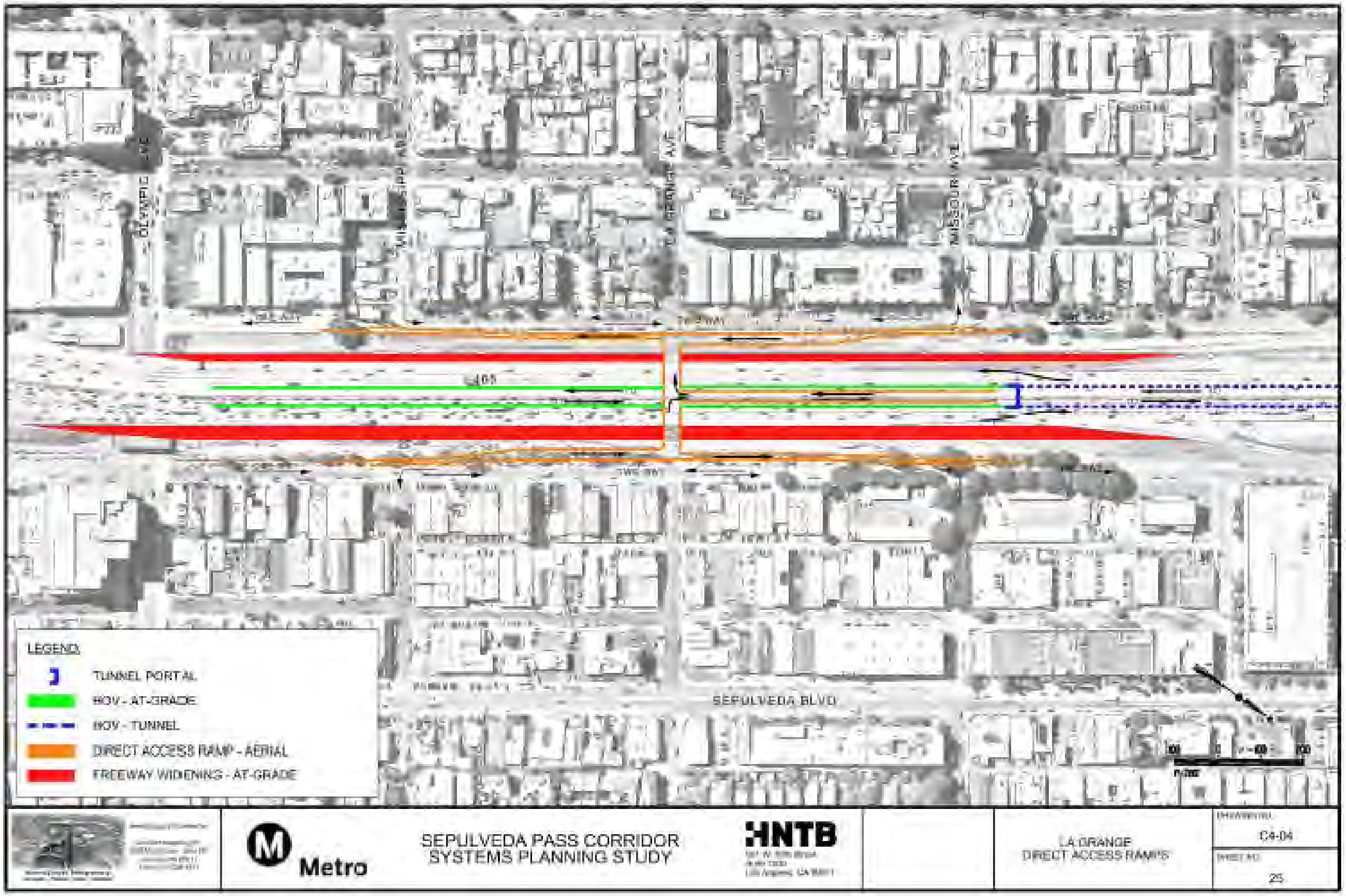
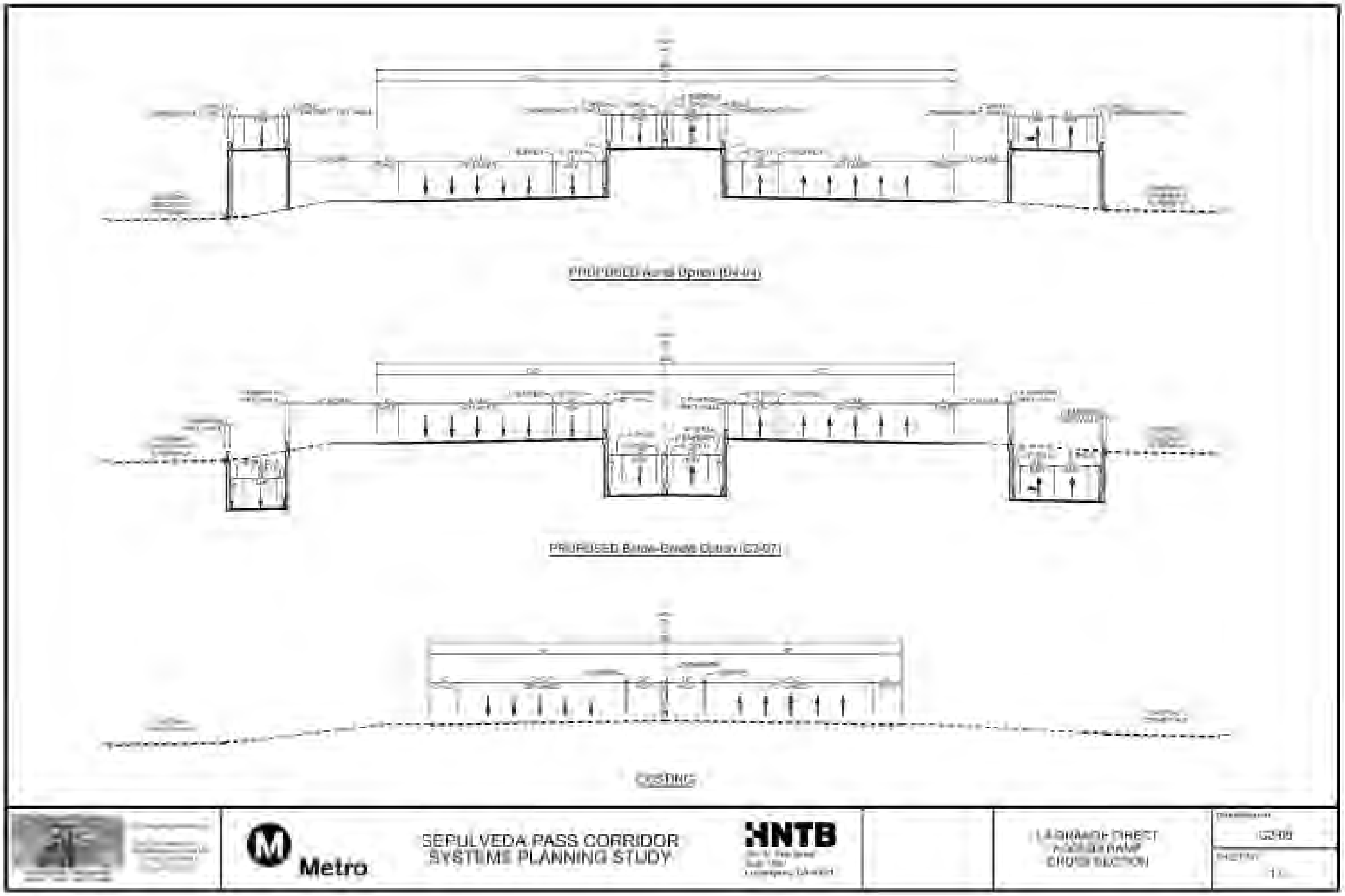


Figure 20. La Grange Direct Access Ramp Cross Section



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- **There is a strong case for exploring alternative financing strategies such as P3s. Because of the significant revenue potential associated with several proposed Sepulveda Pass improvements that include tolling options, alternative financing strategies such as P3 should be further explored in the event that traditional public financing is not sufficient to move the project forward in a timely manner. An at-grade Express Lanes project appears highly feasible at a modest capital cost, and could be implemented in a time frame comparable to the I-10 and I-110 ExpressLanes. Environmental clearance and construction, for example, was completed in approximately 24 months. Toll revenues from such an Express Lanes project could be used to offset financing costs for construction.**

  A more expensive capital project such as a rail or highway tunnel would require a much longer delivery timeline. Given the strong revenue potential for improvements that include toll options, there is a strong case for exploring P3 options for project delivery, financing, construction and maintenance. The Systems Planning Study, which considered multiple improvements in a 30-mile long corridor between Sylmar and LAX, found that the primary "bottleneck" where additional capacity is required is the 10-mile segment between US 101 and the I-10. Any phased strategy should place an initial project on this central segment of the corridor, with the possibility of extending north and south in subsequent phases.

Concepts 1 and 2 have fewer environmental issues. Concepts 3 through 6 have higher levels of environmental impact.

The environmental task focused on identifying fatal flaw issues that would potentially eliminate a systems concept from further consideration. To accomplish this, a literature review was conducted of existing environmental documents prepared for projects within the Sepulveda Pass Corridor, and an analysis was performed using focused Geographic Information Systems (GIS) analyses, database queries, and records searches.

Once the six concepts were identified, a preliminary analysis of the environmental challenges of each concept was conducted.

More detailed environmental analysis would occur as the concepts are better defined. As the concepts move forward, the Sepulveda Pass Corridor Project would need to undergo the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) review process, depending upon the type of funding being used for the project.

The major findings from the environmental task are presented below.

- **Concepts 1 and 2 could be done with minimal environmental impacts.** Concept 1 would involve virtually no disturbance to environmental resources and Concept 2 would have only minor disturbances. The only environmental concerns raised with Concept 1 are associated with the dedicated busway that may be located along the median of Van Nuys or Sepulveda Boulevards. Concept 1 would not cause any concerns for the natural environment and would have only very minor, intermittent effects on the physical environment associated with the noise of the buses traveling on the shoulder. Similar to Concept 1, Concept 2 would have only minor concerns for the physical environment related to air quality and noise as a result of traffic moving closer to receptors as vehicles move to use the outer pavement along the I-405. Concept 2 would only raise concerns for the natural environment, if widening outside of the existing pavement through the Sepulveda Pass were included.

- **Concepts with tunnel/direct access ramp components (Concepts 4, 5, 6, and Concept 2, depending on its final design) would have significant environmental impacts.** Concepts 4, 5, and 6 would raise concerns regarding the placement of ventilation outflows along the tunnel corridor. Additional environmental analysis would be needed as potential sites for ventilation are selected in order to avoid Section 4(f), natural, and community resources through the Sepulveda Pass. The tunnel portals and the location of direct access ramps would also need to be carefully designed in order to minimize and avoid, to the extent feasible, concerns related to local traffic circulation, localized noise and air quality effects, and potential property acquisitions. During construction, the hauling of excavated material away from the site would need to be carefully coordinated in order to best minimize potential noise and community effects.

- **Environmental impacts from concepts with above-ground components (Concepts 1, 2, 4, 5 and 6) would have similar noise, visual, air, and community issues.** Concepts 1 and 2 would have minor environmental concerns. The heavy rail option under Concept 5 would raise greater noise concerns than a light rail option and depending upon the power source for the trains, a heavy rail option may also raise additional air quality concerns. Grade separations for the options with rail would also need further environmental analysis for issues such as visual (design and heights of structures), noise (how would the potential elevation of the trains affect noise) and property acquisitions (grade separations could require additional right of way).

- **All concepts have potential community acceptance concerns.** The communities along the Sepulveda Pass and the I-405 Improvements Project currently under construction would be particularly sensitive to any new proposed project in the area. Community collaboration will be important in the development of design plans and environmental documents. Low-income and minority populations have been identified along the corridor, notably in the location of the direct access ramp near Roscoe Boulevard; environmental justice concerns would need to be further investigated.

- **Concepts 3 to 6 (and Concept 2, depending on its final design) have potential impact to Section 4(f) and Federal Lands.** The Sepulveda Basin, located northwest of the I-405/US 101 Interchange, as well as portions of the Santa Monica Mountains and associated recreational trails, contain several resources protected by Section 4(f), a federal law prohibiting USDOT from approving the use of land from publicly owned parks, wildlife refuge and multiple recreation areas, unless there is no feasible alternative to the use of the land or mitigations to minimize harm to public lands is included. The I-405/Wilshire Boulevard area has federal lands associated with the Veteran's Administration buildings and National cemetery, as well as some facilities and historical sites located on that federal land, which are potentially major constraints and/or are protected as historical sites under Section 4(f).

Next Steps

The concepts analyzed in this eight-month study represent a preliminary assessment of potential improvements in the Sepulveda Pass Corridor. In this Systems Planning phase, a wide range of general assumptions were made. The assumptions, while sufficient for the purposes of this study, do require further analysis in order to better inform planning and system design decisions. For example, the travel demand forecasts analysis would benefit from more detailed value of travel time savings data.

There are several other areas that merit further examination in the subsequent phases of work:

1. Continue to coordinate with the East San Fernando Valley Transit Corridor Study, Westside Mobility Study, and Airport Metro Connector Study to optimize transit connections in the corridor and prepare a phased implementation plan.
2. Conduct a more detailed analysis of systems planning concepts (including alignment and technology options) as part of an alternative analysis and environmental document.
3. Solicit industry comment on the scope of a P3 concessionaire contract as it relates to existing conditions, minimum facility design requirements, performance specifications, financial/revenue assumptions and other considerations.
4. Conduct a willingness to pay survey of I-405 corridor users to calibrate the toll model coefficients based on corridor specific traveler attributes.
5. Further refine revenue and financial models to calculate cash-flow and net present value.
6. Further analyze tunnel portals and direct access ramps, particularly those potentially located near La Grange Avenue to assess potential localized traffic, noise, visual, and air quality concerns.

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2.0 – MOBILITY PROBLEM DEFINITION

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Sepulveda Pass Corridor Systems Planning Study

Mobility Problem Definition

Prepared for:

Prepared by:

Parsons Brinckerhoff
in collaboration with HNTB, IBI Group, Atwell Consulting, and The Robert Group

May 2012

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1.0 INTRODUCTION

The purpose of the Mobility Problem Definition Whitepaper is to document and assess the current Study Area conditions and mobility problem through the Sepulveda Pass and to lay a foundation for the evaluation of systems planning concepts to be evaluated in later tasks. Specifically, this whitepaper provides a definition of the study corridor, including boundaries, demographic context, travel markets and characteristics, land use patterns, existing and planned infrastructure, as well as quantifies the transportation performance and deficiencies in the corridor.

2.0 BACKGROUND

The Sepulveda Pass Corridor Systems Planning Study is a high-level transportation planning systems study being conducted to identify a range of conceptual transportation improvements for easing travel along the I-405 corridor, generally between Sylmar and Los Angeles International Airport (LAX). The work will enable the Los Angeles County Metropolitan Transportation Authority (Metro) to identify a range of high-level systems planning concepts that can be used to form the basis for a future Alternatives Analysis Study and environmental clearance, as well as to possibly solicit for interest in Public Private Partnerships.

The study will evaluate multimodal options and consider both highway and transit improvements. For transit, the study will identify potential connections to other existing and future fixed guideway transit lines that traverse the Study Area, including the Ventura and Antelope Valley Metrolink Lines, the Metro Orange Line Busway, the Metro Purple Line Subway, the Exposition Light Rail Line, the Metro Green Line, the Metro Crenshaw/LAX Line and potential connections to the East San Fernando Valley Transit Corridor being examined on either Sepulveda or Van Nuys Boulevard, or a combination, which is currently in the draft environmental clearance phase.

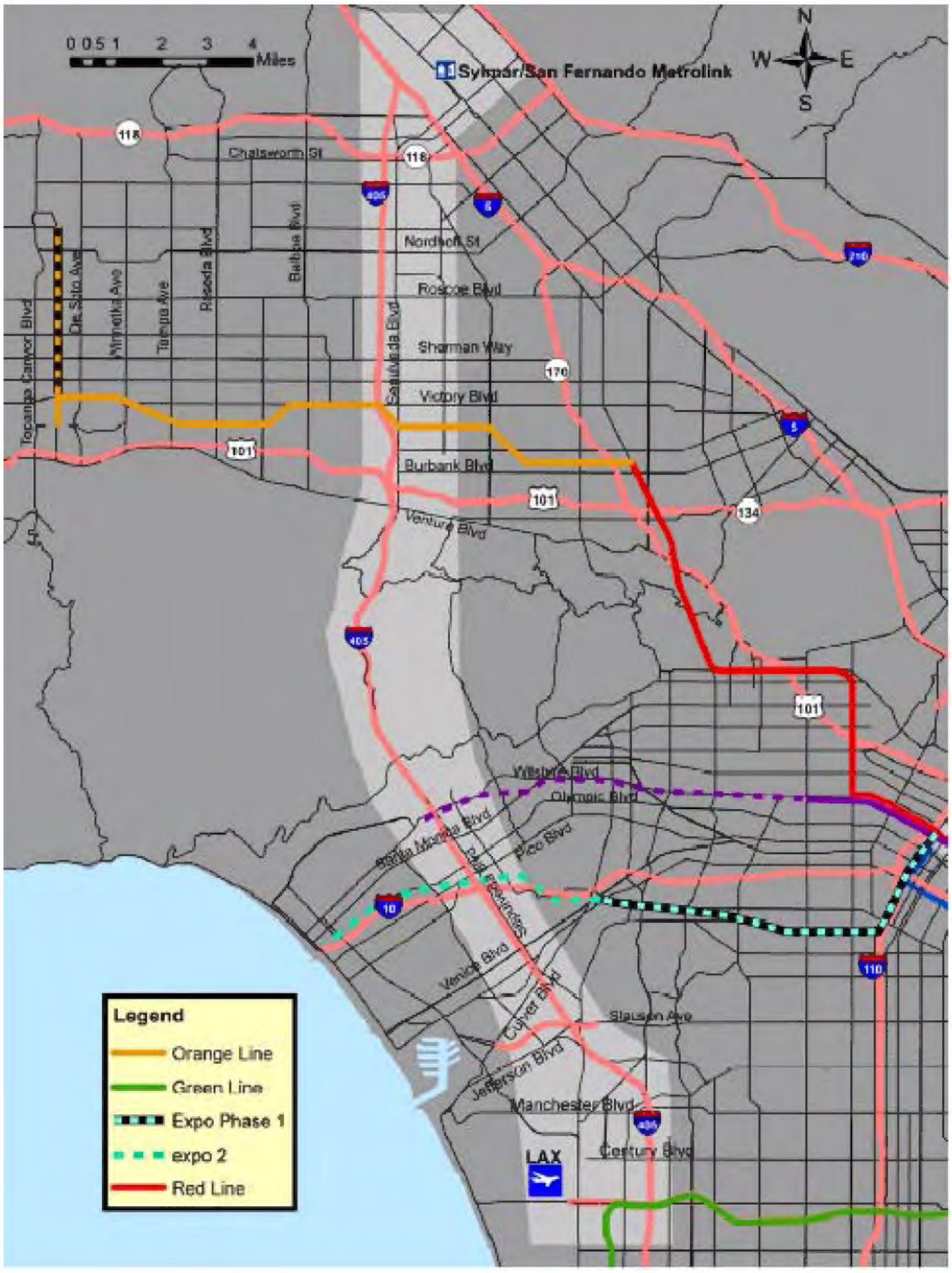
For highway options, the study will consider various systems planning concepts including, but not limited to, direct ramp access to the high-occupancy vehicle (HOV) lanes, additional capacity through managed lanes, toll facilities and capital improvements including grade-separated guideway/tunnel systems planning concepts. A multi-modal grade separated transit and express toll road facility will also be explored.

3.0 APPROACH

In order to define the study corridor boundaries and identify the deficiencies within the corridor, the study team compiled relevant data from existing references and trip table data from the Metro and SCAG regional models. As part of the Study Corridor Definition task, the study team refined the initial study corridor limits defined by Metro.

The study corridor initially defined by Metro extended from Sylmar in the north to Los Angeles International Airport (LAX) in the south (Figure 1). The corridor, as originally defined, is approximately 30 miles in length and is roughly 1 to 1.5 miles on either side of the I-405, with the boundary slightly wider to the east from Sylmar south to SR-90, where the proportion reverses to include LAX.

Figure 1: Study Corridor as Presented in RFP



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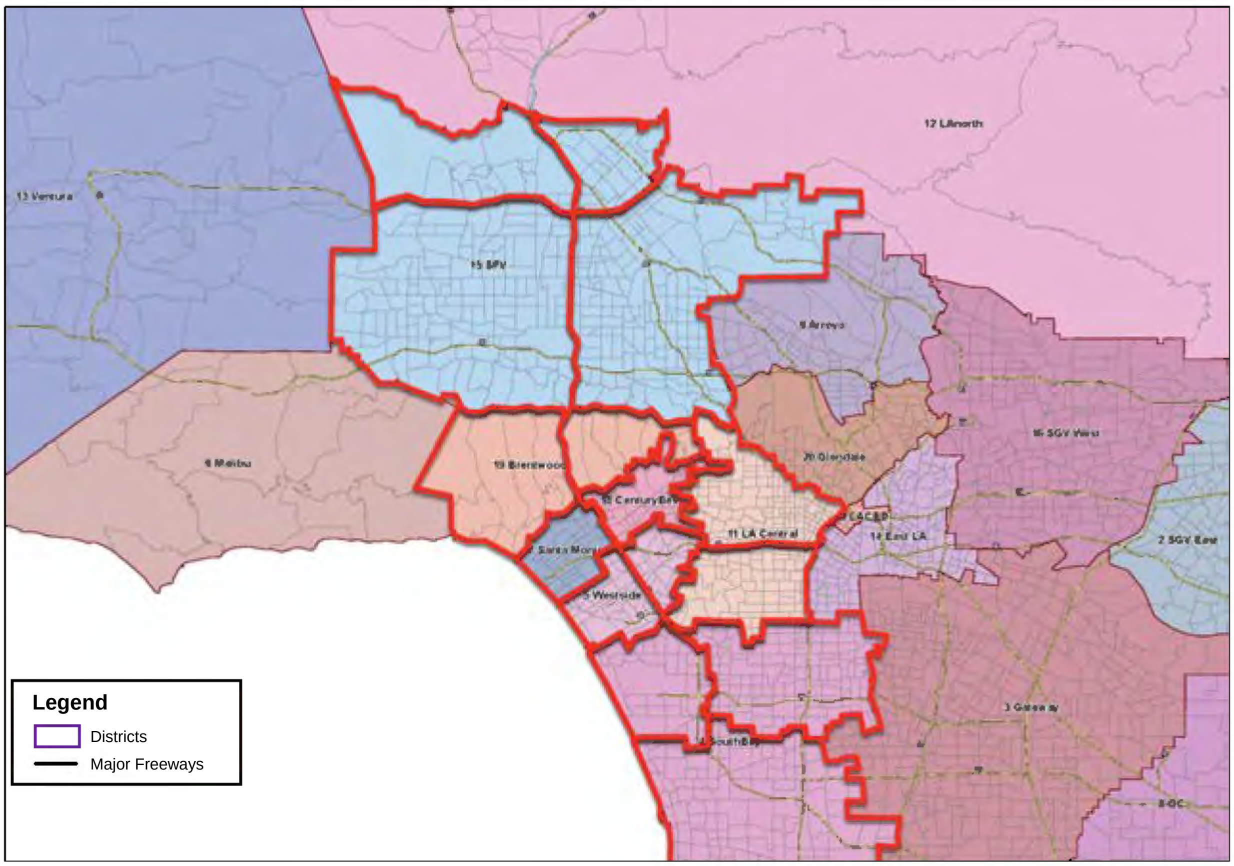
The study team designated 15 study corridor districts that encompass the approximate 30-mile study area. The 15 study districts were created by aggregating transportation analysis zones (TAZs), and consistency was maintained with the larger subregional districts found in Metro's current model (Figure 2)[1]. Trip tables were aggregated to summarize the district-to-district home-based work person trip volumes. In addition, select link analyses were performed for the AM peak in both the southbound and northbound directions of the I-405 at Moraga Drive (just north of Sunset Boulevard at the south end of the Sepulveda Pass), which was selected because all Sepulveda Pass trips via the I-405 must pass through this location.

Figure 2: Sepulveda Pass Districts



Aside from the analyzing trips through the Sepulveda Pass Corridor, the proposed study corridor boundary took into account logical connections with the current and planned transit and highway networks, including the Westside Subway Extension, Exposition Line, East San Fernando Valley Transit Corridor, Crenshaw/LAX Line, and Metrolink. The locations of future rail stations and transit hubs were considered in establishing the limits of the corridor. Consideration was also given to natural and jurisdictional boundaries in defining the study, including factors such as topography, land uses, population and employment densities, major

[1] Model Districts 4, 5, 11, 15, and 19 were subdivided to enable a targeted analysis of certain areas. As a result, there are 28 model districts instead of 20.

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activity centers and employment sites, and areas of physical or institutional constraints, such as areas of sensitive stakeholder and community concerns.

Based on the proposed study corridor boundaries, (as discussed further in Section 4), a four-step process was used to evaluate the study area as follows.

1. The study team analyzed the key travel markets and trip patterns at the district and at select link levels. We examined the current (2006) and projected (2035) population and employment densities in the area, based on updated SCAG socioeconomic data. We then examined demographic data including median household income, auto ownership rates, and transit demand/mode share.
2. Select link analyses were performed for key segments along the I-405 Freeway and Sepulveda Boulevard in order to assess where trips utilizing the Sepulveda Pass originate and where they are destined. The select link analysis augments the district-to-district travel market analysis by analyzing vehicle trips traversing a particular segment along the I-405 and Sepulveda Boulevard and how those trips are distributed across the highway and arterial networks. We also looked at congested travel times for the three districts that have the highest trip attraction to production ratios. This level of detail also gave the study team a better understanding of the travel characteristics of the corridor and its mobility problems.
3. We examined the existing and planned transit and roadway improvements within the corridor to identify concepts already planned. This information is helpful to understand the types of improvements already considered and the right-of-way constraints.
4. We examined the performance of the existing highway and transit system, in order to define the mobility problems that are to be solved by potential system planning concepts. We examined such performance measures as freeway traffic flow, vehicle hours of delay, level of service, speeds, travel time, and travel time variability, as well as HOV lane utilization, travel time, and travel time variability. It should be noted that much of the traffic data presented in this report is from a model that was validated at the regional level and not at the corridor level, which is being conducted as part of the No-Build model run being conducted by the demand modeling team. In addition, transit speeds and reliability were examined in order to quantify the Study Area conditions and the mobility problem and to lay the foundation for the evaluation of systems planning concepts.

4.0 PROPOSED STUDY CORRIDOR BOUNDARIES

Figure 3 is the proposed Study Area, which remains approximately 30 miles in length, stretching from the I-5/I-405 in Sylmar to the north along the I-405 to the I-105 to the south. The length of the corridor reflects the high volume of long-distance travel through the Sepulveda Pass. A widened east-west boundary of approximately two to five miles is proposed in order to capture key activity centers, future transit connections, and major travel sheds (see Figure 3).

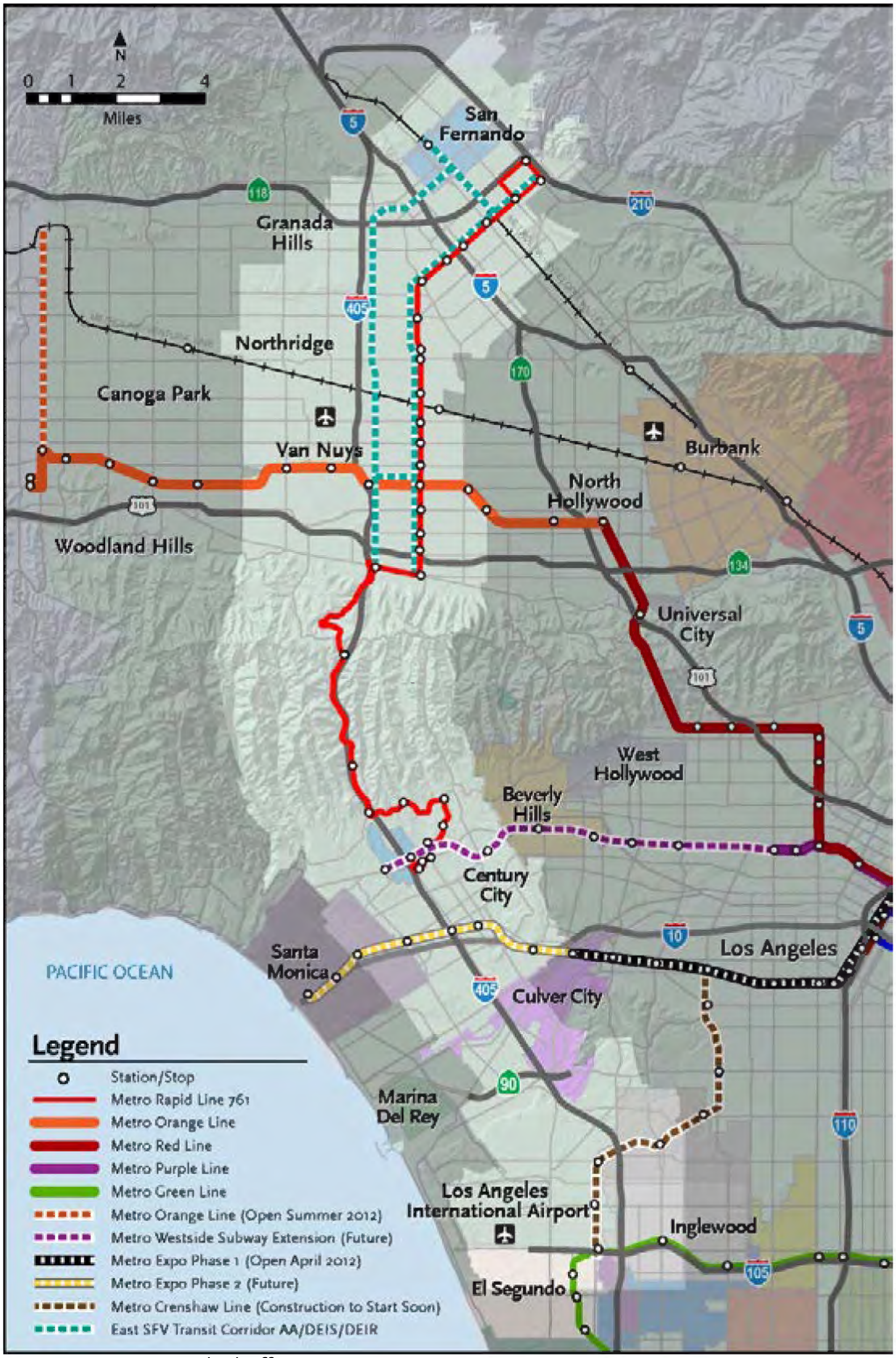
The Study Area encompasses the following:

- Highway connections — potential connections to the I-5, SR 118, and I-105
- Transit connections — potential connections to Metrolink Antelope Valley Line, Metrolink Ventura Line, Metro East San Fernando Valley Transit Corridor, Metro Rapid 761, Metro Orange Line, Metro Westside Subway Extension, Metro Expo Line, Metro Crenshaw/LAX Line, and Metro Green Line
- Major travel sheds — includes those highway and arterial connections that serve the predominant trip pattern from the west San Fernando Valley
- Activity centers — includes the major activity centers for both employment and leisure in the area of interest
- Third-party stakeholders — includes the major third-party stakeholders in the area of interest

The approximate boundaries of the proposed Study Area are:

- North – I-5/I-405 Freeway juncture in Sylmar;
- East – Century City;
- South – LAX/El Segundo; and
- West – White Oak Avenue in the San Fernando Valley; Lincoln Boulevard in Westside/South Bay

Figure 3: Proposed Study Area



Source: Parsons Brinckerhoff, 2012

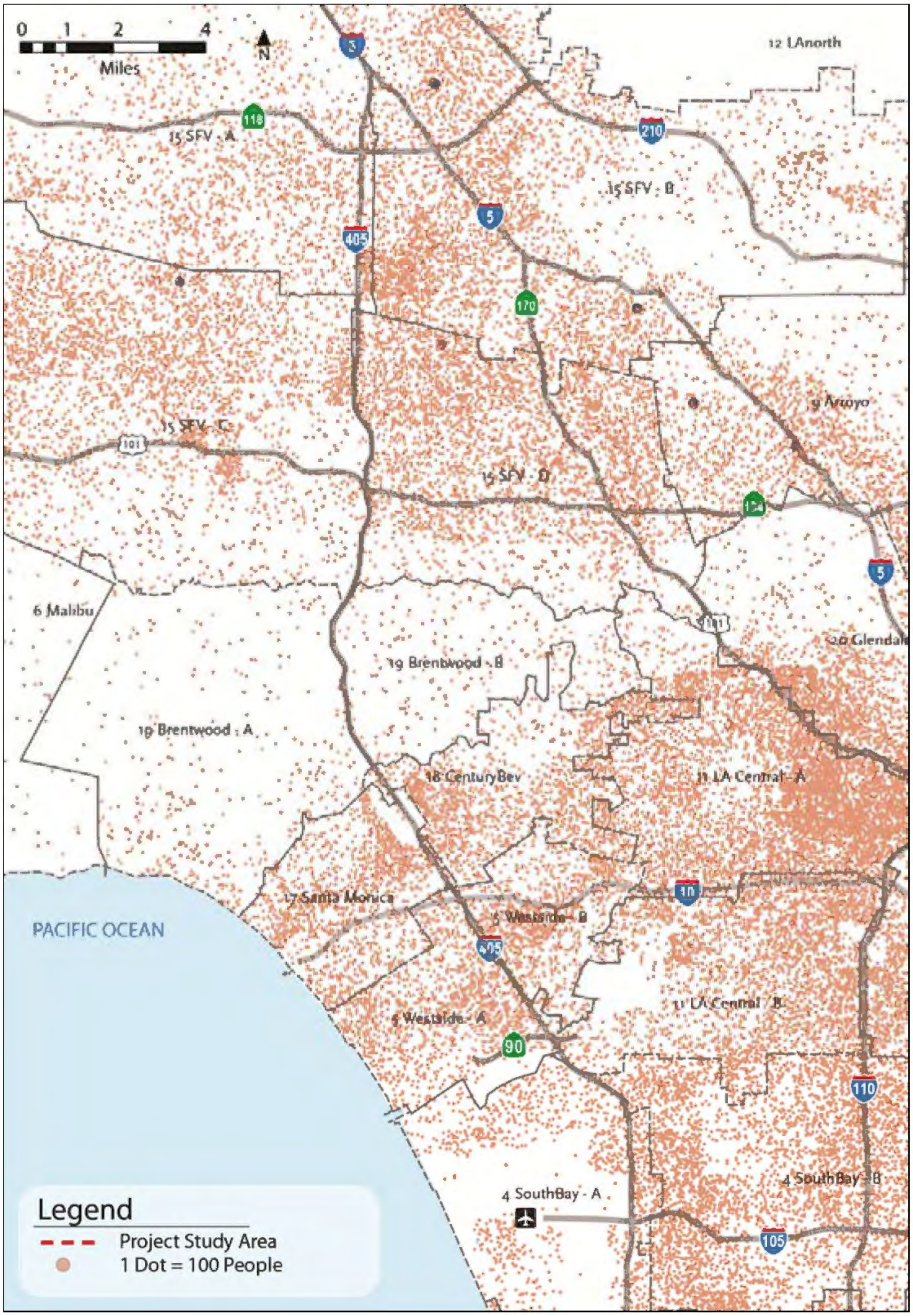
5.0 DEMOGRAPHIC CONTEXT

5.1 Population and Employment

Figure 4 and Figure 5 depict 2006 population and employment density, respectively, which correspond to land use patterns. This information is important because it provides an indication of where population and jobs are concentrated in the Sepulveda Pass area, and where expanded transit service is potentially needed.

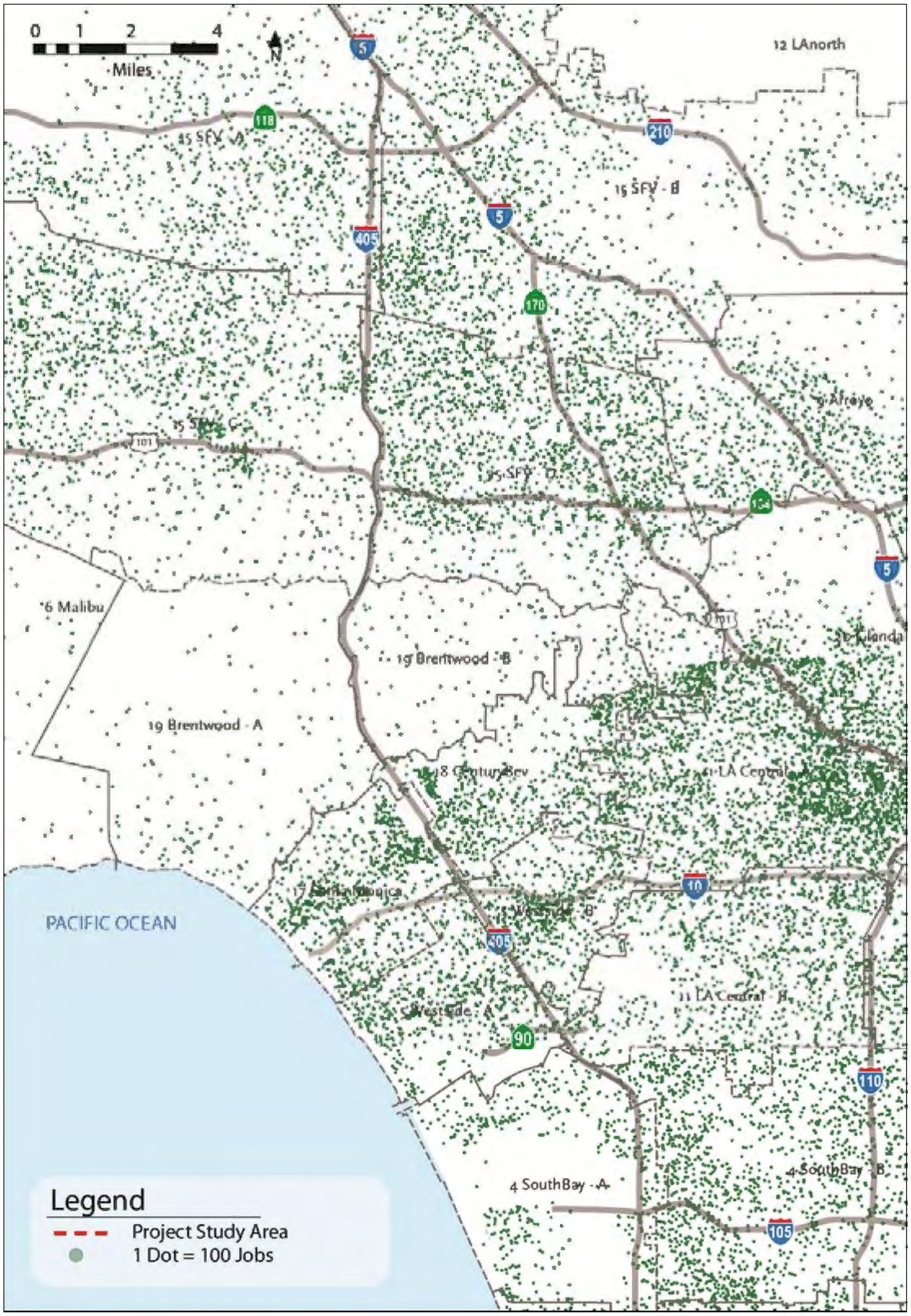
Because travel demand is correlated with the location of housing and jobs, population and employment density data are useful for identifying areas where improvements to the transportation system are likely to have the greatest benefit.

Figure 4: Population Density by Modified Metro Model District, 2006



Note: Model Districts 4, 5, 11, 15, and 19 were subdivided to enable a targeted analysis of certain areas. As a result, there are 28 model districts instead of 20.

Figure 5: Employment Density by Modified Metro Model, 2006



Note: Model Districts 4, 5, 11, 15, and 19 were subdivided to enable a targeted analysis of certain areas. As a result, there are 28 model districts instead of 20.

Of the 28 Metro Model Districts (modified), twelve have a population density higher than the regional average (6,950 people per square mile). Of these twelve, eight are districts in the Project Area, underscoring the fact that the I-405 straddles some of the Los Angeles region's most populous areas. Table 1 lists the districts with above-average population densities; districts in the Project Area are in boldface.

Table 1: Population Density of Metro Model Districts with Above-Average Density

Metro District* (Bold indicates districts in Area of Interest)	**Population Density per square mile (2006)**
11 LA Central - A	**20,900**
4 South Bay - B	**14,400**
14 East LA	14,000
11 LA Central - B	**13,000**
5 Westside - B	**11,400**
10 LA CBD	10,900
18 Century/Beverly	**10,900**
5 Westside - A	**10,100**
17 Santa Monica	**10,500**
15 San Fernando Valley - D	**9,900**
20 Glendale	9,000
3 Gateway	8,400
SCAG Region Average	*6,950*

Source: Metro 2006

Of the 28 Metro Model districts (modified), five have employment densities higher than the SCAG regional average (6,240 jobs per square mile). Of these five high-density employment districts, three are in the Sepulveda Pass Project Area, underscoring how job-rich the Project Area is. Table 2 lists the districts with above-average employment density; districts in or adjacent to the Sepulveda Pass are in boldface.

Table 2: Employment Density of Metro Model Districts with Above-Average Density

Metro District* (Bold indicates districts in Area of Interest)	**Employment Density per square mile (2006)**
10 LA CBD	75,400
18 Century/Beverly	**14,700**
11 LA Central - A	**10,700**
17 Santa Monica	**10,400**
14 East LA	8,400
SCAG Region Average	*6,240*

Source: Metro 2006

5.2 Median Household Income

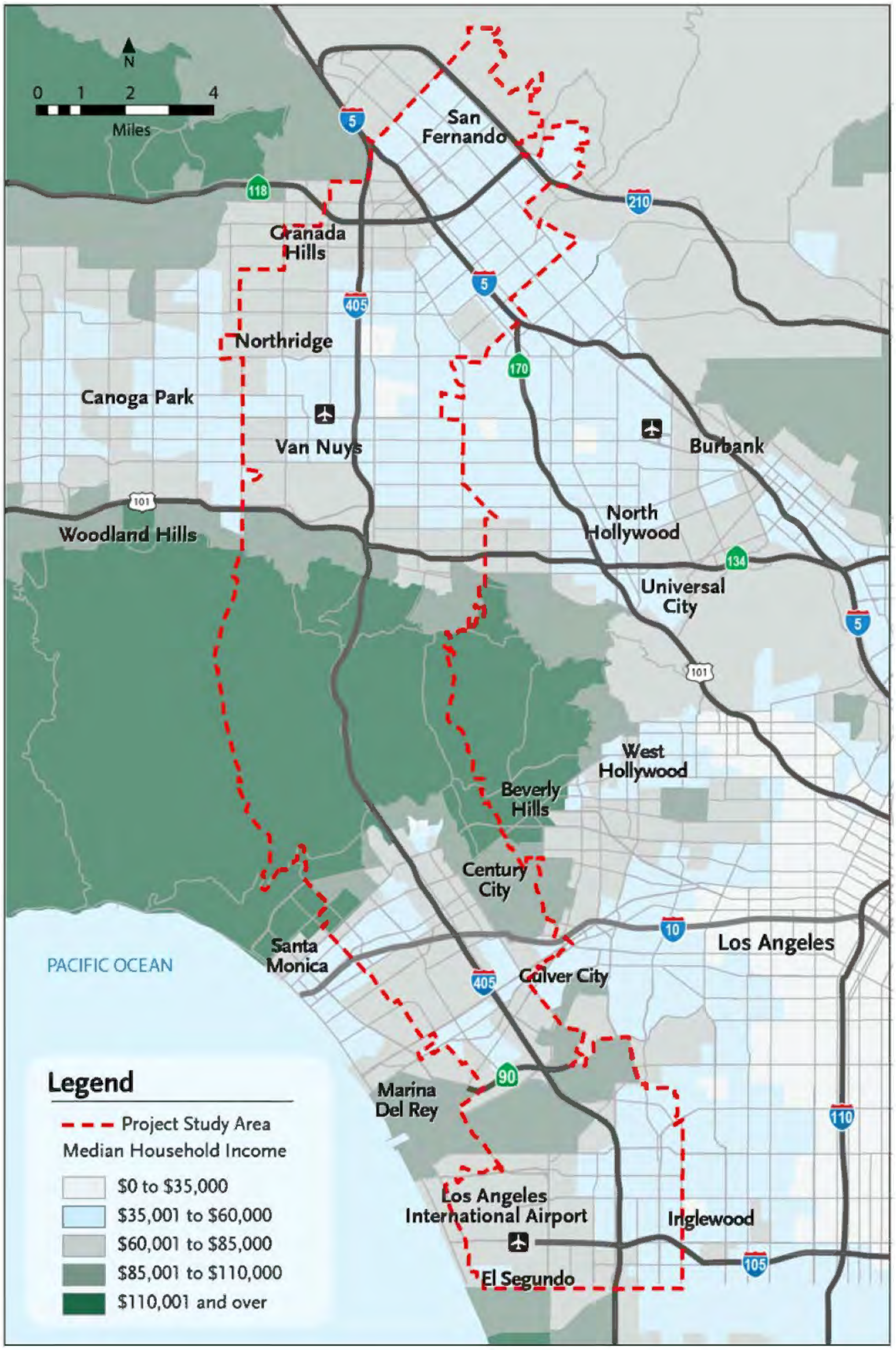
Median Household Income in the Sepulveda Pass Study Area varies greatly, representing the diversity of the region and underscoring the different travel market needs. Lower income households are correlated with a higher rate of transit usage, and automobile ownership is also directly correlated with income. Higher incomes are generally correlated with greater auto ownership and access.

As Figure 6 shows, most zones within the San Fernando Valley have median incomes under $60,000 (the approximate average household income for Los Angeles City).

Income distribution in the Westside of the Study Area skews higher, with the predominant median household income falling between $60,001 and $85,000, which is above the Los Angeles average. Parts of Century City, Beverly Hills, and Santa Monica have median household incomes in the highest income category of $110,001 and above.

The South side of the Study Area is a mix of median household income ranging from $35,001, well below the city average, to $110,000, well above it.

Figure 6: Median Household Income by TAZ (2006) in 2008 Dollars

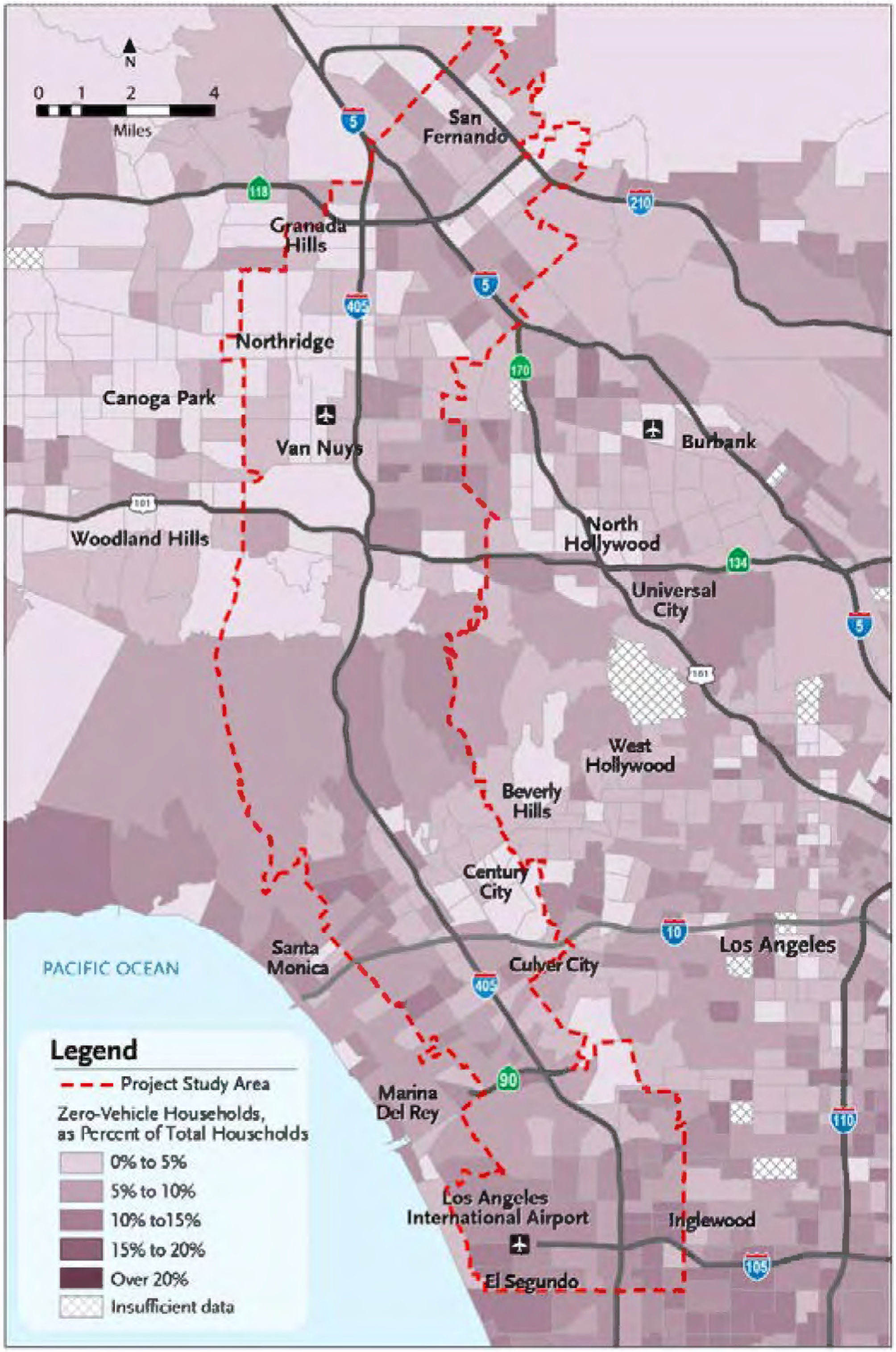


Source: Metro 2006 base year model

5.3 Automobile Ownership and Zero-Vehicle Households

Figure 7 shows the percentage of households with zero vehicles by TAZ. Dark shading indicates a high proportion of zero-vehicle households (over 20 percent), which suggests locations where transit dependency is likely to be highest. High concentrations of zero-vehicle households are found in the San Fernando Valley east of I-405 (North Hills East, Panorama City, and Van Nuys), and in the Westside, Mar Vista, and El Segundo.

Figure 7: Zero-Car Households as Percentage of Total Households (2006)



Source: SCAG 2008 RTP base year model

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5.4 Transit Mode Share

Table 3 depicts the transit mode share of Sepulveda Pass area travelers, by district. Transit mode shares are expressed both as a proportion of all travelers in the Sepulveda Pass area in the morning and evening peaks (6:00 AM to 9:00 AM, 3:00 PM to 7:00 PM), as well as a proportion of daily travelers in the Sepulveda Pass Area. Transit mode shares vary from less than 1 percent to about 11 percent. The district with the highest peak transit mode share is LA Central A (11.1 percent), which is the northern portion of District 11. The district with the second highest peak transit mode share is LA Central B (7.3 percent) – located just below LA Central A. The South Bay B District has the third highest transit mode share with 7.1 percent of travelers using transit. San Fernando Valley B District has the next highest peak transit mode share with 5.1 percent, while other San Fernando Valley districts have between 2.4 and 3.7 percent peak transit mode share. Transit mode share in the Westside districts ranges between 2.5 percent and 4.9 percent. Districts with the lowest mode share (less than 1 percent) are: Brentwood A and B.

Table 3: Percentage of Peak and Daily Trips Taken by Transit, by District (2006)

District	Peak	Daily
11 LA Central - A	11.1	8.9
11 LA Central - B	7.3	6.1
4 South Bay - B	7.1	5.8
15 SFV - D	5.1	4.0
5 Westside - B	4.9	4.0
17 Santa Monica	4.7	3.8
18 Century Beverly	4.1	3.2
5 Westside - A	3.7	3.1
15 SFV - B	3.7	3.1
15 SFV - C	2.9	2.3
4 South Bay - A	2.6	2.0
4 South Bay - C	2.5	2.0
15 SFV - A	2.4	1.8
19 Brentwood - B	0.8	0.7
19 Brentwood - A	0.6	0.6

Source: Metro 2006 base year model

6.0 TRAVEL MARKETS & CHARACTERISTICS

6.1 District to District Person Trip Flows

6.1.1 San Fernando Valley District Productions

Looking at district-to-district trip productions within the 15 study districts, the four San Fernando Valley districts comprised of SFV-A, SFV-B, SFV-C, and SFV-D, produces 35 percent of the study district person trips. Of southbound trips from the San Fernando Valley and US 101, the majority are destined to the Santa Monica, Century/Beverly/L.A. Central-A districts.

Figure 8 shows that 19 percent of the trips start and end within SFV-A district, 8 percent head towards SFV-B, 24 percent head to SFV-C, and 9 percent head towards SFV-D. Approximately 12 percent combined head towards Santa Monica, Century/Beverly, and LA Central - A.

Figure 8: Distribution of Daily 2006 Home-Based Work (HBW) Trips from SFV-A District

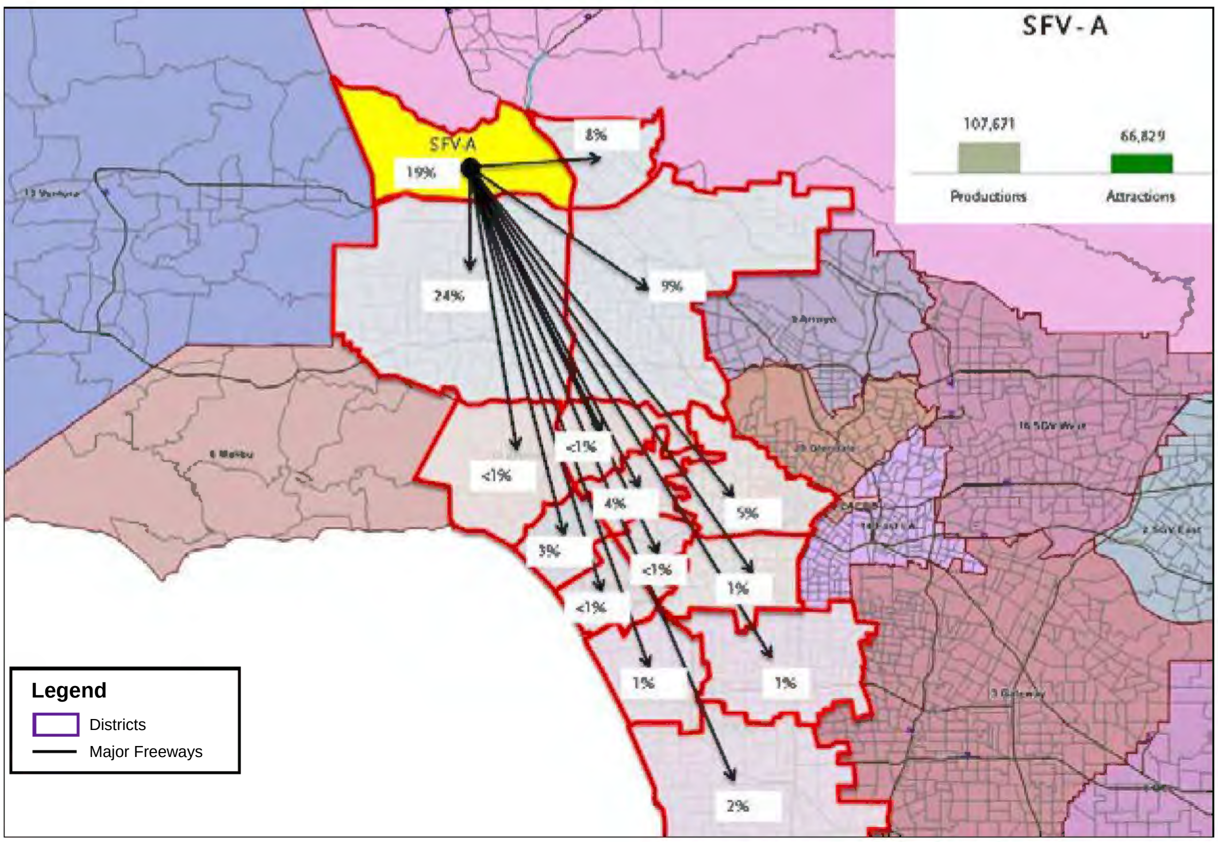
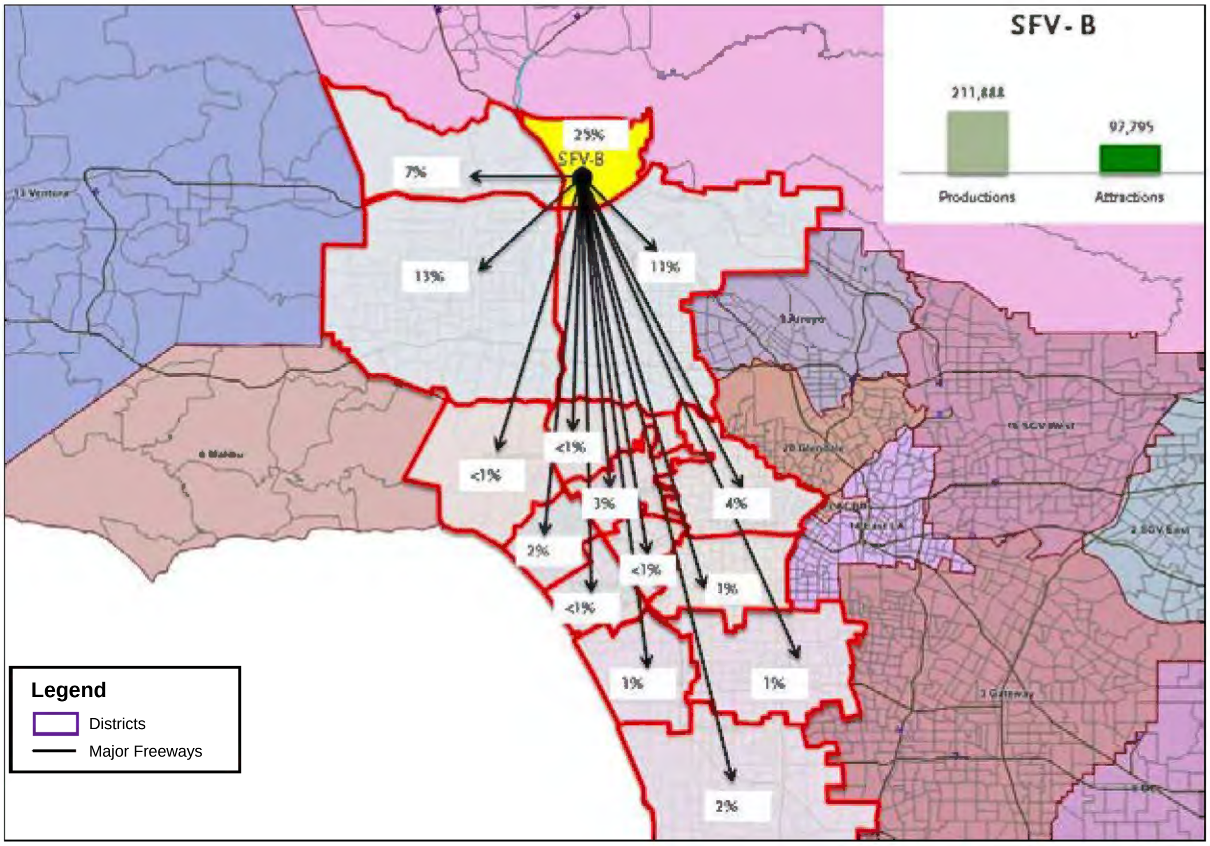


Figure 9 shows that 25 percent of the trips start and end within SFV-B district, 7 percent head towards SFV-A, 13 percent head to SFV-C, and 11 percent head towards SFV-D. Approximately 9 percent head towards Santa Monica, Century/Beverly, and LA Central - A.

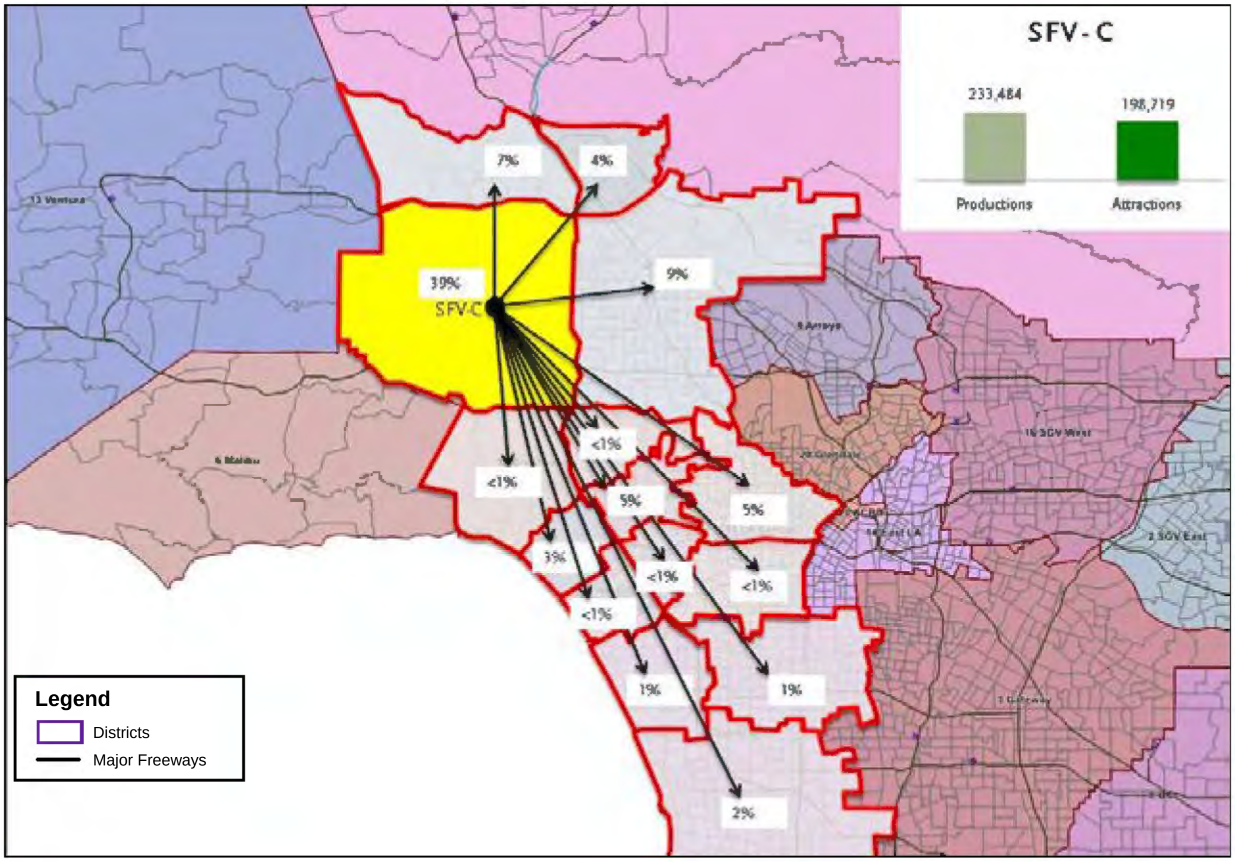
Figure 9: Distribution of Daily 2006 Home-Based Work (HBW) Trips from SFV-B District



Source: Metro 2006 base year model trip tables

Figure 10 shows that 39 percent of the trips start and end within SFV-C district, 7 percent head towards SFV-A, 4 percent head to SFV-B, and 9 percent head towards SFV-D. Approximately 13 percent combined head towards Santa Monica, Century/Beverly, and LA Central - A.

Figure 10: Distribution of Daily 2006 Home-Based Work (HBW) Trips from SFV-C District



Source: Metro 2006 base year model trip tables

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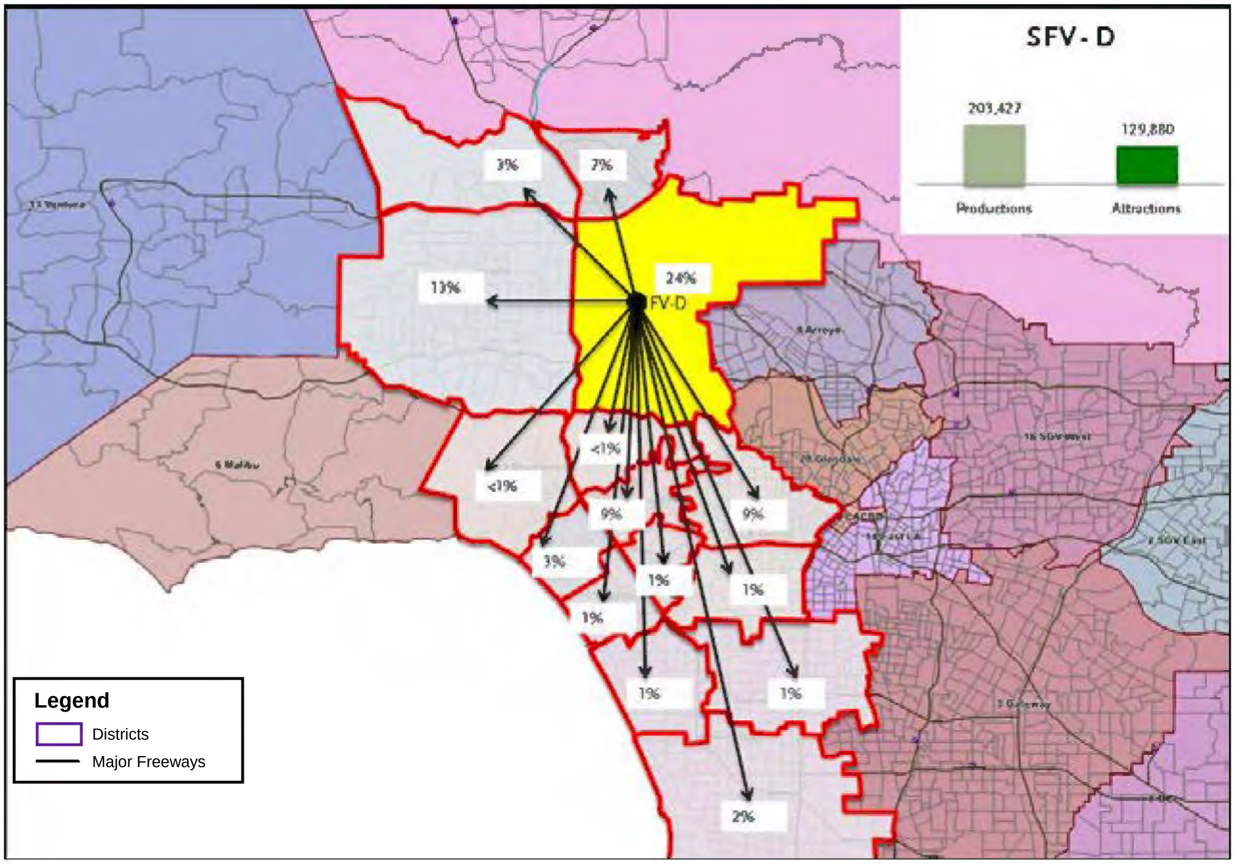
Figure 11 shows that 24 percent of the trips start and end within SFV-D district, 3 percent head towards SFV-A, 7 percent head to SFV-B, and 13 percent head towards SFV-C. Approximately 21 percent combined head towards Santa Monica/Century/Beverly and LA Central - A.

Figure 11: Distribution of Daily 2006 Home-Based Work (HBW) Trips from SFV-D District



Source: Metro 2006 base year model trip tables

6.1.2 District Trip Attractions

Districts with more attractions than productions (i.e., where the ratio of attractions to productions is greater than 1.0) indicate where a high volume of travel demand is generated and where system improvements could have the greatest effect. The three districts with attraction/production ratios above 1.0 are District 18 Century/Beverly (2.04), District 4 South Bay - A (1.89), and District 17 Santa Monica (1.36).

Table 4 through Table 6 show where the trips to these districts originate as a proportion of total daily trips to each district, in order of magnitude. Figure 12 through Figure 14 show these data geographically.

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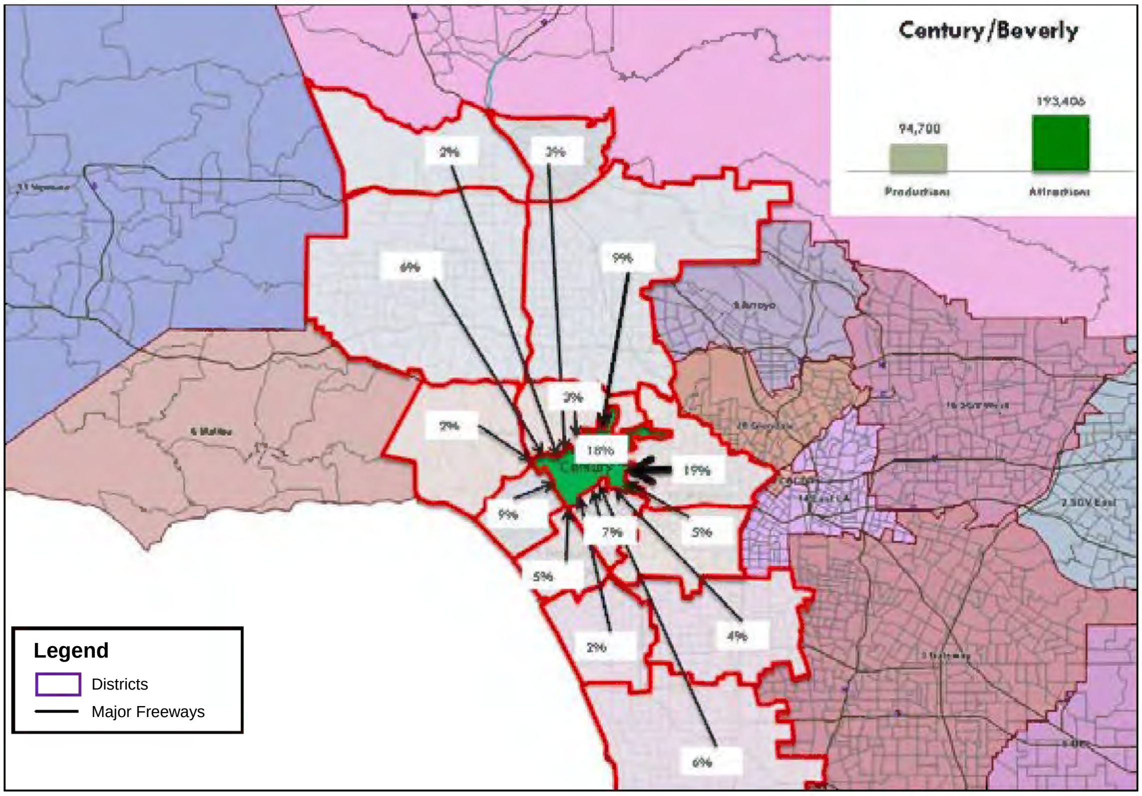
Figure 12: Origin and Proportion of Daily Trips to District 18 Century Beverly from Other Districts

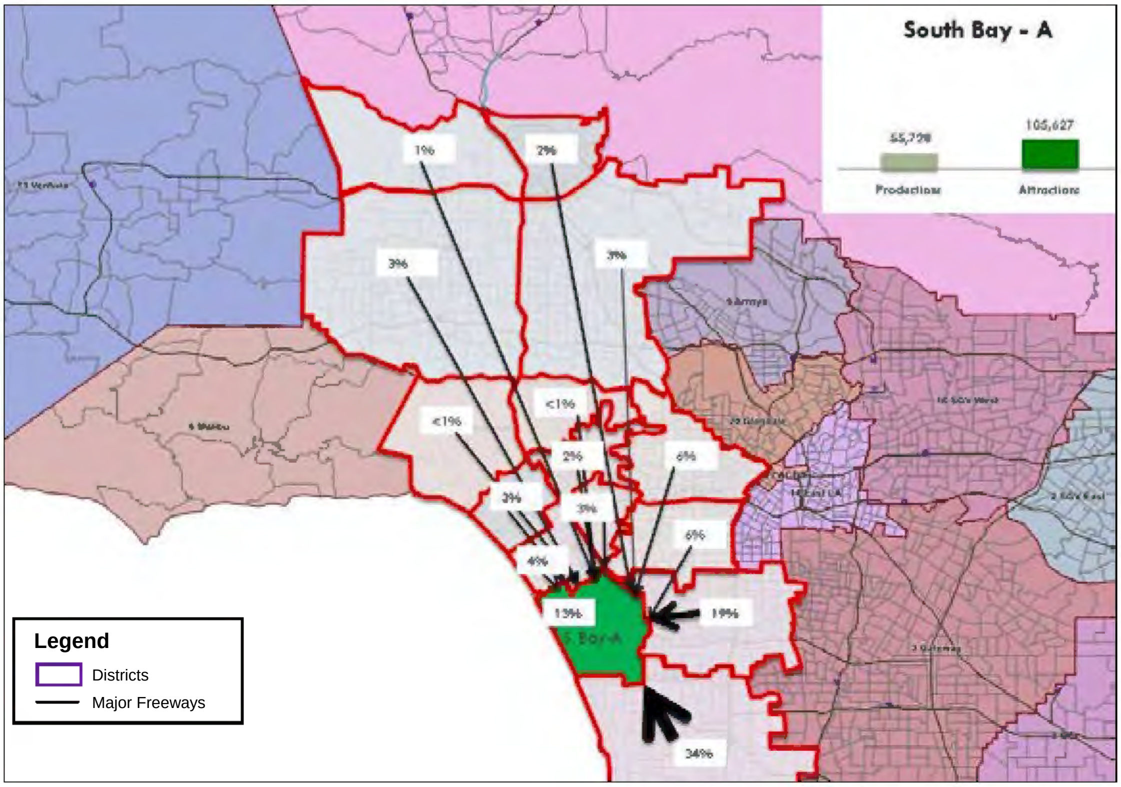


Source: Metro 2006 base year model trip tables

Table 4: Share of Trips and Volume of Trips to District 18 Century Beverly from Other Area Districts

Origin	Share of all trips to District 18 Century Beverly	Volume of daily trips to District 18 Century Beverly
11 LA Central - A	19%	36,976
18 Century Beverly	18%	34,388
17 Santa Monica	9%	17,345
15 SFV - D	9%	17,185
5 Westside - B	7%	14,241
15 SFV - C	6%	11,974
4 South Bay - C	6%	10,818
5 Westside - A	5%	10,388
11 LA Central - B	5%	8,844
4 South Bay - B	4%	7,840
15 SFV - B	3%	6,457
19 Brentwood - B	3%	5,059
15 SFV - A	2%	4,121
4 South Bay - A	2%	3,949
19 Brentwood - A	2%	3,922

Figure 13: Origin and Proportion of Daily Trips to District 4 South Bay - A from Other Districts

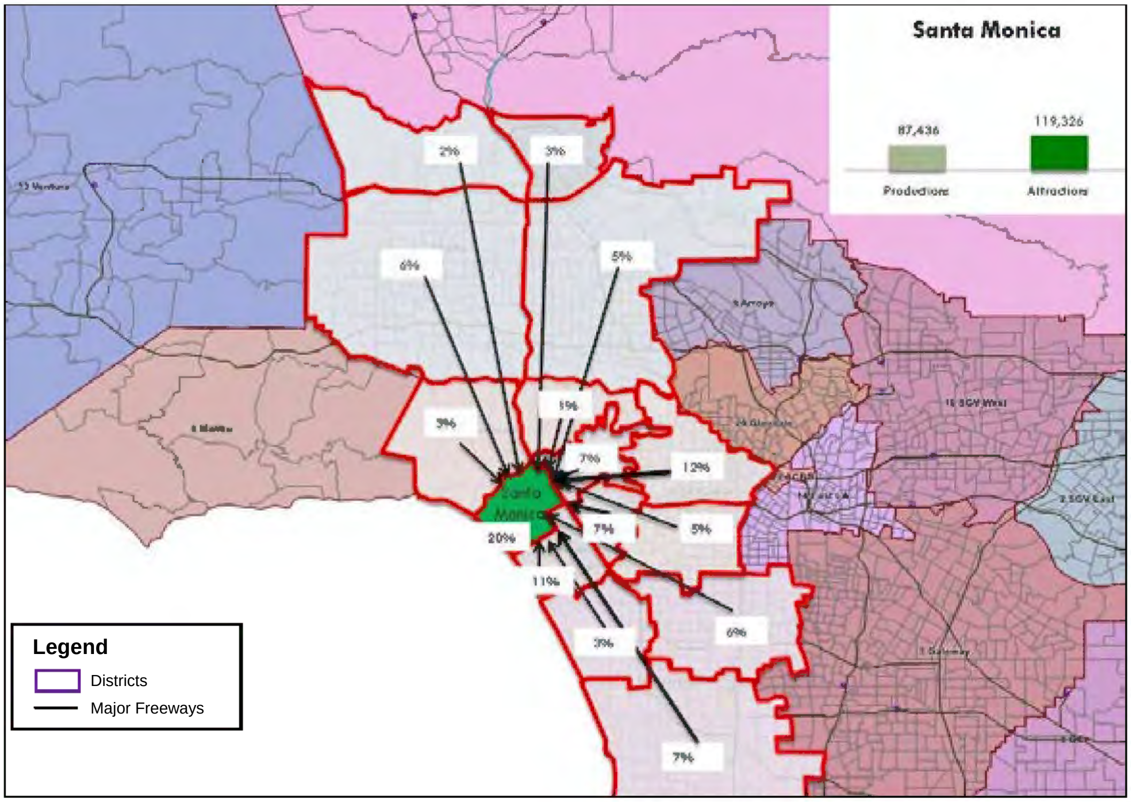


Source: Metro 2006 base year model trip tables

Table 5: Share of Trips and Volume of Trips to District 4 South Bay - A from Other Area Districts

Origin	Share of all trips to District 4 South Bay - A	Volume of daily trips to District 4 South Bay - A
4 South Bay - C	34%	36,398
4 South Bay - B	19%	19,707
4 South Bay - A	13%	14,024
11 LA Central - A	6%	6,581
11 LA Central - B	6%	5,992
5 Westside - A	4%	4,448
15 SFV - C	3%	3,122
17 Santa Monica	3%	2,933
5 Westside - B	3%	2,840
15 SFV - D	3%	2,663
15 SFV - B	2%	2,535
18 Century Beverly	2%	2,184
15 SFV - A	1%	1,419
19 Brentwood - A	0%	466
19 Brentwood - B	0%	315

Figure 14: Origin and Proportion of Daily Trips to District 17 Santa Monica from Other Districts



Source: Metro 2006 base year model trip tables

Table 6: Share of Trips and Volume of Trips to District 17 Santa Monica from Other Area Districts

Origin	Share of all trips to District 17 Santa Monica	Volume of daily trips to District 17 Santa Monica
17 Santa Monica	20%	23,751
11 LA Central - A	12%	14,749
5 Westside - A	11%	13,080
18 Century Beverly	7%	8,620
5 Westside - B	7%	8,583
4 South Bay - C	7%	8,561
15 SFV - C	6%	7,059
4 South Bay - B	6%	6,823
15 SFV - D	5%	6,542
11 LA Central - B	5%	5,498
15 SFV - B	3%	3,923
19 Brentwood - A	3%	3,908
4 South Bay - A	3%	3,808
15 SFV - A	2%	2,797
19 Brentwood - B	1%	1,624

6.2 District-Level Travel Times

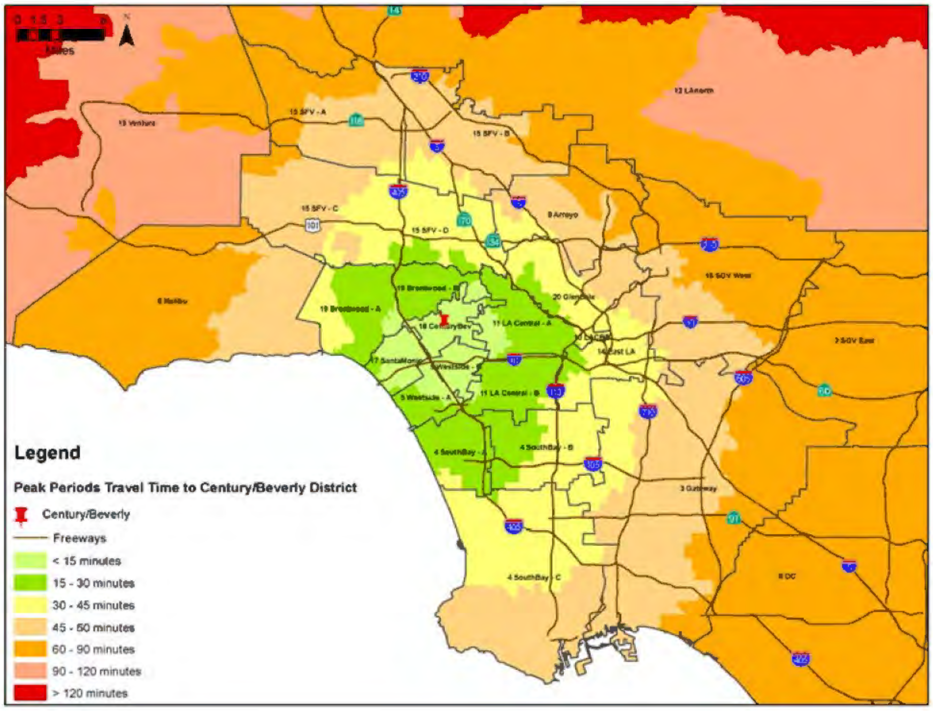
Travel Time Contours represent the average duration of trips to a given district during peak periods, based on traffic models that take into account the roadway network and traffic congestion.

Figure 15 shows travel time to the Century/Beverly district from all other districts. It takes less than 30 minutes to reach Century/Beverly District from the eastern and the western limits of the project study boundary. It takes approximately one hour traveling from Malibu, San Fernando Valley, and Orange County to the Century/Beverly District during the peak periods.

Figure 16 shows travel times to the South Bay-A district from all other districts. As indicated in the map, it takes approximately one hour to travel from the districts at the I-101/I-405 freeway junction, I-5/I-210 freeway junction, and I-5/SR-91 freeway junction to the South Bay District. It takes about 30 minutes during the peak hours when traveling from the districts near the I-405/I-710, I-110/I-405, and I-10/I-110 freeway junctions.

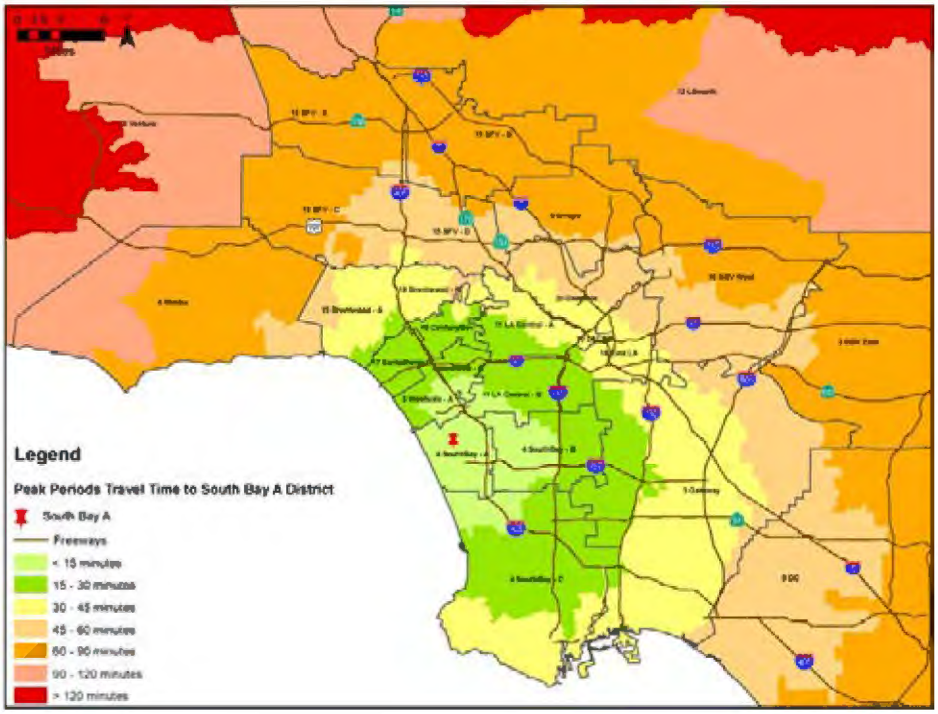
Figure 17 shows travel time to the Santa Monica district from all other districts. The figure shows that traveling from Century/Beverly and Westside districts to Santa Monica takes less than 15 minutes during the peak periods. Traveling from the center of the state park located in the Brentwood A district to Santa Monica takes about 15 minutes while from the remaining area in Brentwood takes about 30 minutes due to the peak period traffic congestions. In addition, it takes approximately 60 to 90 minutes to travel from Malibu, San Fernando Valley, Gateway, and Orange County Districts.

Figure 15: Peak Period Travel Time Contours for Trips to Century/Beverly District



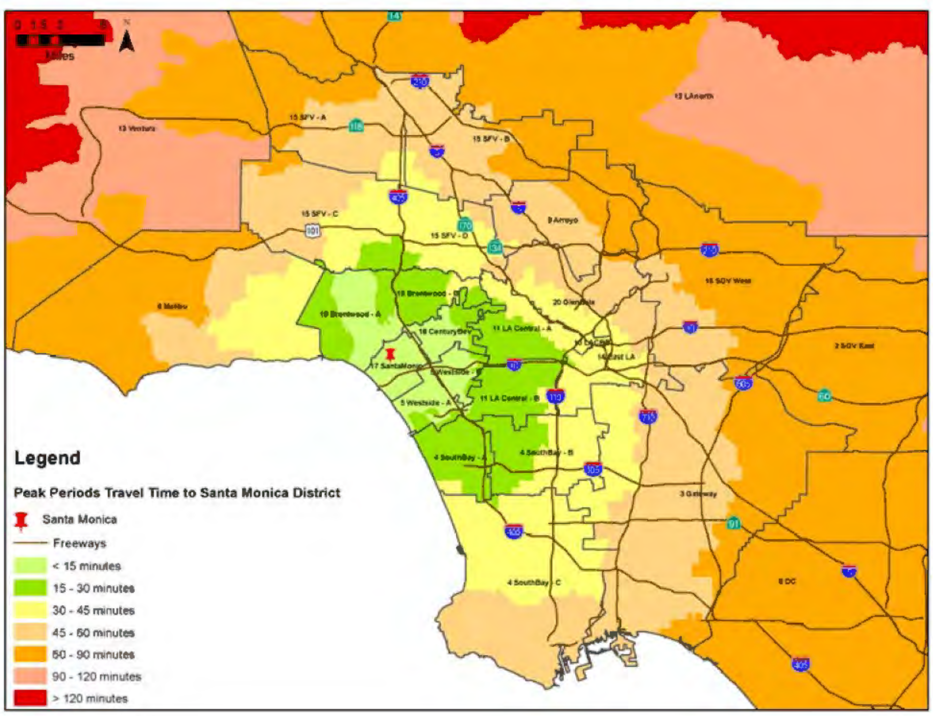
Source: Metro 2006 Base Year Model

Figure 16: Peak Period Travel Time Contours for Trips to South Bay – A District



Source: Metro 2006 Base Year Model

Figure 17: Peak Period Travel Time Contours for Trips to Santa Monica District



Source: Metro 2006 Base Year Model

6.3 Select Link Trip Productions and Attractions through Sepulveda Pass

6.3.1 AM Peak Period – Southbound

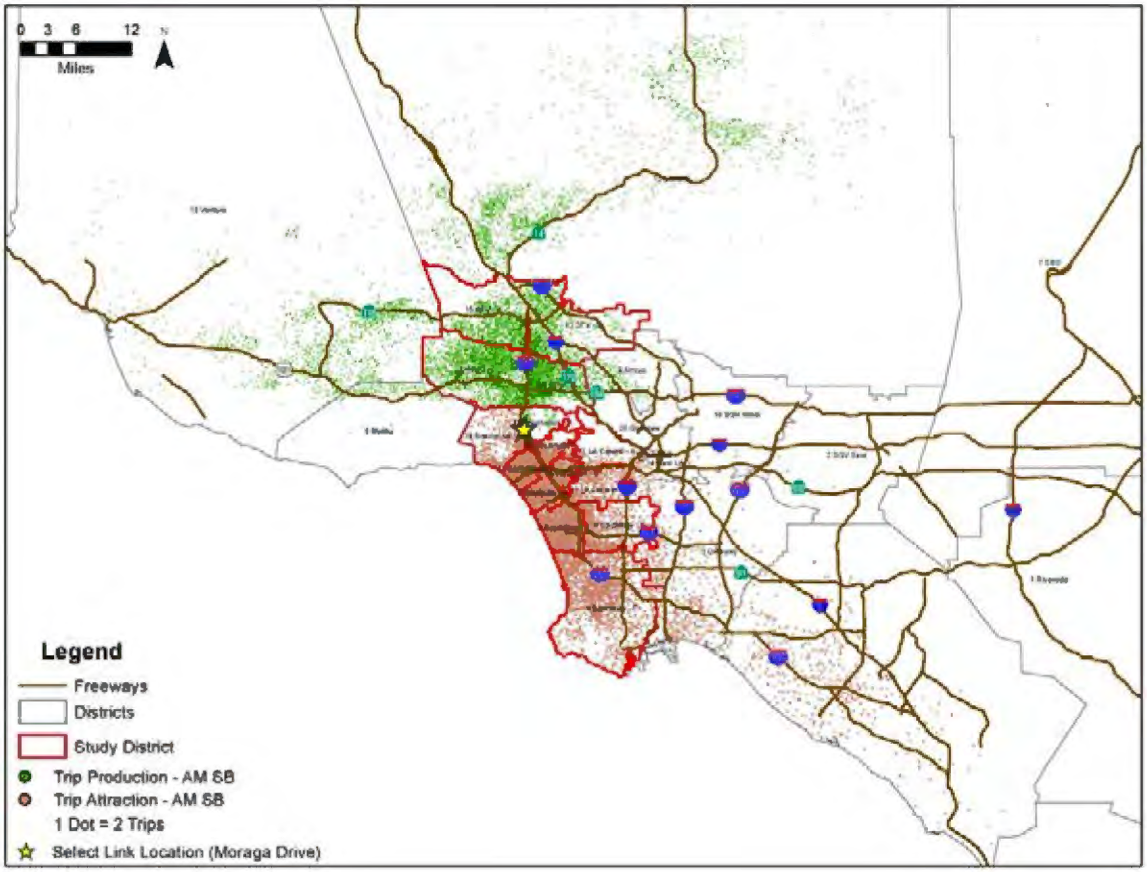
Figure 18 shows the spatial distribution of origins and destinations of AM peak period trips heading over the Sepulveda Pass in the southbound direction. Green dots represent trip origins and brown dots represent trip destinations. Quantification of these trips appears in Table 15 (Appendix). There are several observations that can be gleaned by presenting trip origins and destinations spatially.

While the overwhelming majority of trips heading south over the Sepulveda Pass in the AM peak period via I-405 originate in the heart of the San Fernando Valley, there appear to be a sizeable share of trips that originate in the Santa Clarita Valley and further north in the Antelope Valley. This suggests that there is a very long-distance travel market segment of trips starting north of the I-5/I-405 junction.

While the distribution of trip origins is quite dispersed, trip destinations appear to be clustered relatively tightly along the I-405 corridor, with a higher concentration of trip destinations west of the I-405 corridor between Santa Monica and LAX/El Segundo. This pattern is consistent with the socioeconomic data presented earlier, which showed that the highest concentration of employment within the Study Area is located in Santa Monica, West Los Angeles and LAX/El Segundo.

The share of trips destined beyond the northern part of the South Bay diminishes significantly, which suggests that a Study Area that extends south past the I-105 may not be warranted. Overall, this analysis shows that the I-405 corridor serves a captive market of commute trips from the San Fernando Valley to Westside employment areas that cannot be served by other freeway alternatives. In addition, the I-405 is typically not used as a bypass route from the San Fernando Valley to central and downtown Los Angeles, a market that is served almost entirely by SR-170, U.S. 101 and I-5.

Figure 18: Total Trip Productions and Attractions through Select Link, AM Southbound



Source: SCAG 2008 RTP base year model, select link analysis I-405 north of Moraga

6.3.2 AM Peak Period – Northbound

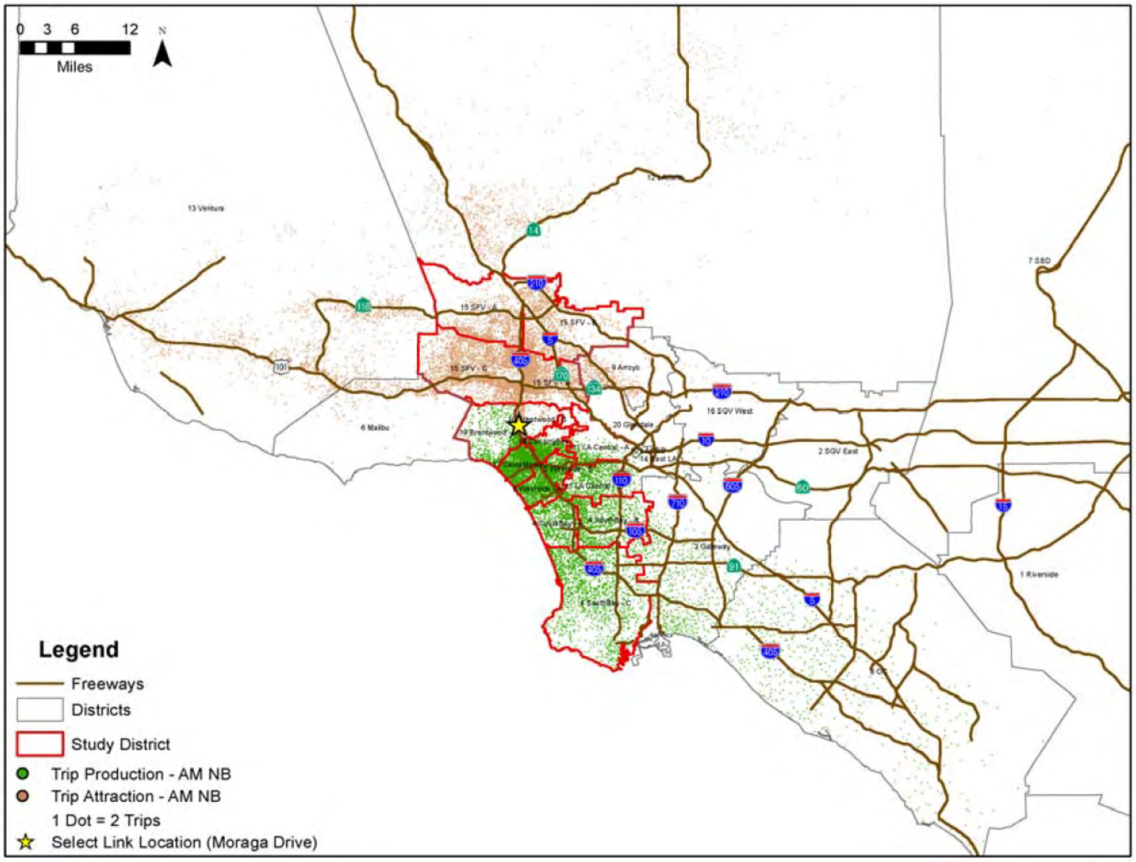
Figure 19 shows the spatial distribution of origins and destination of AM peak periods trips heading over the Sepulveda Pass in the northbound direction. Quantification of these trips appears in Table 16 (Appendix). The share of total AM period trips over the Sepulveda Pass via I-405 is about 45 percent in the northbound direction and 55 percent in the southbound direction. While most AM peak period traffic is in the southbound direction, there is still a sizeable trip market of northbound AM peak period trips from the Westside to the Valley.

Several observations can be gleaned from the spatial distribution of trips origins and destinations shown below. First, the highest concentration of trip origins comes from the four-district area encompassed by Santa Monica, Century City/Beverly Hills, Venice/Marina del Rey and Culver City, which highlights the fact that these areas do have a significant amount of residential land use. A sizeable amount of trips originate from the heart of the South Bay.

North of the Sepulveda Pass, trip destinations are oriented along major commercial corridors like Ventura Boulevard, Van Nuys Boulevard, Topanga Canyon Boulevard and Nordhoff Street.

Beyond the San Fernando Valley, a small cluster of long distance trips are made in Agoura Hills along U.S. 101, Simi Valley along SR-118 and Santa Clarita/Antelope Valley along I-5.

Figure 19: Total Trip Productions and Attractions through Select Link, AM Northbound

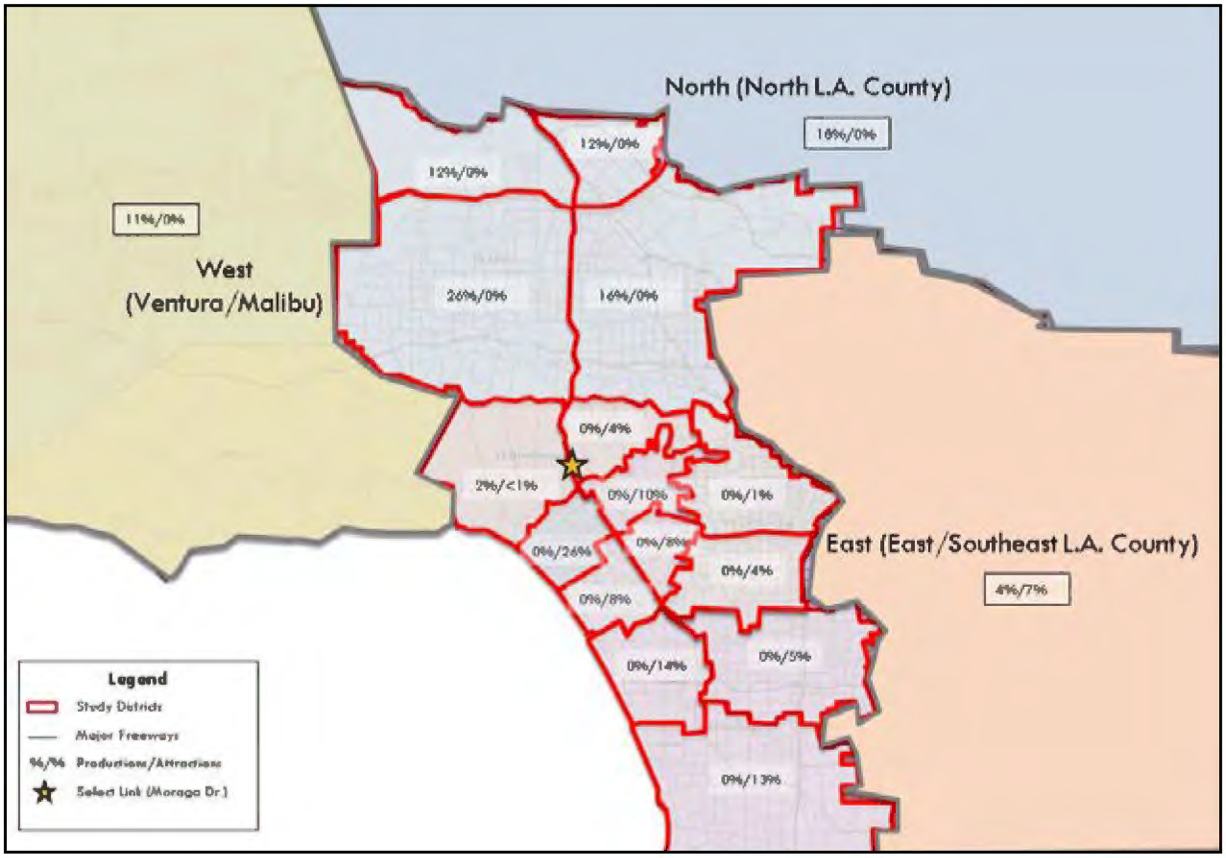


Source: SCAG 2008 RTP base year model, select link analysis I-405 north of Moraga

6.4 District-Level Freeway Select Link Analysis

The select link data, which is coded by TAZ, was also aggregated to the district level to determine where the 30,600 AM vehicle trips passing through the Sepulveda Pass in the southbound and northbound directions of the I-405 start and end. For the purposes of this analysis, areas outside the 15 study districts were split into three super regions: 1) West (Ventura County and Malibu), 2) North (North Los Angeles County), and 3) East (East/South Los Angeles County), as shown in Figure 20 and Figure 21. This district-level designation allows for an analysis of the share of AM peak trips over the Sepulveda Pass in both southbound and northbound I-405 directions that: a) start and end within the 15-district study area, and b) start or end outside the 15-district study area (or both).

Figure 20: Select Link by District Productions and Attractions (2006), AM Southbound



Source: SCAG 2008 RTP base year model, select link analysis I-405 north of Moraga

Note: The sum of the percentages depicted and described in this section is greater than 100% due to rounding.

6.4.1 AM Southbound

Overall, 68 percent of vehicle trips over the Sepulveda Pass in the southbound AM peak begin and end within the 15 districts, referred to as 'district trips.' Of the remaining 32 percent of non-district trips, the highest share (18 percent) is those that begin in the North super region. This makes sense because there is a significant volume of trips feeding onto the I-405 via the I-5/I-405 junction. The second highest share of non-district trips comes from the West super region (11 percent), which connects to the I-405 via US 101.

Within the study district area, an overwhelming share of the total southbound AM peak trips over the Sepulveda Pass originate in the four San Fernando Valley districts (SFV-A, SFV-B, SFV-C and SFV-D). These four districts combined account for 66 percent of the start of all district trips. Of these four districts, the largest share of these trips (26 percent) comes from the southwest quadrant of the San Fernando Valley (SFV-C). The share of trips originating from the north San Fernando Valley (SFV-A and SFV-B) is also significant, accounting for 24 percent of total trips over the Pass.

Approximately 52 percent of the trips over the Sepulveda Pass are destined for the four districts (Santa Monica, Beverly/Century City, Westside-A, and Westside-B) area that covers

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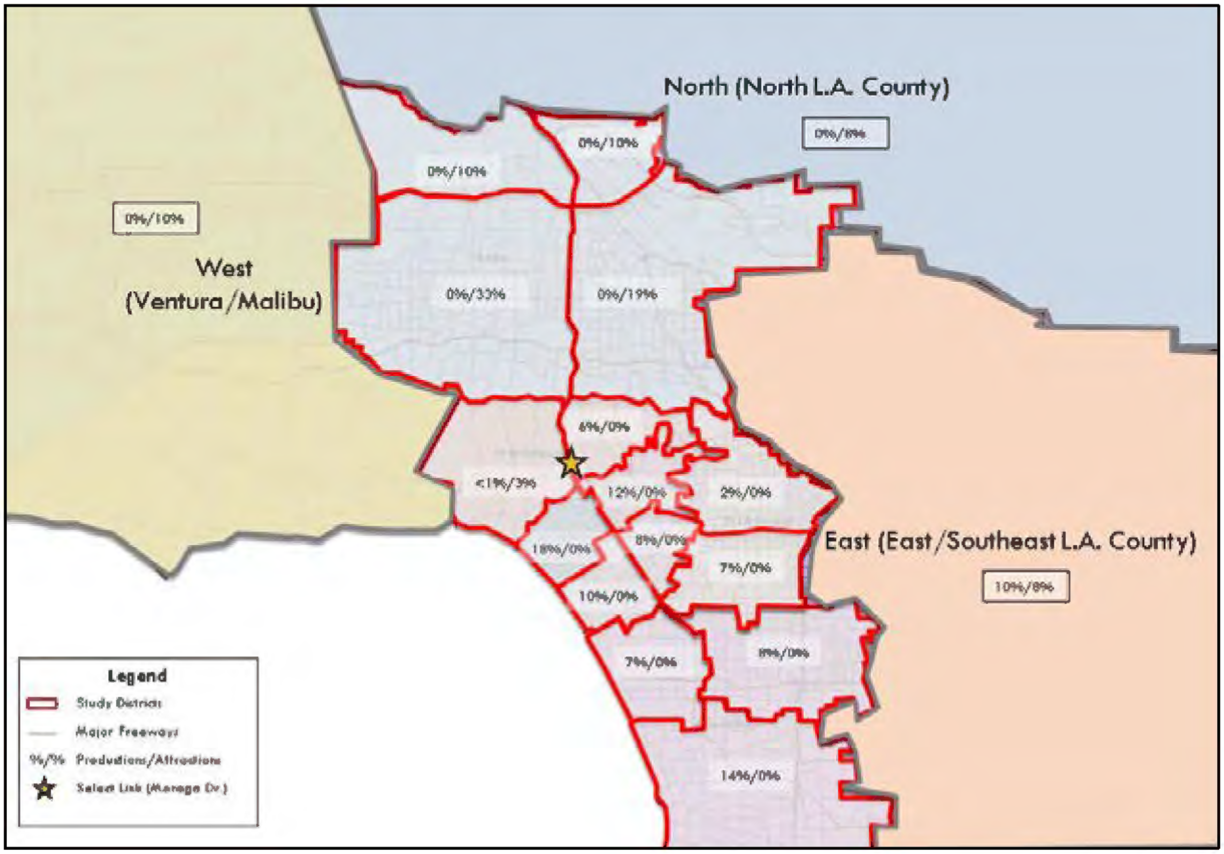
Santa Monica, Beverly Hills/West Hollywood/Century City, Venice, Marina Del Rey and Culver City. In other words, one in four trips over the Sepulveda Pass in the AM peak is destined for the Santa Monica district, which has the third highest concentration of employment of all of the 15 study districts. The share of trips to the Century City/Beverly Hills/West Hollywood district is comparatively lower because that area is also served by SR-170 and US-101, which feed more directly into the eastern part of this district.

The district that attracts the second highest share of AM southbound trips (14 percent) is the LAX/El Segundo district (South Bay-A), another employment rich district. The district attracting the third highest share of trips is South Bay-C, which suggests that the Sepulveda Pass via I-405 funnels a significant number of longer distance trips from the San Fernando Valley beyond the LAX/El Segundo area into the South Bay peninsula area.

6.4.2 AM Northbound

In the AM northbound direction, a significant share of the total vehicle trips over the Sepulveda Pass originate from the four districts (Santa Monica, Beverly/Century City, Westside-A, and Westside-B) area that covers Santa Monica, Beverly Hills/West Hollywood/Century City, Venice, Marina Del Rey and Culver City. These four districts combined account for 48 percent of the start of all district trips. Of these four districts, the largest share of these trips (18 percent) comes from the Santa Monica district. The share of trips originating from the South Bay area (South Bay-A, South Bay-B, and South Bay-C) is also significant, accounting for 29 percent of total vehicle trips over the Sepulveda Pass.

Figure 21: Select Link by District Productions and Attractions (2006), AM Northbound



Source: SCAG 2008 RTP base year model, select link analysis I-405 north of Moraga

Note: The sum of the percentages depicted and described in this section is greater than 100% due to rounding.

Three out of four northbound AM peak trips (72 percent) over the Sepulveda Pass are destined for the four north San Fernando Valley districts (SFV-A, SFV-B, SFV-C and SFV-D). The SFV-C district attracts the largest share of trips (33 percent) of those districts north of the Sepulveda Pass.

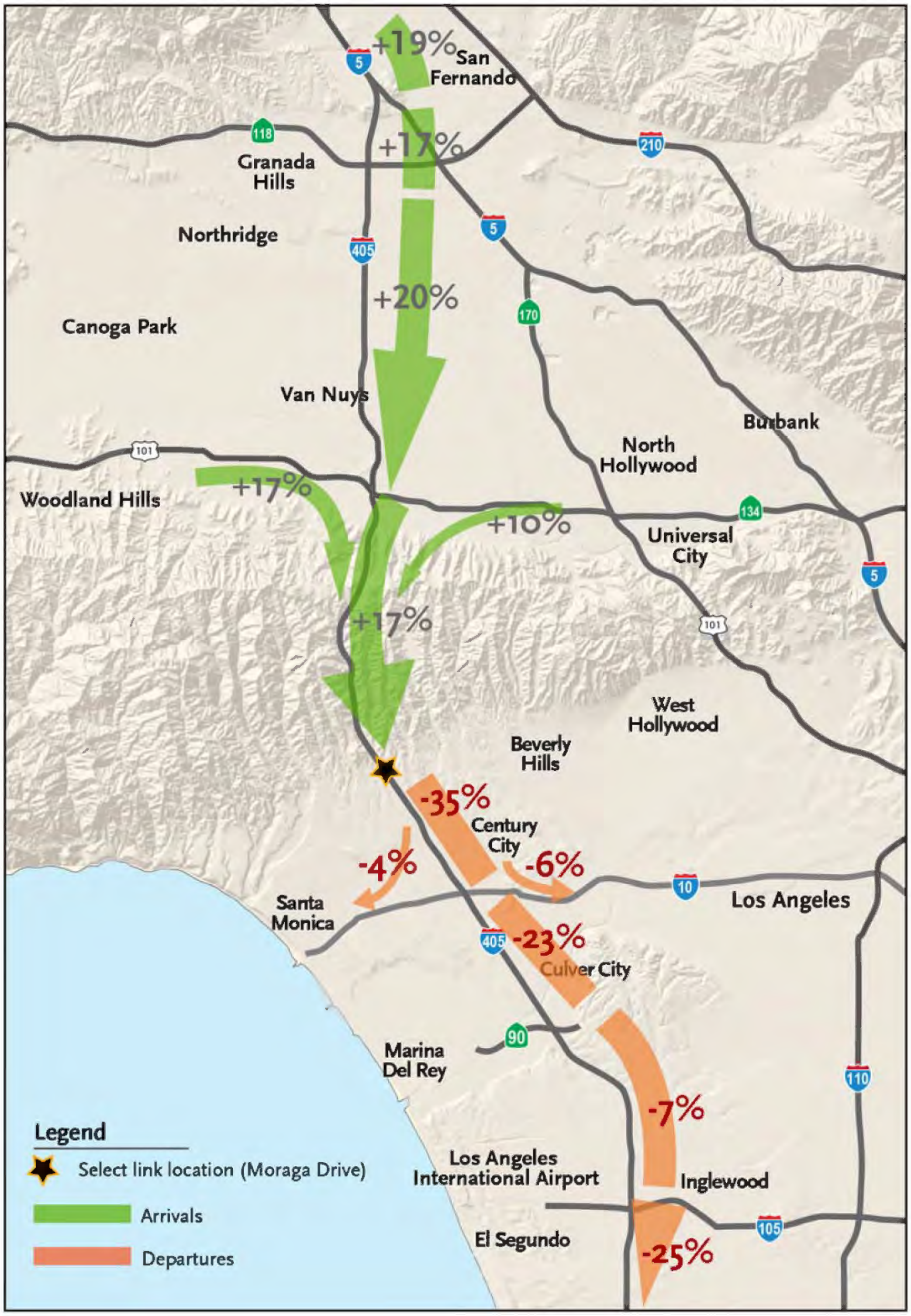
The district that attracts the second highest share of AM northbound trips (19 percent) is the SFV-D district, another employment rich district. It is worth noting that the districts attracting the third highest share of trips is SFV-A and SFV-B, which suggests that the Sepulveda Pass via I-405 funnels a significant number of longer distance trips from the Santa Monica and South Bay areas into the north San Fernando Valley area.

6.5 Freeway Select Link Analysis

6.5.1 Highway Select Link – AM Peak, SB I-405

Figure 22 is a select link analysis map showing trip volumes for the AM peak in the southbound direction of the I-405 that pass Moraga Drive. Select link analysis is useful because it shows where trips that pass through a particular point on a highway are feeding onto and exiting the highway.

Figure 22: 2008 AM Peak Period Select Link Analysis - Southbound



Source: SCAG 2008 RTP base year model, select link analysis I-405 north of Moraga

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In the AM peak period, there are approximately 30,600 vehicles that travel over the Sepulveda Pass via the I-405 into West Los Angeles. Of these:

- 56 percent arrive via the I-405 from north of the 101/I-405 interchange
- 17 percent arrive via the 101 from the west
- 10 percent arrive via the 101 from the east
- 17 percent arrive via connecting roads between 101/I-405 and Moraga Drive

Of the 17,100 vehicle trips that arrive via the I-405 from north of the 101/I-405 interchange, 6,000 (or 19 percent) enter the I-405 between Nordhoff and 101/I-405, 5,200 (or 17 percent) enter the I-405 between Nordhoff and just north of the 118/I-405 junction, and 5,900 (20 percent) enter the I-405 from north of the I-5/I-405 junction. This indicates that 37 percent of the trips that travel over the Sepulveda Pass Corridor via I-405 in the AM peak originate from the northern part of the San Fernando Valley and locations as far north as Sylmar/San Fernando in the North County, suggesting a robust longer distance market along the Corridor.

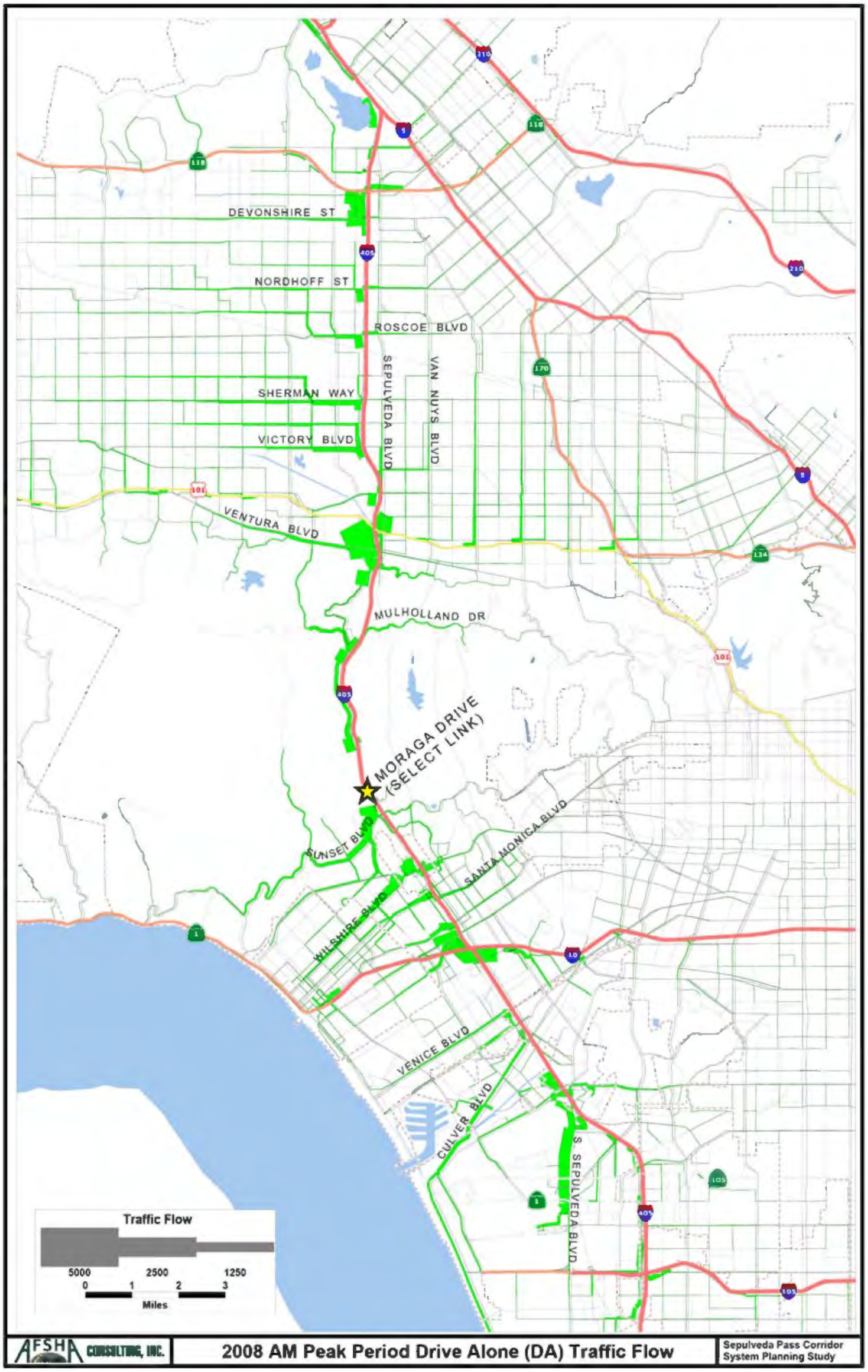
The percentage of trips headed over the Sepulveda Pass arriving via US 101 in the AM peak is approximately 27 percent, with a higher share headed in the eastbound direction from the west. This is less than half of the trips arriving via the I-405, suggesting the predominant market is north of the 101/I-405 interchange and along the I-405 itself.

Of trips traveling south of the Sepulveda Pass, 35 percent are destined for an exit between Sunset and Pico Boulevards, a stretch of the I-405 that connects to the jobs-rich area that includes Santa Monica, Westwood and Century City. Roughly 4 percent head westbound on the I-10 and 6 percent head eastbound on I-10. Approximately 23 percent exit between I-10 and SR 90, and 7 percent exit between SR 90 and Century Boulevard. The remaining 25 percent of trips that originated north of the Sepulveda Pass continue to points south of the I-105, underscoring that one out of four trips across the Sepulveda Pass is long distance.

6.6 Arterial Select Link – AM Peak, SB I-405

Figure 23 shows AM peak traffic volumes on arterial links connecting to the I-405 by varying bandwidths corresponding to traffic volumes.

Figure 23: Peak AM Arterial Traffic (2008), Southbound



Source: SCAG 2008 RTP base year model, select link analysis I-405 north of Moraga

Metro

Most of the auto trips from the San Fernando Valley destined for the Sepulveda Pass in the AM peak via the I-405 originate west of the I-405. North of the US 101/I-405 interchange, the ratio of trips from the west and east of the I-405 corridor is about 2:1. This is mainly because travelers who are making trips from east of the I-405 to central Los Angeles have a choice between the I-405 and other north-south highways like the I-5, SR 170 and US 101.

7.0 TOPOGRAPHY, LAND USE & ACTIVITY CENTERS

7.1 Topography

The study corridor consists of two, wide east-west Valleys that are bisected by the Santa Monica Mountains. The terrain within both the San Fernando Valley, from SR 118 to US 101 and in Westside Los Angeles from I-105 to SR 2 is considered "flat" by Caltrans, while the Sepulveda Pass and the section from SR 118 to I-5 is considered "rolling" by Caltrans. The grade coming from Westside Los Angeles varies more, with sections that are "flat" and more moderate grades, with an extended grade of 3 percent on the approach to the top of Sepulveda Pass. The grade coming from the San Fernando Valley to the top of Sepulveda Pass is higher at 5.5 percent (-5.5 percent heading northbound) for a shorter distance of approximately 1.4 miles. The elevation at the top of Sepulveda Pass is approximately 1,150 feet above sea level.

There are a number of topographic constraints within the Sepulveda Pass that are caused by both the natural and built environments. As shown in Figure 24, the terrain surrounding the roadway is quite steep and the current I-405 widening project for the construction of the northbound HOV lanes has included the construction of large retaining walls adjacent to the roadway. In addition, significant grade differences create a challenging environment for physical infrastructure improvements.

In addition to the natural topographic environment, the existing built environment and roadway infrastructure also present implementation challenges for future transportation concepts. A number of interchanges would require extensive modification to accommodate additional freeway widening or alternative modes outside of the current freeway right-of-way. The interchange structures at Sunset, Skirball and Santa Monica are all constrained by bents, piers or columns and further widening would require complete replacement of the structures. The I-10 interchange also has column constraints and is particularly complex from a construction feasibility standpoint.

In addition to the above mentioned structure related constraints, right-of-way across the Sepulveda Pass is constrained by both the built and natural environment, particularly at the Getty Museum, the federal property location that includes the Veteran Administration Hospital, the General Services Administration building and the National Cemetery at Wilshire Boulevard, Bel Air Crest, and the Santa Monica Mountain Conservancy.

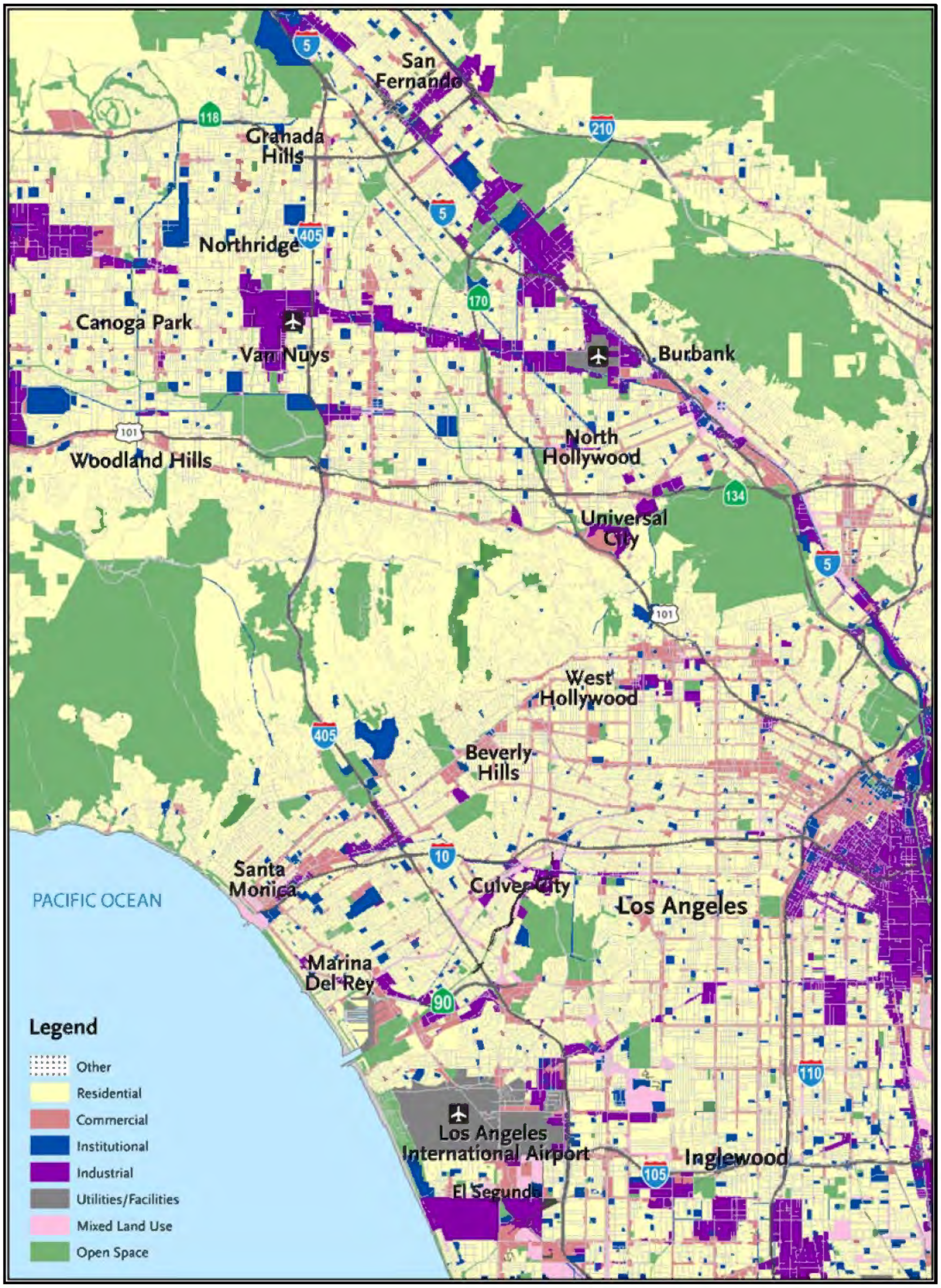
Figure 24: Sepulveda Pass Looking North Towards the San Fernando Valley

7.2 Land Use

The mix of land uses in the proposed study corridor play an important role in determining the potential benefits and impacts, of implementing any transportation system improvement. The Study Area has a diverse mix of land uses, as shown in Figure 25.

Figure 25 shows that the San Fernando Valley is primarily residential and that commercial activity is concentrated along major arterials such as Topanga Canyon, Sepulveda, Van Nuys and Victory Boulevards. The Westside also has abundant residential uses with a higher intensity of commercial and retail activity, especially along major arterials such as Wilshire, Santa Monica and Venice Boulevards. In contrast to San Fernando Valley in the north, residential and commercial densities are higher south of the Sepulveda Pass. These land use patterns contribute to roadway congestion along the Sepulveda Pass in these specific areas.

Figure 25: Land Use in Sepulveda Pass Area



Source: Southern California Association of Governments, 2009; Los Angeles County, 2012

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7.3 Activity Centers

The Corridor Study Area contains a wide variety of civic, education, commercial, cultural, entertainment, recreational, and employment activity centers, as Figure 26 shows. They include:

- **Public facilities:** including civic centers, community centers, Los Angeles International Airport, Van Nuys Airport, Van Nuys Government District, Warner Center, Los Angeles Veteran's Affairs (VA) hospital, Los Angeles National Veterans Park, Los Angeles National Cemetery, the Federal Building, Cheviot Hills Park and Recreational Center, Mar Vista Gardens and Recreational Center, Hollywood Park;
- **Educational institutions**, including public and private schools and seven colleges and universities – Cal State Northridge, Los Angeles Valley College, American Jewish University, University of California at Los Angeles (UCLA), Loyola Marymount University (LMU), University of West Los Angeles, Los Angeles Southwest College;
- **Commercial areas,** including local and regional shopping centers such as Sherman Oaks Galleria, Westfield Fashion Square, Westwood, Westfield Century City, Westside Pavilion, Downtown Culver City, Westfield Fox Hills;
- **Cultural and entertainment venues**, including Skirball Cultural Center and Museum, Getty Center, Hammer Museum, 20th Century Fox Studios, Japenese Institute of Sawtelle, Sony Studios, Universal City;
- **Employment centers**, including Northridge, Van Nuys Airport, Van Nuys West, and Van Nuys, Sherman Oaks, Wilshire Corridor, Culver City, Marina Del Rey, LAX/El Segundo.

7.4 Employment Centers

As mentioned in Section 7.3, there are nine major employment centers located within the Study Area. These activity centers are defined by the research of Guiliano et al. (2012).[2] Their research examined the impact of accessibility on the growth of employment centers in the Los Angeles region between 1990 and 2000. Employment centers in the 2012 study were identified using the Guiliano and Small method (1991), which defines a center as cluster of contiguous zones with total jobs per acre of 10,000.[3]

The research identified 48 employment centers in the Los Angeles region. Nine of these centers fall within or intersect the Sepulveda Pass Study Area.[4] The centers range in

[2] Guiliano, G., Redfearn, C., and Agarwal, A. *et al.* (2012) Network accessibility and employment centres, *Urban Studies,* 49 (1), pp. 77-95.

3 Giuliano, G. and Small, K. (1991) Subcenters in the Los Angeles region, *Regional Science and Urban Economics*, 21(2), pp. 163–182.

[4] Guiliano, G., Redfearn, C. and Agarwal, A. *et al.* (2007) Employment concentrations in Los Angeles, 1980-2000, *Environment and Planning A,* 39, pp. 2935-2957.

geographic size, the largest spanning about 950 acres (Van Nuys) to 14,000 acres (Santa Monica-Wilshire-Hollywood). These activity centers are meant to represent a clustered area in which key destinations are located. These destinations are trip attractors and generators for travel markets in the area of interest.

The Sepulveda Pass employment centers are listed in Table 7 and are displayed in Figure 26.

Table 7: Employment Centers

	Employment Centers
1	Santa Monica-Wilshire-Hollywood
2	LAX/El Segundo
3	Van Nuys Airport
4	Northridge
5	Sherman Oaks
6	Culver City
7	Marina Del Rey
8	Van Nuys West
9	Van Nuys

Santa Monica-Wilshire-Hollywood: This center spans east-west along Wilshire Boulevard. It contains a number of activity centers, including: Century City, UCLA/Westwood Village, Los Angeles Veteran's Affairs Hospital, Santa Monica beach fronts, 3rd Street Promenade/Santa Monica Place, Federal Building, and Cedars Sinai Medical Center. Wilshire Boulevard is dominated by commercial land uses in this corridor. For example, commercial campuses such as the Watergarden in Santa Monica house numerous firms across a range of industries and generate commute trips from throughout the Los Angeles region.

LAX/El Segundo: Located in the southern end of the area of interest, the LAX/El Segundo area is home to the sixth busiest airport in the world, LAX, accommodating 59 million annual passengers in 2010 (Airports Council, 2011; LAWA, 2011). There are 33,218 daily commute trips to LAX daily (Metro, 2010). Many airport-related businesses located adjacent to LAX, such as hotels, long-term parking facilities, and restaurants, also attract air passengers and area employees. Also located in this center are freight and aerospace businesses, Hollywood Park and the University of West Los Angeles.

Van Nuys Airport/Van Nuys West/Van Nuys: Located in San Fernando Valley, Van Nuys is home to commercial corridors, such as Van Nuys Boulevard, as well as Van Nuys Airport. Van Nuys Airport is dedicated to noncommercial air travel (private, corporate, and government interests) located in San Fernando Valley. Commute trips to this airport correlate with the aviation-related businesses located on-site. Van Nuys City Hall/Civic Center Area is located southeast of the Van Nuys Airport.

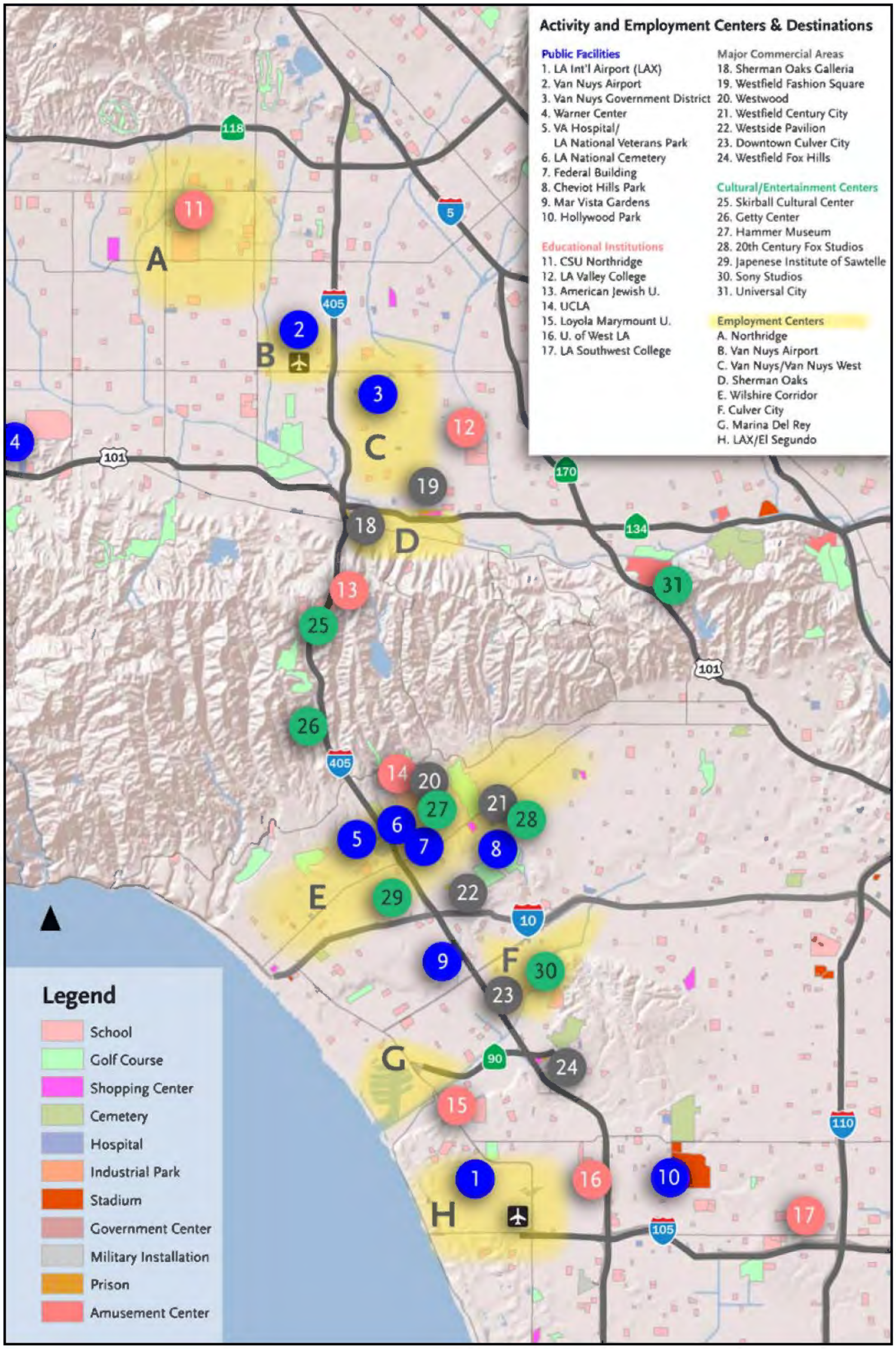
Northridge: Located in the San Fernando Valley, Northridge is home to California State University, Northridge, the Northridge Hospital and Medical Center, and the Northridge Fashion Center.

Sherman Oaks: Sherman Oaks is located just north of the Santa Monica Mountains. Just off of the I-405 and US 101 interchange is the Sherman Oaks Galleria, a shopping, entertainment, offices, and education complex that generates both recreational and employment trips.

Culver City: Located near the intersection of the I-405 and the I-10, Culver City contains activity centers such as: Downtown Culver City, Fox Hills Mall. Sony Studios is a major employer located within this activity center.

Marina Del Rey: Marina Del Rey is located north of LAX/El Segundo. Key destinations in this activity center include Loyola Marymount University.

Figure 26: Activity Centers in the Sepulveda Pass Study Area



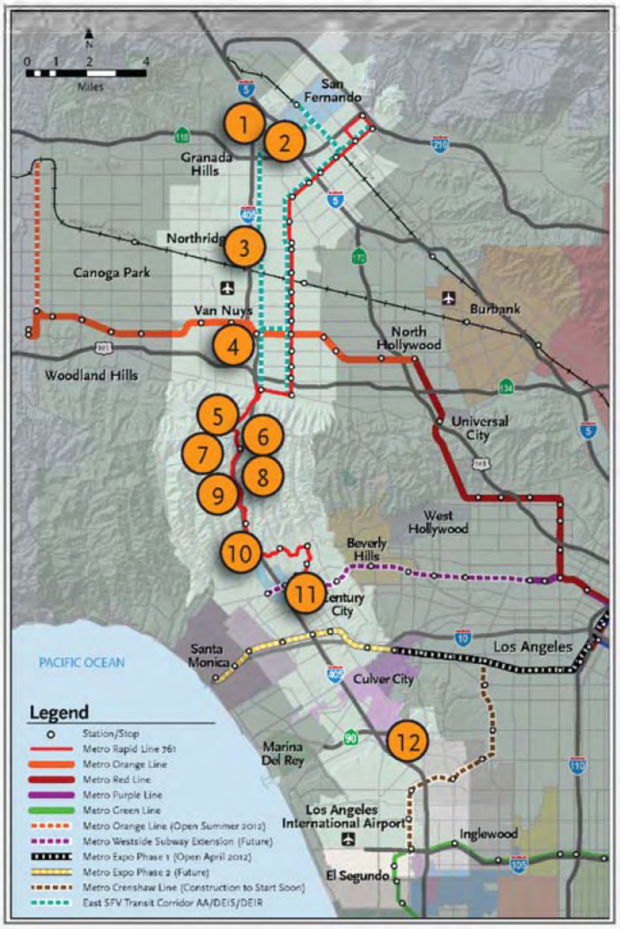
Source: Esri, 2007; Parsons Brinckerhoff, 2012

Metro

7.5 Stakeholders & Sensitive Areas

There are a number of stakeholders and sensitive areas located within or near the study corridor. The sensitive areas shown in Figure 27 do not represent all of the potential stakeholders or sensitive areas, but highlight the key stakeholders that should be considered in the development of system concepts.

Figure 27: Third-Party Stakeholders and Sensitive Contexts



1. Van Norman Lakes Reservoir
2. S.F. Mission Cemetery/Eden Memorial Park
3. James Monroe H.S.
4. Sepulveda Basin Recreation Area
5. MECA, Skirball Cultural Center
6. American Jewish University
7. Santa Monica Mountains Conservancy
8. Bel Air – Beverly Crest Neighborhood Council
9. Mountain Gate/Mt. St. Mary's College/Getty Ctr.
10. VA Hospital / National Cemetery
11. Bad News Bears Park / GSA
12. Holy Cross Cemetery / Hillside Memorial Park

North of the US 101/I-405 interchange, there are several sensitive land uses. The San Fernando Mission Cemetery and Eden Memorial Park are located east of the I-405 at its junction with the I-5 near Sylmar. James Monroe High School, along with a number of other high schools, elementary and middle-schools are also within the study corridor. The Sepulveda Basin Recreation Center located just north of the interchange is a major environmental constraint.

Within the Pass, sensitive stakeholders include: MECA, the Santa Monica Mountain Conservancy, several residential neighborhoods, and the Getty Center. South of the Pass, key sensitive land uses include the VA Hospital and the National Cemetery.

8.0 EXISTING TRANSPORTATION FACILITIES

The following discussion provides an overview of the existing major roadway and transit facilities and services within or adjacent to the I-405 Sepulveda Pass Study Corridor.

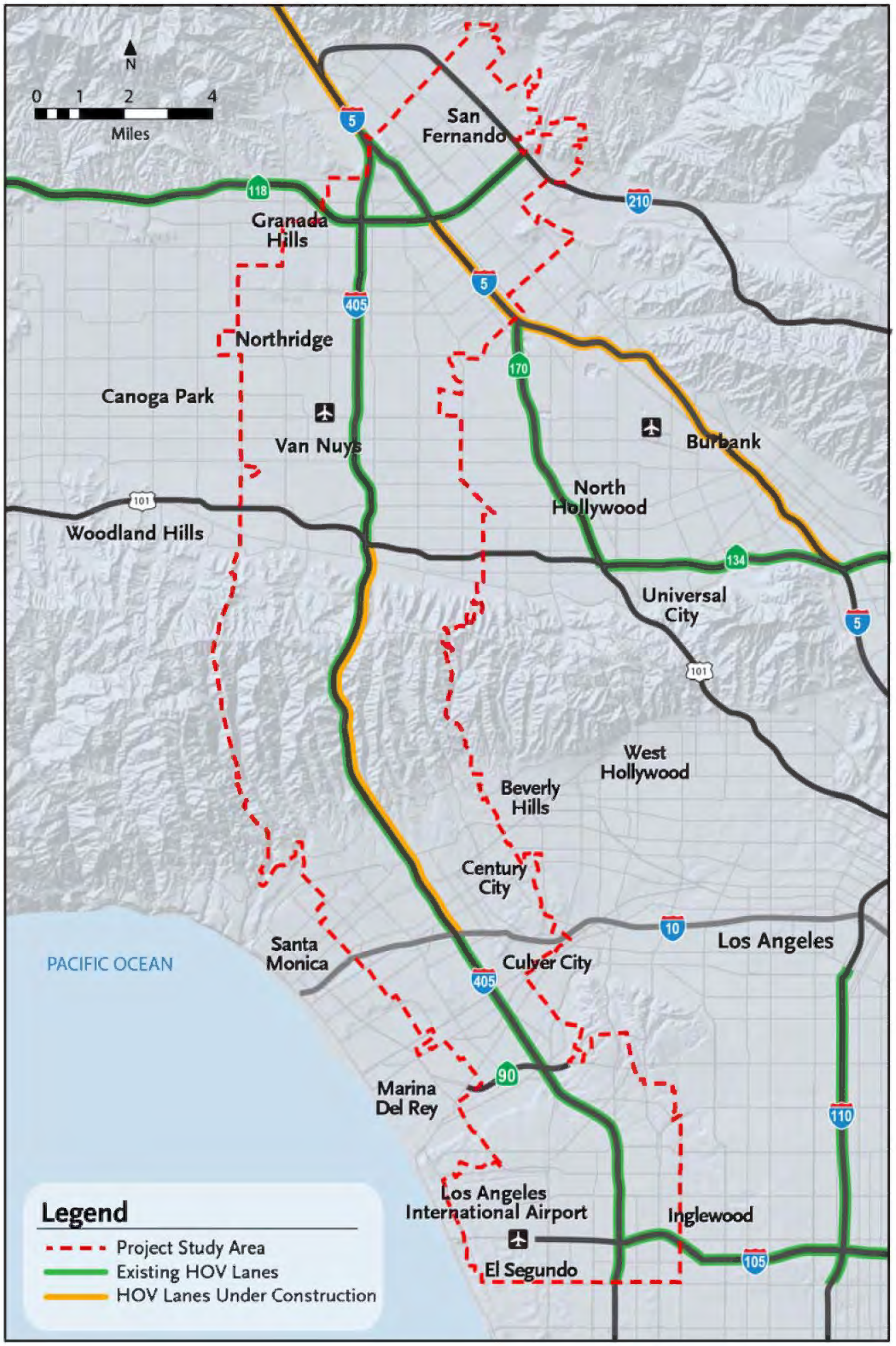
8.1 Highway/Roadway Facilities

Figure 28 depicts the existing highway system in the Sepulveda Pass area. Within most of the Study Area, the I-405 varies between four and six general purpose lanes in each direction and includes a continuous HOV lane in the southbound direction.

The I-405 Sepulveda Pass Improvements Project, currently underway, will add a 10-mile HOV lane in the northbound direction of the I-405 between the I-10 and the US 101 freeways. When complete the I-405 will have continuous HOV lanes in both directions from the I-5/I-405 junction in San Fernando in the north to the I-5/-I-405 junction in Irvine in the south, a distance of approximately 73 miles. However, due to growth trends in the corridor, the travel time advantage of the HOV lanes will be difficult to maintain because of the high utilization. As discussed later in this section, there is already significant travel time variability in the HOV lanes during the peak periods. Unless vehicle occupancy requirements are changed, the lanes are actively managed, or alternative improvements are made in the corridor, the I-405 HOV lanes will be over-utilized over time.

In addition to the HOV lanes on the I-405 Freeway, there are existing HOV lanes in both directions of the SR-118, I-5 (SR-118 to SR-14), SR-170 (I-5 to SR-134), and I-105 (I-405 to I-605). HOV lanes are also under construction on the I-5 (SR-170 to SR-118), at the I-5/SR-170 HOV direct connectors, and at the I-5/SR-14 HOV direct connectors. Future HOV direct connectors are also planned at the I-5/I-405 junction in San Fernando.

Figure 28: Existing and Planned HOV Network in Sepulveda Pass Area



Metro

Table 8 summarizes the future lane configuration of the I-405 between the I-5 and the I-105 upon the completion of the current widening project.

Table 8: Future I-405 Lane Configuration in Sepulveda Pass

<table>
<tr><th rowspan="2">Cross Street</th><th colspan="2">Southbound</th><th colspan="2">Northbound</th></tr>
<tr><th>General Purpose Lanes</th><th>HOV Lanes</th><th>General Purpose Lanes</th><th>HOV Lanes</th></tr>
<tr><td>I-5</td><td rowspan="2">3</td><td rowspan="26">1</td><td rowspan="2">3</td><td rowspan="26">1</td></tr>
<tr><td>Rinaldi St</td></tr>
<tr><td>San Fernando Mission Blvd.</td><td rowspan="8">4</td><td rowspan="8">4</td></tr>
<tr><td>SR 118</td></tr>
<tr><td>Devonshire St.</td></tr>
<tr><td>Nordhoff St.</td></tr>
<tr><td>Roscoe Blvd.</td></tr>
<tr><td>Sherman Way</td></tr>
<tr><td>Victory Blvd</td></tr>
<tr><td>Burbank Blvd.</td></tr>
<tr><td>US 101</td><td>3</td><td>3</td></tr>
<tr><td>Skirball Center Dr.</td><td>5</td><td rowspan="5">5</td></tr>
<tr><td>Moraga Dr.</td><td rowspan="2">4</td></tr>
<tr><td>Sunset Blvd</td></tr>
<tr><td>Wilshire Blvd</td><td rowspan="2">5</td></tr>
<tr><td>Santa Monica Blvd</td></tr>
<tr><td>I-10</td><td rowspan="2">4</td><td rowspan="2">4</td></tr>
<tr><td>National Blvd</td></tr>
<tr><td>Matteson Ave</td><td rowspan="2">5</td><td rowspan="3">5</td></tr>
<tr><td>Culver Blvd</td></tr>
<tr><td>SR 90</td><td rowspan="6">4</td></tr>
<tr><td>Howard Hughes Pkwy</td><td rowspan="5">4</td></tr>
<tr><td>La Tijera Blvd</td></tr>
<tr><td>W Manchester Ave</td></tr>
<tr><td>W Century Blvd</td></tr>
<tr><td>I-105</td></tr>
</table>

Source: HNTB 2012

Other major north-south highways in the San Fernando Valley include the I-5 and SR-170. Between Branford and Sheldon Streets, the SR-170 splits off from I-5 and travels south through the Hollywood Hills, merges with the US 101 through Hollywood and continues to downtown Los Angeles. The I-5 and the SR 170/US 101 provide important north-south capacity and roadway alternatives for areas east of the I-405 in the San Fernando Valley.

The SR 118 and the US 101 provide the major east-west grade-separated roadway capacity in the San Fernando Valley, with the SR 118 at the very northern edge of the valley and the US 101 at the southern edge against the Santa Monica Mountains. The SR 118 is an east-west facility from the I-210 in San Fernando through Simi Valley to Moorpark in the west where it connects to the SR 23, which travels south through Thousand Oaks and connects with the US 101 in Ventura County.

The US 101 is the primary connection to coastal and suburban communities between Santa Barbara and the San Fernando Valley with generally four travel lanes in each direction. Within the San Fernando Valley, the SR 118 and the US 101 are complemented by a comprehensive arterial grid that provides additional capacity and system redundancy, particularly east of the I-405.

8.2 Highway and Arterial Connectivity & Convenience

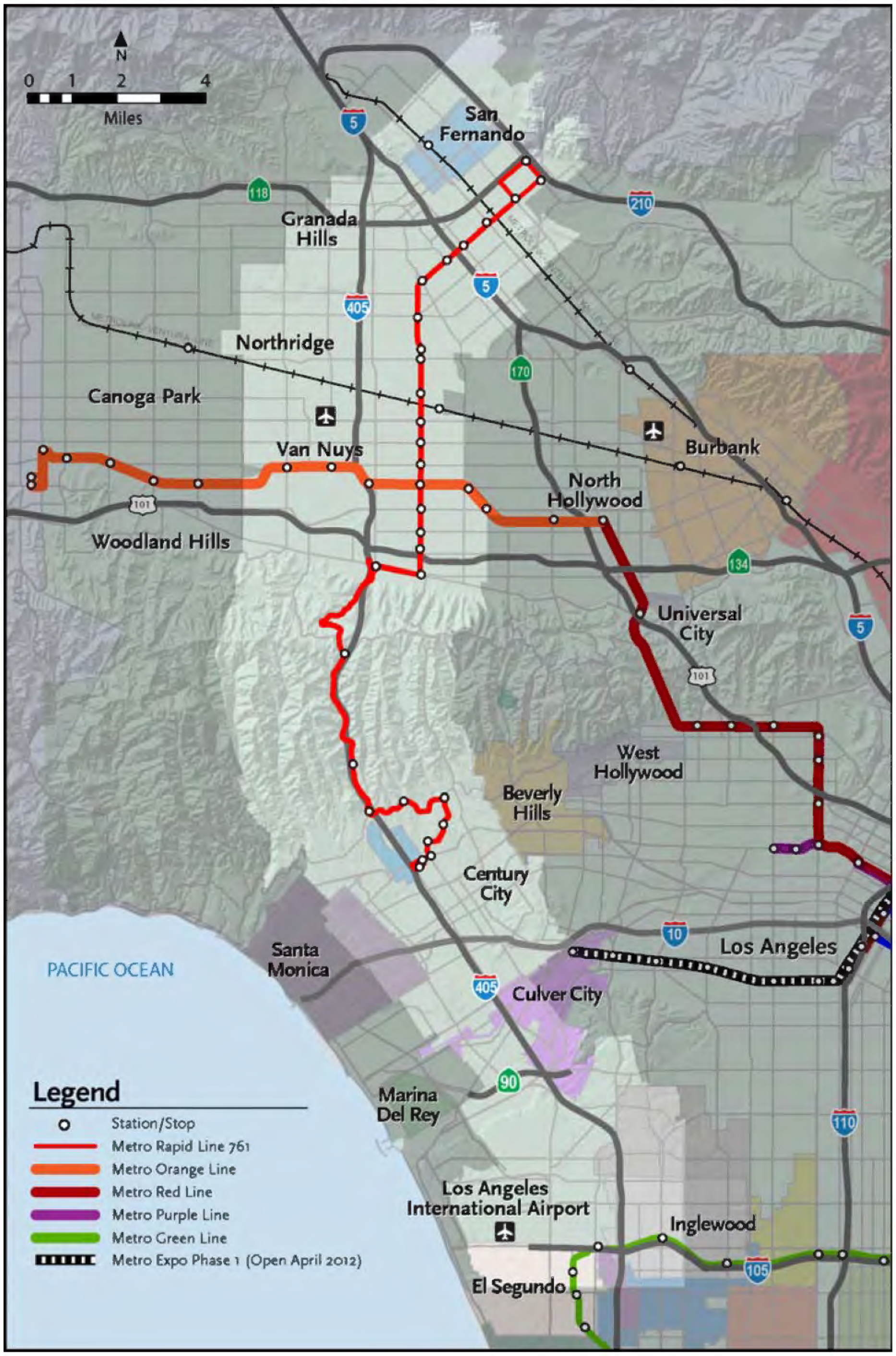
South of the Sepulveda Pass, there are few primary or secondary roadway facilities that provide additional north-south capacity. Due to development, roadway configuration and topographic constraints, there are only a very limited number of continuous north-south arterial roadways and no freeway or highway facilities in the Westside LA area. In addition, the arterial grid is also not continuous and in many instances is rather irregular with a large number of streets running at diagonals, curvilinear, or intersecting at skewed angles.

East-west capacity is also hampered in the same manner, but to a somewhat lesser degree, as the arterial grid east of the I-405 is somewhat more continuous, and the I-10 freeway provides capacity through the larger Study Area between Santa Monica and downtown LA. At the southern end of the Study Area, the I-105 freeway provides east-west capacity into LAX and to the I-110 and points east.

8.3 Transit Facilities & Services

Figure 29 depicts the existing transit route network in the Sepulveda Pass area. Key connectivity points in San Fernando Valley, Westside, and South Bay are highlighted.

Figure 29: Existing Major Transit Route Network in Sepulveda Pass Area



8.3.1 San Fernando Valley Transit Facilities and Services

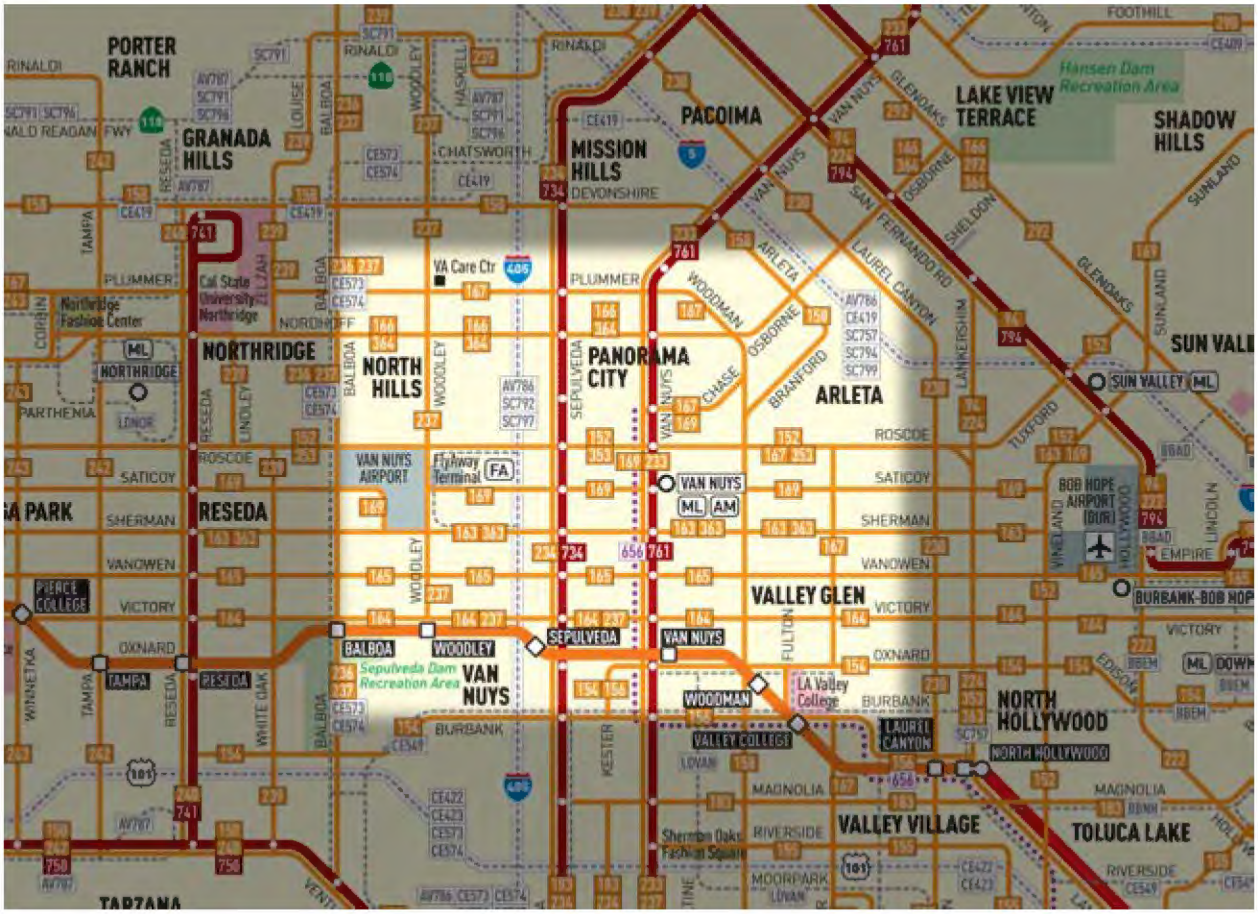
At the northern end in Sylmar, the Study Area includes the Sylmar/San Fernando Metrolink Station with service between Lancaster and downtown LA on the Antelope Valley line (Figure 30). Connecting Metro bus service for both local and Rapid routes (94, 224, 230, 236/237, 239, 734 and 794) and LADOT Commuter Express (574) are available at or near the Sylmar/San Fernando Metrolink Station in Ventura County.

Figure 30: Transit Connections at Sylmar/San Fernando Valley Metrolink Station

The Study Area is also crossed by the Metrolink Ventura Line near Roscoe Boulevard, with both Metrolink and Amtrak service provided at the Van Nuys Station at Van Nuys Boulevard and Saticoy Street. Metrolink service runs between Montalvo and downtown Los Angeles providing both peak and off-peak services.

Amtrak service is on the Pacific Surfliner that runs from San Luis Obispo to San Diego and the Coast Starlight that provides inter-state service from Seattle Washington to Los Angeles. Local, Rapid and late-night Metro bus routes connecting at or near the Van Nuys Metrolink station on the Metrolink Ventura County Line include the 152, 158, 163/363, 167, 169, 233, 234/734, 353, and Rapid 761 (Figure 31).

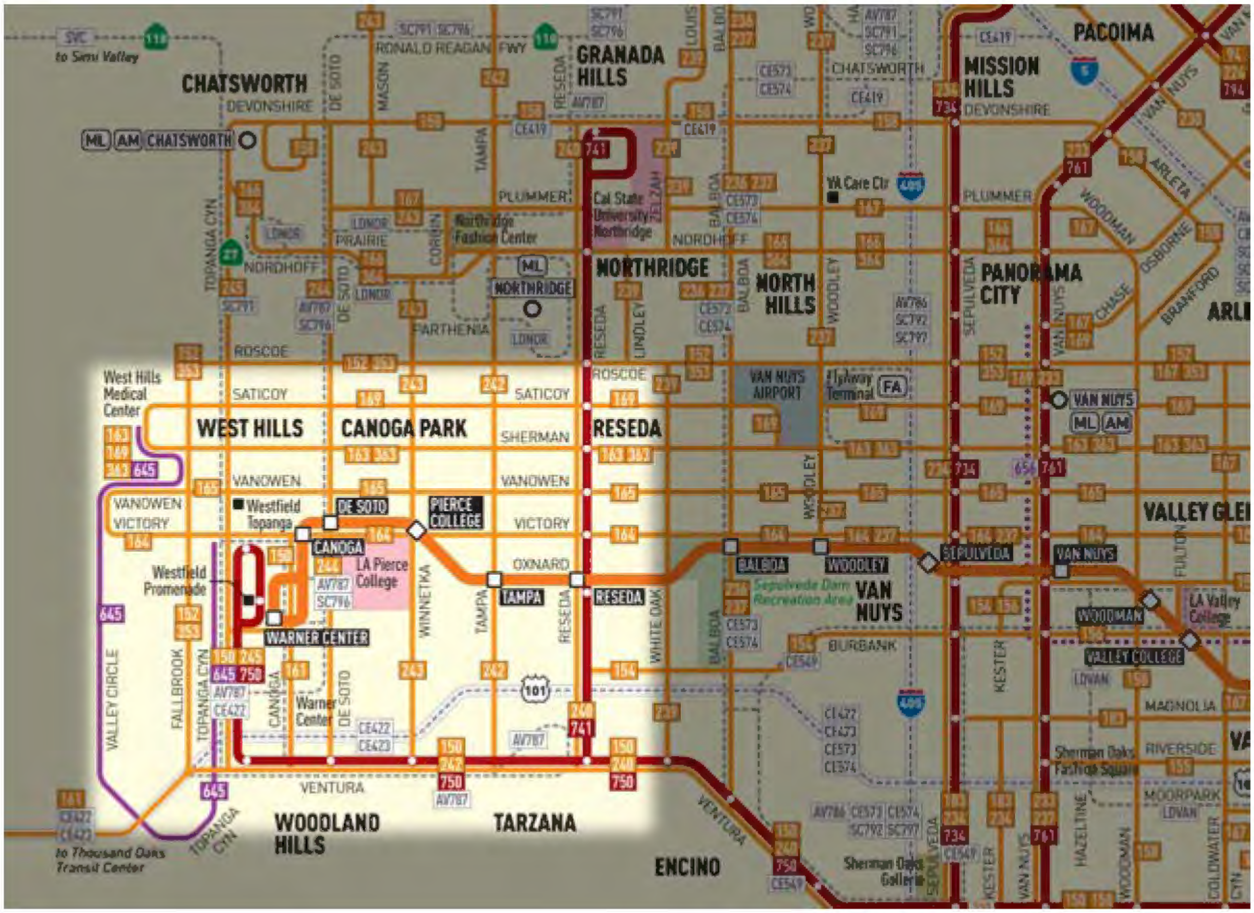
Figure 31: Transit Connections at Van Nuys Metrolink Station



The Metro Orange Line also crosses the study corridor, just north of US 101 at Victory Boulevard, with stations west of I-405 at Balboa and Woodley Avenues and east of I-405 at Sepulveda and Van Nuys Boulevard (Figure 32). The Metro Orange Line provides BRT service through the San Fernando Valley from the West Hill/Woodland Hills area in the west, to North Hollywood/Valley Village in the east where the Metro Orange Line connects with the Metro Red Line at the North Hollywood station.

Metro

Figure 32: Western Segment of Metro Orange Line



The Metro Rapid route 750 runs on Ventura Boulevard providing service between West Hills/Woodland Hills and the Metro Red Line Universal City station, as do the Metro Local routes of 150 and 240 that provide service between West Hills/Woodland Hills and Cal State Northridge, respectively, and the Universal City Metro Red Line station. North-south Metro Rapid routes include the route 741 west of I-405 traveling on Reseda and routes 734 and 761 that travel on Sepulveda and Van Nuys Boulevard respectively from the Sylmar/San Fernando area to Sherman Oaks and UCLA. These primary transit services are complemented by Metro Local routes that provide service throughout the San Fernando Valley.

Transit service across the Sepulveda Pass is provided by the Metro Rapid route 761 between Sylmar and UCLA and the Metro Local late-night/early morning route 233, both of these route travel through the pass primarily on Sepulveda Boulevard, not the I-405. Two LADOT Commuter Express routes, the 573 and 574 provide service from the Sylmar/San Fernando/Mission Hills area across the pass using the I-405 to UCLA/Century City and LAX/El Segundo, respectively. The Antelope Valley Transit Authority provides commuter-based service from Lancaster/Palmdale to the Century City/Hollywood area on the route 786 traveling on the I-405 across the Sepulveda Pass.

The City of Santa Clarita Transit provides service between Santa Clarita and UCLA, Westwood and Century City on two routes – the route 797 provides service from Santa Clarita in the morning and back in the afternoon, while the route 792 provides reverse commute service to Santa Clarita in the morning and to Westside LA in the afternoon. The Santa Clarita routes typically travel across the pass on I-405, but drivers are given discretion to divert to Sepulveda Boulevard based on traffic. Los Angeles World Airport Flyaway coach service is offered between the Van Nuys Airport and LAX across the Sepulveda Pass using the I-405. The Flyaway service is provided throughout the day with headways ranging between 15 minutes and an hour based on time of day.

8.3.2 Westside Transit Facilities and Services

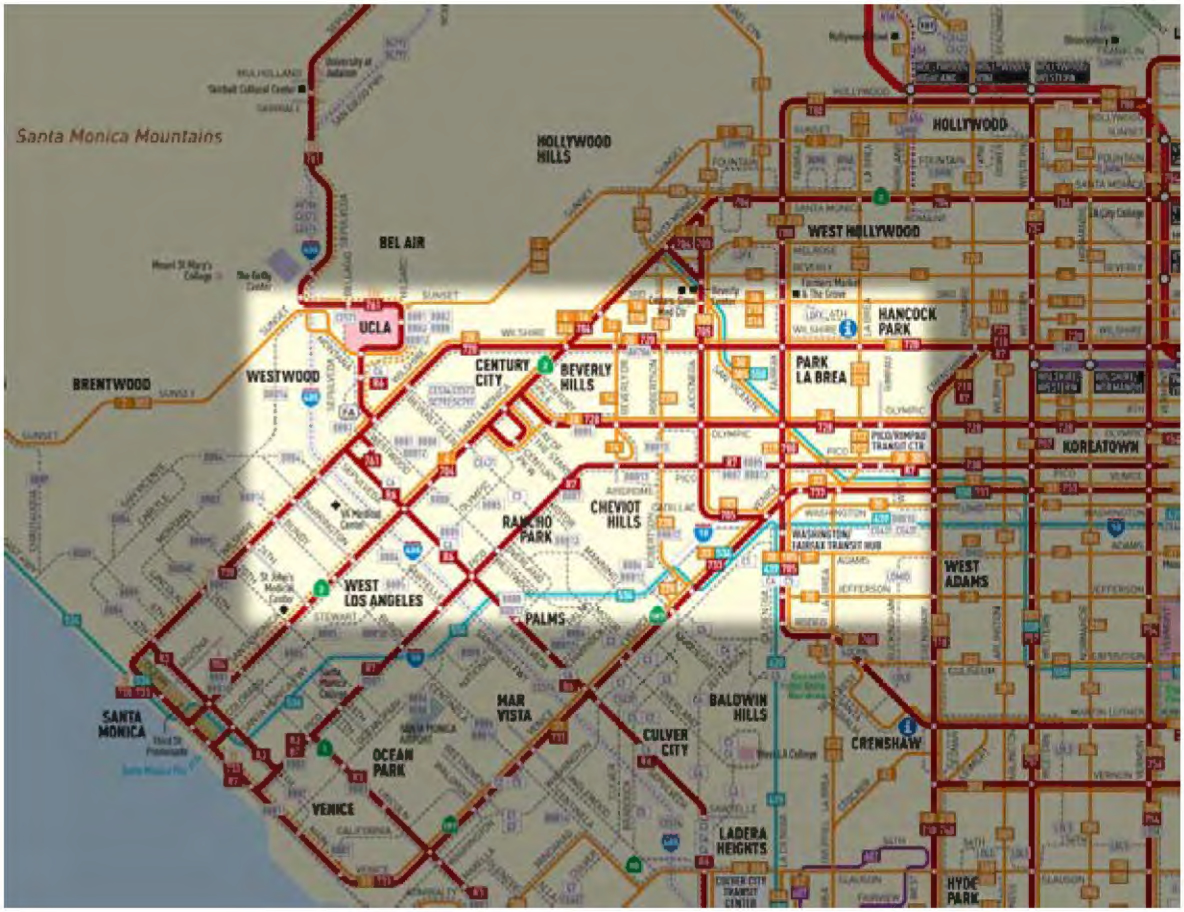
There are fewer major transit station connections in Westside LA in comparison to the San Fernando Valley (Figure 33). The Study Area intersects with a number of Metro Rapid routes between Santa Monica, Venice and Marina Del Rey, but the only major rail connection is with the Green Line at Aviation/LAX at the southern end of the identified Study Area.

The Study Area also includes the Culver City Transit Center, located at Sepulveda Boulevard and Slauson Avenue, in the northeast quadrant of I-405 and SR 90. Metro routes with service to the Culver City Transit Center include the 108/358, 110, 728 local routes and the Metro Express route 439.

Metro Rapid routes providing east-west service that intersect with the study corridor in the Westside LA area include the routes 720, 704, and the 733 traveling on the major arterials of Wilshire, Santa Monica, Olympic, and Venice Boulevards, respectively. The Rapid routes are complemented by the Santa Monica Rapid route 7 that provides service to downtown LA and Hollywood and intermediate locations. North-south Rapid service is provided by the Santa Monica's Big Blue Bus Routes 3 and Rapid 3, offering service from LAX to Santa Monica and Westwood via Lincoln and Culver City Rapid Line 6, connecting LAX to Westwood via Sepulveda.

The City of Santa Monica’s Big Blue Bus operates many bus lines within the proximity of the I-405 corridor that provide transit service between residential neighborhoods and employment centers. Generally, the Big Blue Bus lines connect the surrounding cities to the City of Santa Monica. None, however, travel across the Sepulveda Pass using the I-405 Freeway. The Big Blue Bus operates thirteen local routes, three Rapid routes, the Super 12 (UCLA Commuter), and the VA Commuter. In addition, the Big Blue Bus operates the Crosstown, the Sunset, and the Downtown Ride, which are community circulator routes. The Big Blue Bus local routes generally operate on Wilshire Boulevard, Santa Monica Boulevard, Olympic Boulevard, Pico Boulevard, and National Boulevard. Most connect downtown Santa Monica with the VA Hospital and UCLA/Westwood areas in an east-west direction. Route 14 is one of the few local routes that run north-south connecting Culver City to Brentwood via Bundy Drive and Barrington Avenue. Rapid 3 connects downtown Santa Monica with LAX via Lincoln Boulevard; Rapid 7 connects downtown Santa Monica to the Metro Wilshire/Western station via Pico Boulevard; and Rapid 10 provides service between downtown Santa Monica and downtown Los Angeles via the Interstate 10 Freeway.

Figure 33: Westside East-West Transit Service



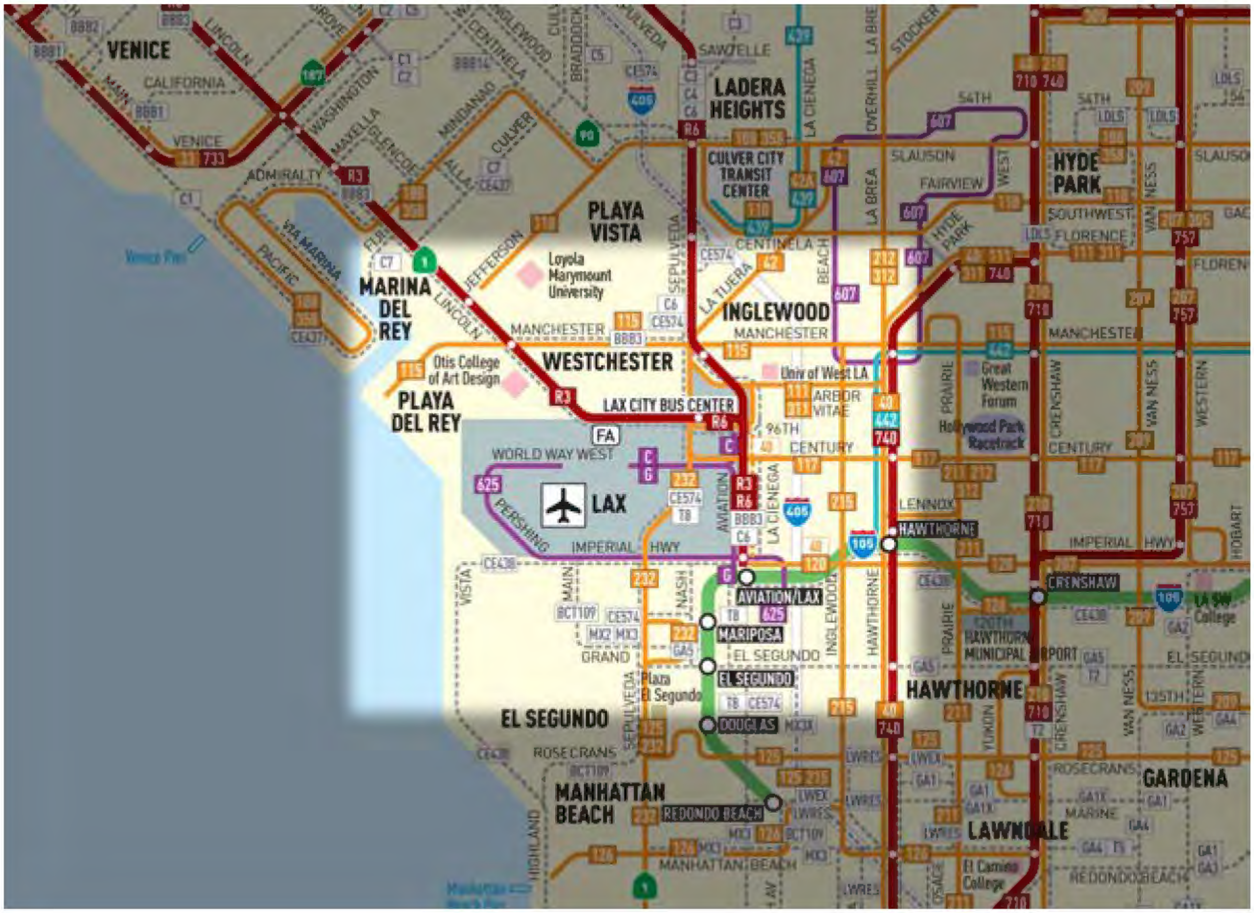
8.3.3 South Bay Transit Facilities and Services

Figure 34 depicts existing transit service in the LAX area. The Aviation/LAX Green Line station is at the southern terminus of the identified study corridor. The Metro Green Line provides rail service between the El Segundo/Redondo Beach areas to areas, east to Norwalk, with connections to the Silver Line at the Harbor Freeway station and the Metro Blue Line at the Imperial/Wilmington station, as well as multiple agency bus routes. Approximately 12 bus routes provide connecting service to the Aviation/LAX Green Line Station: Metro routes 120 (shuttle service to terminals) and 625(shuttle service to maintenance area west of terminals), Santa Monica's Big Blue Bus Rapid and local routes 3, Culver City local route 6, Los Angeles World Airport (LAWA) "G" shuttle, LADOT Commuter Express 438, Beach Cities Transit route 109, Torrance Transit Route 8, and Max Transit routes 2, 3/3X.

Approximately 12 bus routes serve the LAX City Bus Center, located slightly northeast of the terminals in Parking Lot C: Metro routes 40 (OWL), 42, 111/311, 117, and 232, Culver City Rapid and local routes 6, Santa Monica's Big Blue Bus Rapid 3 and local route 3, LAWA "C" Shuttle, Beach Cities Transit route 109, and Torrance Transit route 8.

Metro

Figure 34: Transit Near LAX



8.4 Transit Connectivity and Convenience

Fixed-route bus service in the Sepulveda Pass Area is more developed on major east-west arterials. In the San Fernando Valley, the east-west arterials with strongest transit service in terms of travel times, connectivity, and convenience are Oxnard and Ventura Boulevards. Oxnard Boulevard is served by the Metro Orange Line.

The Metro Orange Line offers travelers short travel times, due to the dedicated bus way the vehicles travel on, as well as connectivity to key north-south arterials, such as Reseda, Sepulveda, and Van Nuys Boulevards. The Metro Orange Line also includes a key transfer point to the Metro Rail Red Line at the North Hollywood Station, offering passengers a one-seat ride into downtown Los Angeles. Ventura Boulevard is served by Metro Bus routes 750 (Rapid) and 242, 240 and 158.

Three major north-south arterials are served by rapid bus lines, Reseda, Sepulveda, and Van Nuys Boulevards, and the southern-most portion of Topanga Canyon Road near the Warner Center. However, in order for a passenger to make an east-west connection between these major arterials, they must travel on local or municipal bus lines, unless it is convenient for them to take Metro Rapid 750 on Ventura Boulevard or the Orange Line on Van Nuys

Boulevard. Making an east-west connection via transit is challenging for passengers making trips in the northern portion of San Fernando Valley, as all east-west arterials in this area are served by local bus services with longer travel times.

In the Westside, east-west connections are much stronger than north-south connections. West of the I-405, there are four Rapid lines: 720 on Wilshire, 704 on Santa Monica, 733 on Venice Boulevard (all operated by Metro), and R7 on Pico (operated by Santa Monica's Big Blue Bus). East-west connections are mainly provided by Santa Monica's Big Blue Bus local service.

The strongest north-south connections in the Big Blue Bus System travel along Westwood Boulevard (1, 8, 12/Super 12, 11). Culver City Bus Rapid 6 serves Sepulveda Boulevard.

In the South Bay, north-south connections are stronger than east- west connections. Metro Rapid route 740, Santa Monica's Big Blue Bus Rapid route R3, and Culver City Bus Rapid route R6 serve major north-south arterials in the South Bay (Lincoln, Sepulveda, and Hawthorne Boulevards). Aside from Metro Rapid 733 on Venice Boulevard, all other east-west arterials are served by local bus services with longer travel times.

9.0 PLANNED TRANSPORTATION FACILITIES

The following discussion provides an overview of the planned major roadway and transit facilities and services within or adjacent to the I-405 Sepulveda Pass Study Corridor.

9.1 Highway/Roadway Facilities

Table 9 lists the planned roadway improvements within the study corridor. Within or adjacent to study corridor, the primary roadway facility changes are those that are currently underway on the I-405 with the addition of the northbound HOV lane from the I-10 to the US 101. Direct connectors for the west movements at the I-405 and US 101 interchange are under study in the preliminary planning phase. The right-of-way along US 101 is constrained, but operations improvements have been explored.

Other major HOV projects that are either currently under construction or anticipated to be constructed in the future include the addition of an HOV lane in each direction on I-5 between SR 118 and SR 170, immediately to the south of Sylmar/San Fernando, as well as the construction of direct connection ramps at I-5 and SR 14, and I-5/SR 170 under construction.

There are a number of other operational, ramp and interchange improvements under consideration across Los Angeles County, including those under consideration in Las Virgenes and Malibu, Arroyo Verdugo, and South Bay Subregions. However, all of these locations are considerably beyond the Study Area and do not add major general purpose or HOV capacity.

Table 9: Planned Roadway Improvements

Project Name	Project Description	Relevance to Sepulveda Pass Transit Study
I-405 Sepulveda Pass Improvement Project	Construct a northbound HOV lane from I-10 to US 101 across Sepulveda Pass. Associated interchange improvements. • Ramp modifications at Santa Monica Blvd interchange • Ramp modifications and grade separations at Wilshire Boulevard interchange. • Closure of the NB off-ramp to Montana/Sepulveda • Ramp modifications and Sunset Bridge improvements. • Ramp improvements at Moraga Dr. northbound off and on ramps • Modification of Skirball Center Drive ramps and intersection with Sepulveda Blvd. • Reconstruction of southbound Valley Vista/Sepulveda Blvd off-ramp.	This project will allow the consideration of potential Express Bus and BRT operations to address demand across Sepulveda Pass within the study corridor, as well as the potential to explore changes in the current lane configuration to accommodate two managed lanes while still maintaining five general purpose travel lanes.
I-405, I-110, I-105 and SR 91 Ramp & Interchange Improvements	Development, design and construction of freeway and arterial related operational improvements in the South Bay Area. Projects that may be recommended include the addition of auxiliary lanes, modification of interchanges and ramp connections that could include metering and changes in access points. Recommended projects may also include arterial improvements that show congestion pricing benefits to these facilities.	Projects are expected to improve freeway and arterial flows in the southern portion of the corridor, however, these are expected to be localized in nature and not greatly affect demand across Sepulveda Pass. The proposed projects may influence potential express bus and BRT alternatives under consideration.

Project Name	Project Description	Relevance to Sepulveda Pass Transit Study
I-5/SR 14 Direct Connections	Construction of a HOV to HOV connector to join the HOV lanes on I-5 and SR 14, improving HOV connectivity at this location.	This project is just to the north of the study corridor, but will provide HOV connectivity at a major junction point and could influence potential express bus and BRT alternatives.
I-5 Capacity Improvement SR 134 to SR 118	Construction of an HOV lane on the I-5 in each direction, between SR 134 and SR 118, as well as an HOV to HOV direct connector between the existing SR 170 HOV lanes and the I-5 HOV lanes.	This project is just to the south and east of the Study Area, but will provide greater overall HOV network capacity and connectivity with potential to reduce demand on I-405 within the San Fernando Valley.
Overland Avenue/I-10 Freeway Project	Widening the existing bridge to eight lanes, providing an additional lane in the northbound direction.	This project provides localized intersection traffic benefits at the Overland Avenue interchange with I-10
Skirball Center Drive Widening Phase II	Widen and realign Skirball Center Drive to provide an additional southbound lane from Mulholland Drive to just south of the northbound I-405, and restriping of the westbound Skirball Center Drive approach to the I-405 southbound on-ramp for improved operations.	Project provides improved localized traffic benefits to Skirball Center Drive. Improved operations at the intersection of Sepulveda and Skirball Center drive may benefit bus operations on Sepulveda Pass.
San Fernando Mission Boulevard Widening (Sepulveda Blvd to I-5)	Widen San Fernando Mission Blvd from one lane of traffic in each direction to two lanes between Sepulveda Blvd and the I-5.	Project will provide additional east-west capacity in the northern section of the study corridor, and may influence the express bus or BRT alternatives under consideration due to the proximity to the Sylmar/San Fernando Metrolink Station and associated transit connections.

Project Name	Project Description	Relevance to Sepulveda Pass Transit Study
Culver City Sepulveda Boulevard Widening Project	Construction of a third southbound lane on Sepulveda Boulevard between Jefferson Boulevard/Playa Street and Green Valley Circle (approximately ½ mile).	Reduces congestion on Sepulveda Boulevard by improving southbound capacity. May influence potential express bus and BRT alternatives under consideration due to proximity to Culver City Transit Center.

9.2 Transit Facilities & Services

Figure 35 depicts the existing and planned transit infrastructure in the Sepulveda Pass Area. Major planned transit facilities and services include the extension of the Metro Orange Line from Canoga Park (Canoga station) north to Chatsworth, connecting to the Chatsworth combined Metrolink and Amtrak station. Also, currently underway is the East San Fernando Valley Transit Corridor AA/DEIS/DEIR Study. While this study is on-going with no finalized transit mode or routing selected, the potential outcomes of this study have been taken into consideration while assessing the potential transit concepts for the Sepulveda Pass project.

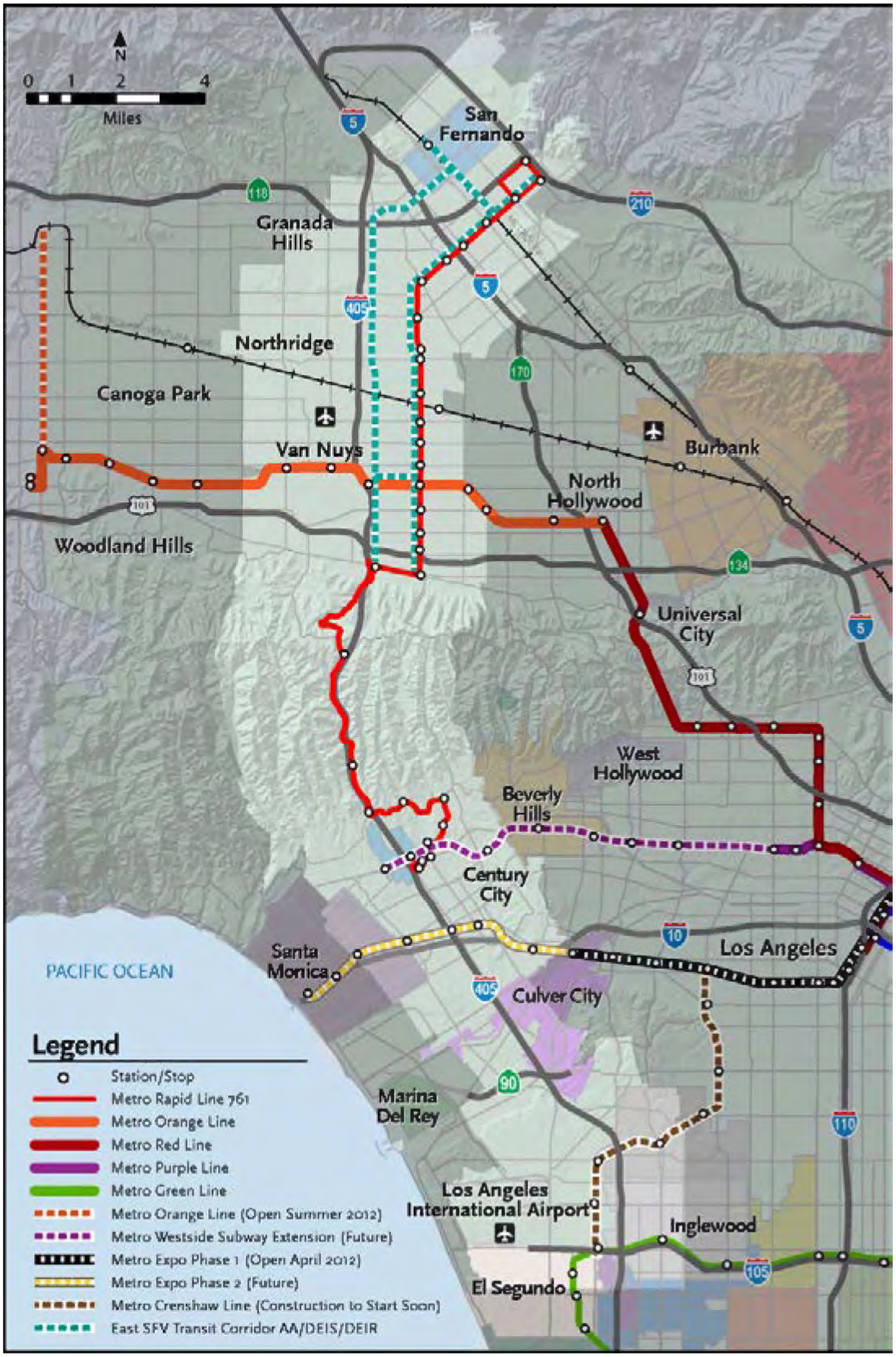
South of Sepulveda Pass in the Westside LA area, a number of rail extensions are in various stages of planning, design and construction. The first is the Westside Subway Extension that will extend the current terminus of the Purple Line from Koreatown to Westwood with stations on both the east and west sides of I-405 at UCLA and the VA Hospital.

Continuing south along the study corridor, the under construction Exposition Line will intersect with the study corridor near the I-10. Five stations are planned that are either within or adjacent to the study corridor – they include the Olympic/26th Station in Santa Monica and the Expo/Bundy station that are east of I-405, the Expo/Sepulveda, Expo/Westwood and the National/Palms stations are west of the I-405 in Mid-City.

Near Westchester and LAX, the study corridor will include the Crenshaw/LAX Line that will soon start construction and connect the Exposition Line to the Green Line via Hyde Park and Inglewood. Stations along the Crenshaw line include one immediately east of LAX on Aviation at Century, the Green Line connection station at Aviation/LAX. Extension of the Green Line to LAX and south from the Redondo Beach station are in the early planning and Alternatives Analysis stages.

The City of Los Angeles Westside Mobility Plan is evaluating potential transit improvements such as bus only lanes, bus tunnel (to bypass I-405 congestion) alternatives and other strategies in the Westside of Los Angeles. The study is ongoing and alternatives are still under evaluation.

Figure 35: Existing and Planned Transit Infrastructure in Sepulveda Pass Area



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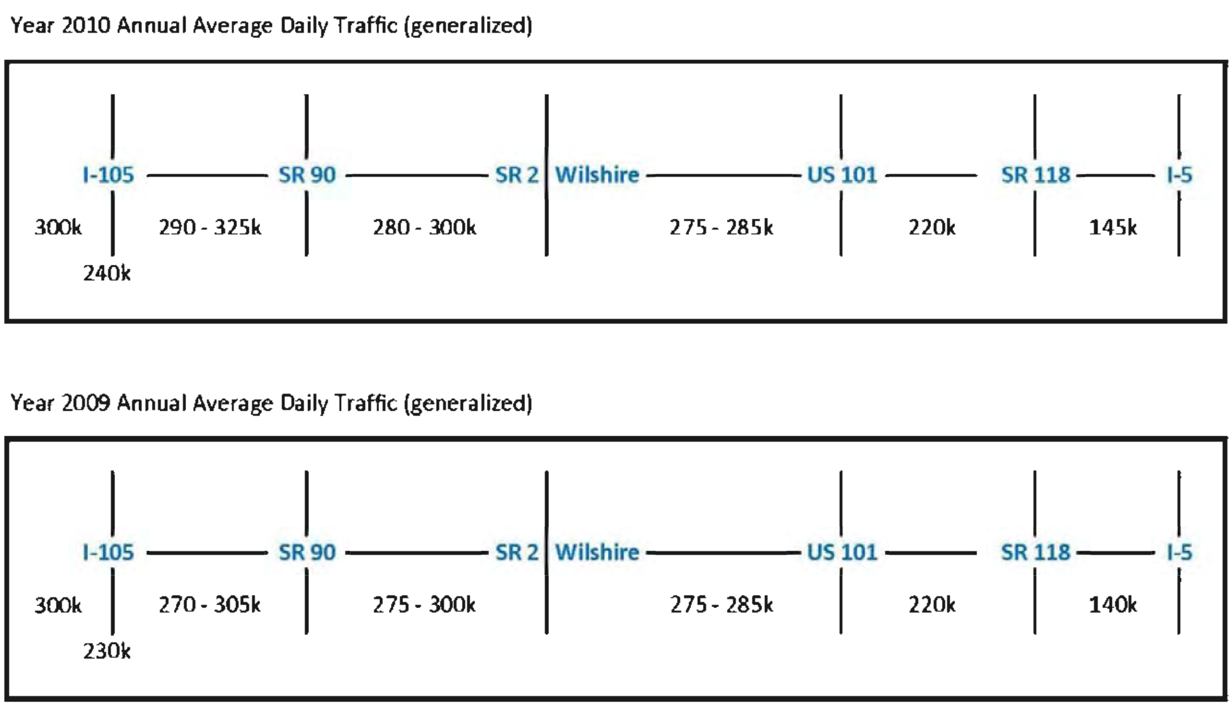
10.0 FREEWAY MAINLINE PERFORMANCE

10.1 Annual Average Daily Traffic (AADT)

In reviewing Caltrans Annual Average Daily Traffic data for I-405 within the Study Area for the years 2010 and 2009, clear patterns of travel emerge in both years (see Figure 36). The interchange junction with I-105 is a major connection point south of Sepulveda Pass, as are the US 101 and SR 118 north of Sepulveda Pass.

I-105 is one of the access points for LAX and the surrounding airport related employment and provides primary access to points east and major north-south freeway connections to I-110, I-710 and I-605. As a result, there is a considerable change in Annual Average Daily Traffic (AADT) at the I-105 interchange, as traffic south of I-105 is estimated at 300,000 AADT, while traffic estimations within the interchange area are estimated at 240,000, with an estimated 60,000 AADT exiting and entering the roadway.

Figure 36: Annual Average Daily Traffic



AADT is highly variable between I-105 and the Wilshire and Santa Monica Boulevard (SR 2) interchanges, though there are some generalizations that can be drawn for the traffic patterns south and north of SR 90. High volumes of traffic enter and exit I-405 between I-105 and SR 90, varying from 240,000 AADT within the I-105 interchange to 325,000 AADT prior to the exit points to La Cienega, La Tijera and Sepulveda Boulevards and the surrounding areas south of SR 90. North of SR 90, AADT generally remains in the 280,000 to 300,000 range, with major entry and exit points being I-10 and Santa Monica Boulevard (SR 2).

Across Sepulveda Pass, AADT stays relatively stable, ranging between 275,000 and 285,000, with Sunset Boulevard generating the largest change in traffic of the interchanges across the pass. On the north side of the Sepulveda Pass, US 101 is a clear connection point for I-405 traffic, with an approximate change in AADT on I-405 of 60,000 north of US 101.

Within the San Fernando Valley, AADT on the I-405 stays relatively stable in the 220,000 range, between the US 101 and SR 118. SR 118 is another clear break/transition point in traffic demand and resulting volumes, with AADT value of approximately 145,000 between SR 118 and the I-5.

10.2 Freeway Traffic Flow

10.2.1 Freeway Performance – AM & PM Peak Period Traffic Flows

The following discussion provides 2008 (Existing Condition) morning and evening peak period[5] traffic flow data for general purpose lanes on the I-405, as extracted from the SCAG 2008 Base Year RTP model, which is in the process of being validated for the Study Area. HOV lane performance is discussed separately in Section 11.0.

10.2.2 AM Peak Period

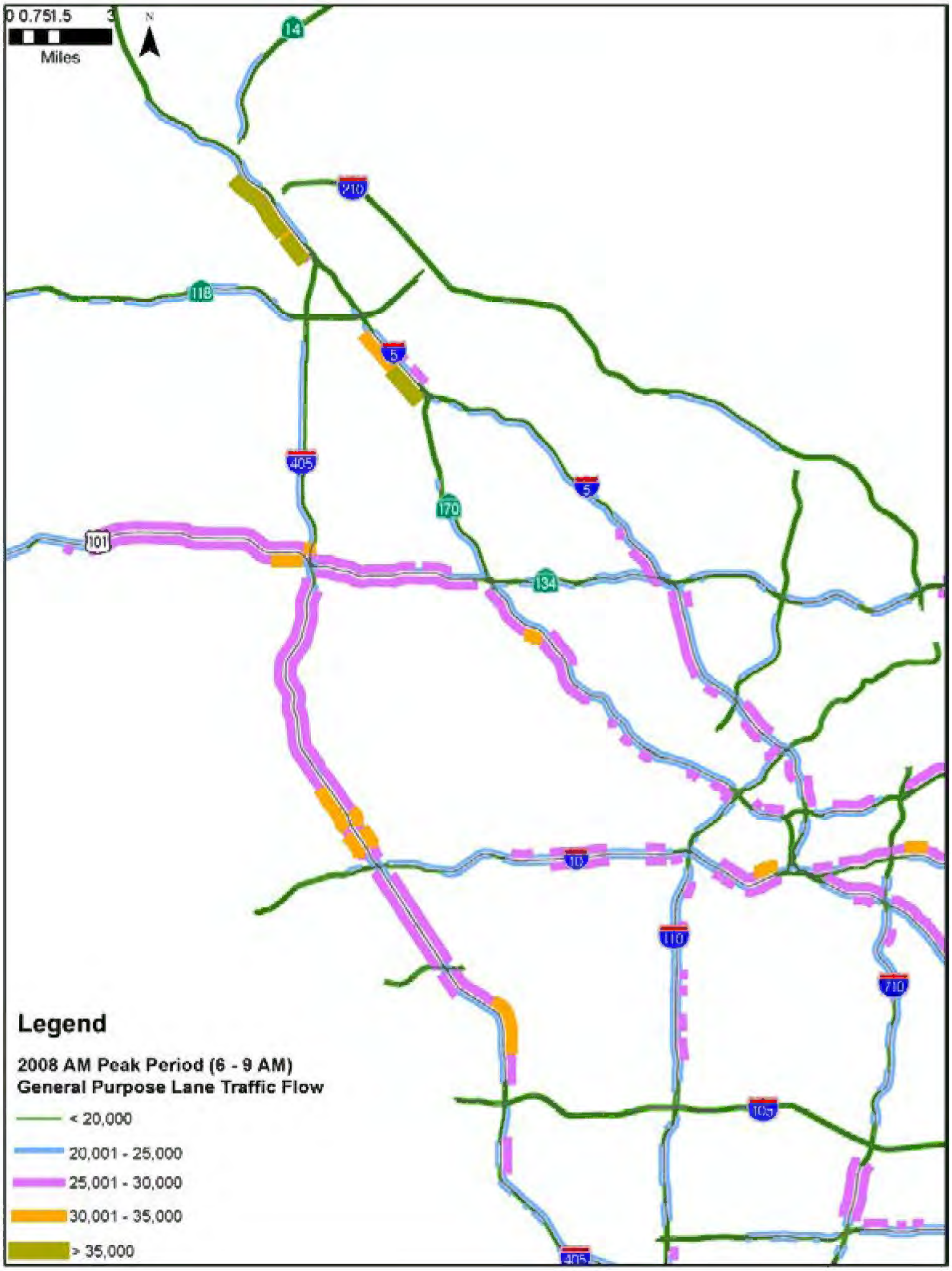
Figure 37 depicts the freeway mainline traffic flow in the AM peak period in 2008. Northbound traffic volume flows entering the study corridor on I-405 combine with those entering at I-105 for a peak period northbound traffic flow of 25-30,000 just after I-105, with volumes building to 30-35,000 approaching the Manchester and La Cienega Boulevards connections. After this point, northbound traffic flows are maintained within the 25-30,000 range to the I-10 interchange. Traffic flows increase immediately after the I-10 interchange accommodating both I-405 and traffic from I-10, and then are maintained in the 25-30,000 range as traffic disperses and joins I-405 through the Culver City, West LA and Santa Monica areas. AM peak traffic flows of 25-30,000 are maintained across Sepulveda Pass to the Sepulveda and Ventura Boulevard and US 101 exit points. North of the US 101, northbound morning period traffic flow drops to less than 20,000 vehicles through the San Fernando Valley and to the junction with the I-5.

In the southbound direction, traffic flows on the I-405 at the very northern portion of the study corridor are projected at less than 20,000 vehicles in the morning peak period. Traffic flows increase to the 20-25,000 range after SR 118 and this range is maintained through the San Fernando Valley, as traffic disperses and joins I-405 traffic to the connection point at US 101. Traffic volumes increase to the 25-30,000 range after the US 101 interchange and remain in this range across Sepulveda Pass to the Sunset interchange area, where traffic flows increase to 30-35,000 and are maintained to the I-10 interchange, with a noted change in traffic flows at Santa Monica Boulevard/SR 2 interchange. South of the I-10, southbound morning peak traffic flows of 25-30,000 are steady to just after the SR 90 interchange, where traffic flows to Westchester, Fox Hills and LAX areas via the Sepulveda Boulevard and Howard Hughes exit. South of this point to the I-105 interchange, traffic flow drops to 20-25,000 and then to less than 20,000 as traffic exits I-405 to I-105 and the surrounding arterial streets.

[5] The morning peak period is designated as 6 to 9 AM and the evening peak period is designated as 3 to 7 PM.

Other morning peak traffic flows within the corridor to note are those on US 101 as they approach I-405 from the west, with traffic flows of 30-35,000 during the morning peak period. In general, all traffic flows on US 101 exceed those found for other major interchange points of SR 118, I-10 and I-105 during the morning peak period, which illustrates the demand at this interchange and the overall demand funneling through this area. Also indicative of overall demand in the Santa Monica, West LA and Culver City areas are the high bi-directional vehicle volumes just north of the I-10 interchange.

Figure 37: Mainline Traffic Flow in the AM Peak Period (2008)



Source: SCAG 2008 RTP base year model

10.2.3 PM Peak Period

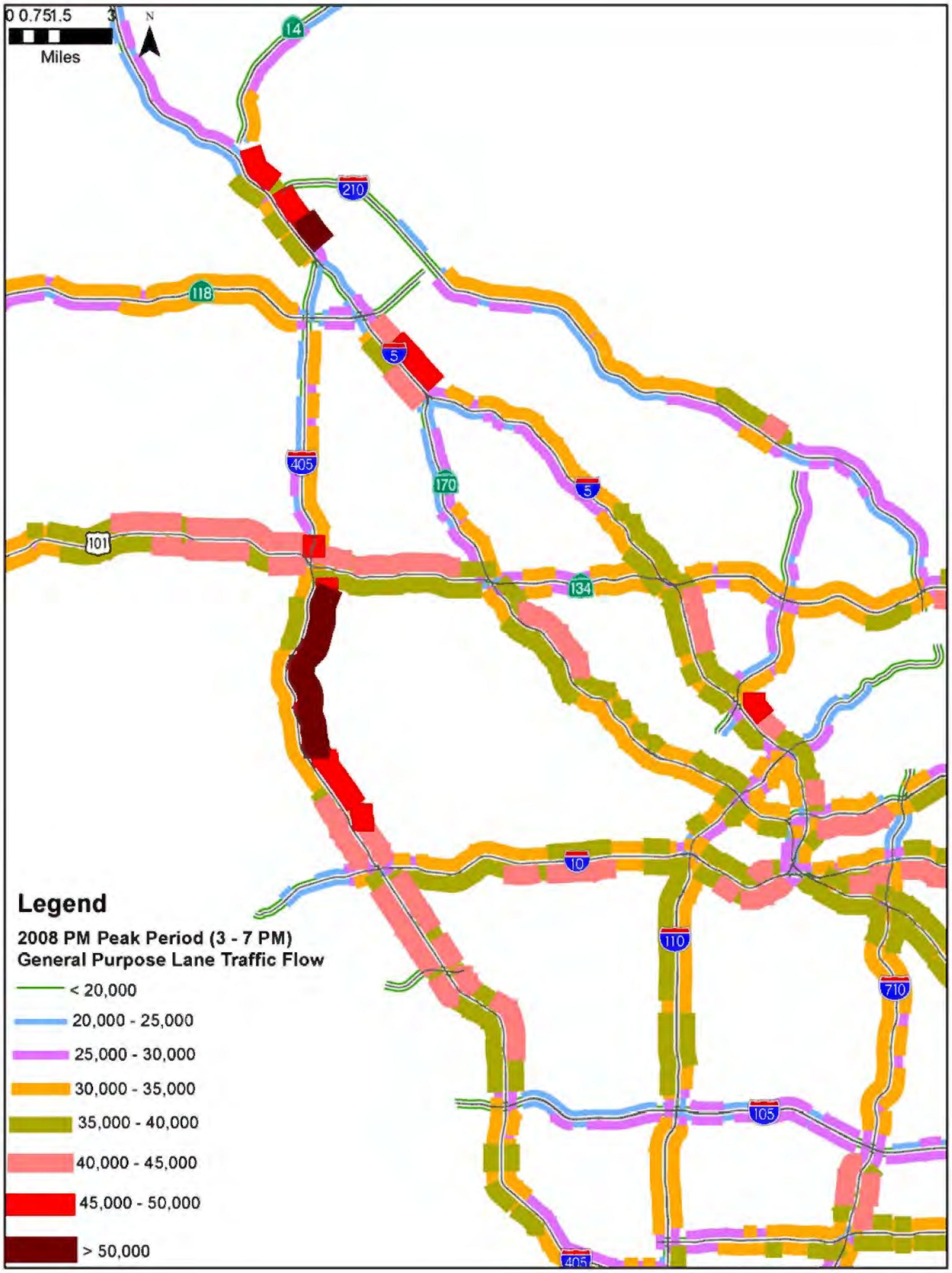
Figure 38 depicts the freeway mainline traffic flow in the PM peak period in 2008. PM peak period traffic flows are considerably higher across the entire roadway network when compared to the morning peak period; nowhere is that in evidence more than on I-405 within the study corridor, where the longest segment of traffic flows greater than 50,000 is across Sepulveda Pass.

Entering the study corridor from the south general purpose traffic volumes are for northbound I-405 and I-105 combine to the 35-40,000 range and quickly increase to 40-45,000, generally remaining at this level to just north of I-10. Traffic flows increase at the Santa Monica Boulevard interchange to the 45-50,000 range and then increase again at the Sunset interchange to greater than 50,000 and is maintained in this range across Sepulveda Pass to US 101. Northbound traffic volumes on I-405 after the US 101 interchange drop considerably to the 30-35,000 range, as traffic disperses to US 101 and Sepulveda and Ventura Boulevards. Through the San Fernando Valley, traffic flows on I-405 remain in the 30-35,000 range. After the SR 118 interchange, northbound traffic flows drop to the 20-25,000 range, as traffic disperses primarily to the west on SR 118.

The PM peak period traffic flows at the north end of the study corridor are relatively high on southbound I-5 and similar to the morning findings, split and are less than 20,000 on I-405 approaching the SR 118 interchange. Traffic flows are relatively moderate through the San Fernando Valley, with the majority of this segment being in the 20-25,000 range until Sherman Way, where traffic flows increase to 25-30,000 approaching the I-405 and US 101 interchange. Across Sepulveda Pass, traffic volumes are relatively steady at 30-35,000, with an increase seen between the US 101 merge and the exit to Mulholland Drive. Traffic flows increase coming out of the pass approaching Wilshire Boulevard to the 40-45,000 range and generally remain at these levels until just south of SR 90, where traffic exits to Westchester, Fox Hills and LAX areas at the Sepulveda Boulevard/Howard Hughes exit. South of this location, traffic flows remain in the 35-40,000 range to I-105, where traffic flows are slightly less, but remain at greater than 30,000 vehicles.

Other traffic flows to note include those on northbound I-5 immediately after the junction with I-405, where traffic flows are greater than 50,000 and then 45,000 approaching SR 14. Similar to the morning peak period findings, traffic flows on US 101 are quite heavy in all directions, with higher flows on the west legs. Again these traffic flows are indicative of the overall high demand levels across Sepulveda Pass and at this particular interchange as traffic funnels to Sepulveda Pass.

Figure 38: Mainline Traffic Flow in the PM Peak Period (2008)



Source: SCAG 2008 RTP base year model

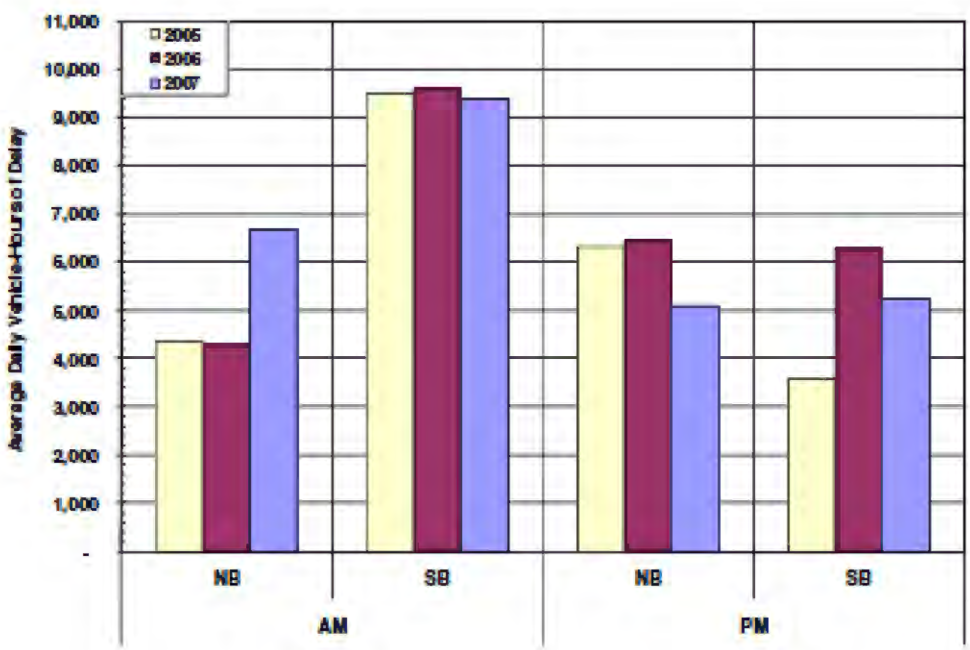
Metro

10.3 Freeway Vehicle Hours of Delay

Another important measure of mobility in the corridor is vehicle hours of delay. Vehicle-hours of delay is defined as the total observed travel time less the travel time under non-congested conditions. Annually, Caltrans used to prepare the Highway Congestion Monitoring Program (HICOMP) report. HICOMP captures recurrent congestion during "typical" incident-free weekday peak periods. Recurrent delay is defined as a condition where speeds drop below 35 mph for a period of 15-minutes or longer during weekday AM or PM commute periods.

According to the SCAG/Caltrans I-405 Corridor Systems Management Plan (September 2010), which conducted an extensive analysis of three years worth of HICOMP data, the I-405 southbound direction had the most significant congestion during the AM peak period while the northbound direction experienced the most congestion during the PM peak period. This is consistent with the traffic flow and speed maps presented above. Figure 39 shows the average daily vehicle hours of delay from 2005-2007 for the AM and PM peak travel period for both directions of the I-405 freeway.

Figure 39: Average Daily Vehicle-Hours of Delay



Source: I-405 Corridor Systems Management Plan (September 2010); Caltrans HICOMP reports

In 2009, Caltrans replaced the HICOMP report with the statewide Mobility Performance Report (MPR), which employed a new, standardized statewide methodology for measuring freeway traffic congestion using automatically collected traffic data that is reported every day of the year, twenty-four hours a day. According to the MPR 2009, Los Angeles County experienced 87.5 million annual vehicle-hours of delay (AVHD) below 60 mph. Table 10 presents the top 20 freeway bottleneck locations for 2009. Out of the 20 top bottleneck locations in Los Angeles County, five of the locations are located along the I-405 Freeway as highlighted in bold below.

Table 10: Top 20 Bottleneck Locations by Annual Vehicle-Hours of Delay

No.	County	Route and Direction	Post Mile	Name	2009 AVHD (60 mph)
1	Los Angeles	I–110 N	24.46	Dodger Stadium	957,000
2	Los Angeles	I–605 S	R15.48	Rose Hill 1	946,000
3	Los Angeles	SR–60 E	R7.74	Paramount 1	764,000
4	Los Angeles	SR–101 S	4.2	Vermont	626,000
5	Los Angeles	I–110 S	23.05	Third	619,000
6	**Los Angeles**	**I–405 N**	**34.71**	**Getty/Sepulveda**	**580,000**
7	Los Angeles	I–605 S	R9.75	North of I–5	551,000
8	Los Angeles	I–10 W	R7.81	Robertson	488,000
9	**Los Angeles**	**I–405 S**	**34.73**	**Getty/Sepulveda**	**428,000**
10	Los Angeles	I–210 E	R36.6	NB 605 To EB 210 Connector	411,000
11	Los Angeles	I–5 S	22.76	North of SR–2	403,000
12	Los Angeles	I–10 E	35.9	Lark Ellen	383,000
13	Los Angeles	SR–101 N	17.59	Haskell	374,000
14	Los Angeles	I–5 S	10.76	Garfield	372,000
15	Los Angeles	I–605 N	R19.365	Valley 1	370,000
16	Los Angeles	SR–60 W	14.98	Turnbull Canyon Rd	370,000
17	**Los Angeles**	**I–405 S**	**27.35**	**Culver**	**366,000**
18	**Los Angeles**	**I–405 S**	**33.42**	**Moraga**	**354,000**
19	**Los Angeles**	**I–405 N**	**33.42**	**Moraga**	**347,000**
20	Los Angeles	SR–101 S	12.75	Laurel Canyon	342,000

Source: Caltrans 2009 Mobility Performance Report

10.4 Freeway Level of Service (LOS)

The following discussion provides an overview of the roadway performance for the existing system and adjacent to the I-405 Sepulveda Pass Study Corridor.

10.4.1 Freeway Performance – AM & PM Peak Period Traffic Flows

The following discussion provides 2008 (Existing Condition) morning and evening peak period Level of Service for I-405, as extracted from the SCAG 2008 Base Year RTP model which is in the process of being validated for the Study Area. The morning peak period is designated as 6 to 9 am and the PM peak period is designated as 3 to 7 pm.

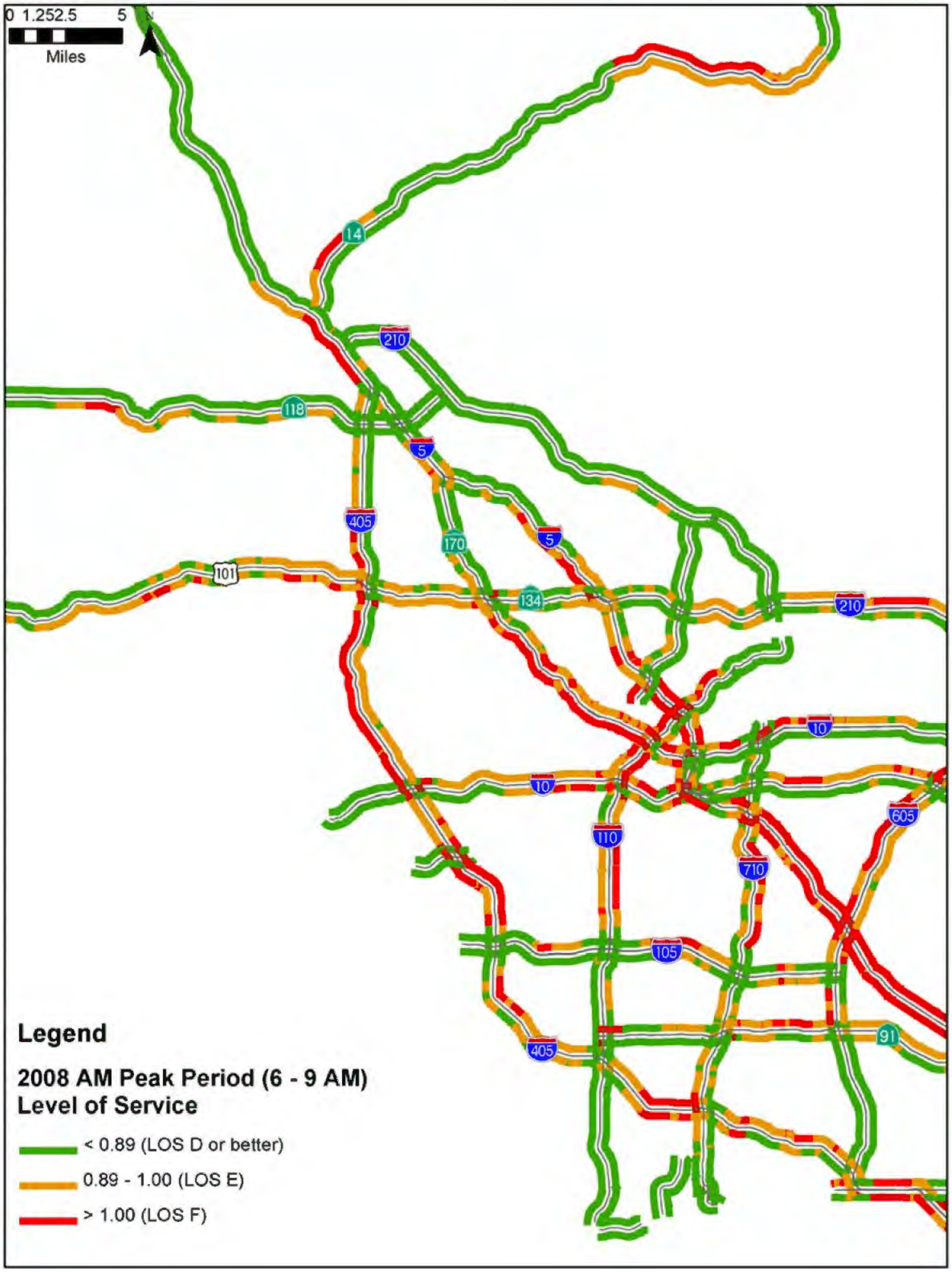
10.4.2 AM Peak Period

Figure 40 depicts AM peak period freeway level of service in both directions in 2008. In the northbound direction, traffic approaching the southern end of the study corridor is at the level of service (LOS) E to LOS F range, with a short segment where LOS improves to LOS D or better at the I-105 interchange between the exit and entrance ramps. North of the I-105 interchange, LOS degrades to LOS F to and through the SR 90 interchange, these LOS findings correspond to the projected speeds that are less than 35 mph and 20 mph approaching the SR 90 interchange. North of SR 90, through Culver City, West LA, Santa Monica and across Sepulveda Pass to the Mulholland Drive exit is at LOS E, which represents highly congested and unstable traffic flows throughout the entire morning peak period. Approaching the US 101 interchange, LOS improves to LOS D or better and continues to be at LOS D or better through the San Fernando Valley to I-5 and the northernmost portion of the study corridor.

Southbound LOS approaching the I-5/I-405 split is at LOS F, again corresponding to the speeds that are less than 20 mph. Projected LOS on I-405 through the San Fernando Valley to roughly Sherman Street varies between LOS D or better and LOS E, with the majority being at LOS E. Approaching the I-405 and US 101 interchange LOS deteriorates to LOS F, where the volumes outstrip available capacity on I-405 as it funnels into Sepulveda Pass. Across Sepulveda Pass, through Westwood, Santa Monica, West LA and Culver City, LOS is at F, indicating traffic demand is far greater than capacity and traffic flows have reached and exceeded breakdown conditions. South of the I-10 interchange, LOS varies between E and F through the remainder of the study corridor until the I-105 interchange where LOS improves to a mix of D and E exiting the study corridor.

As with speed and traffic flow projections, westbound LOS on US 101 approaching I-405 is projected to vary between unstable LOS E operations and breakdown LOS F conditions, which underscore the resultant slow speeds and high traffic demand funneling to I-405 and Sepulveda Pass discussed previously.

Figure 40: Level of Service (LOS), AM Peak Period (2008)



Source: SCAG 2008 RTP base year model

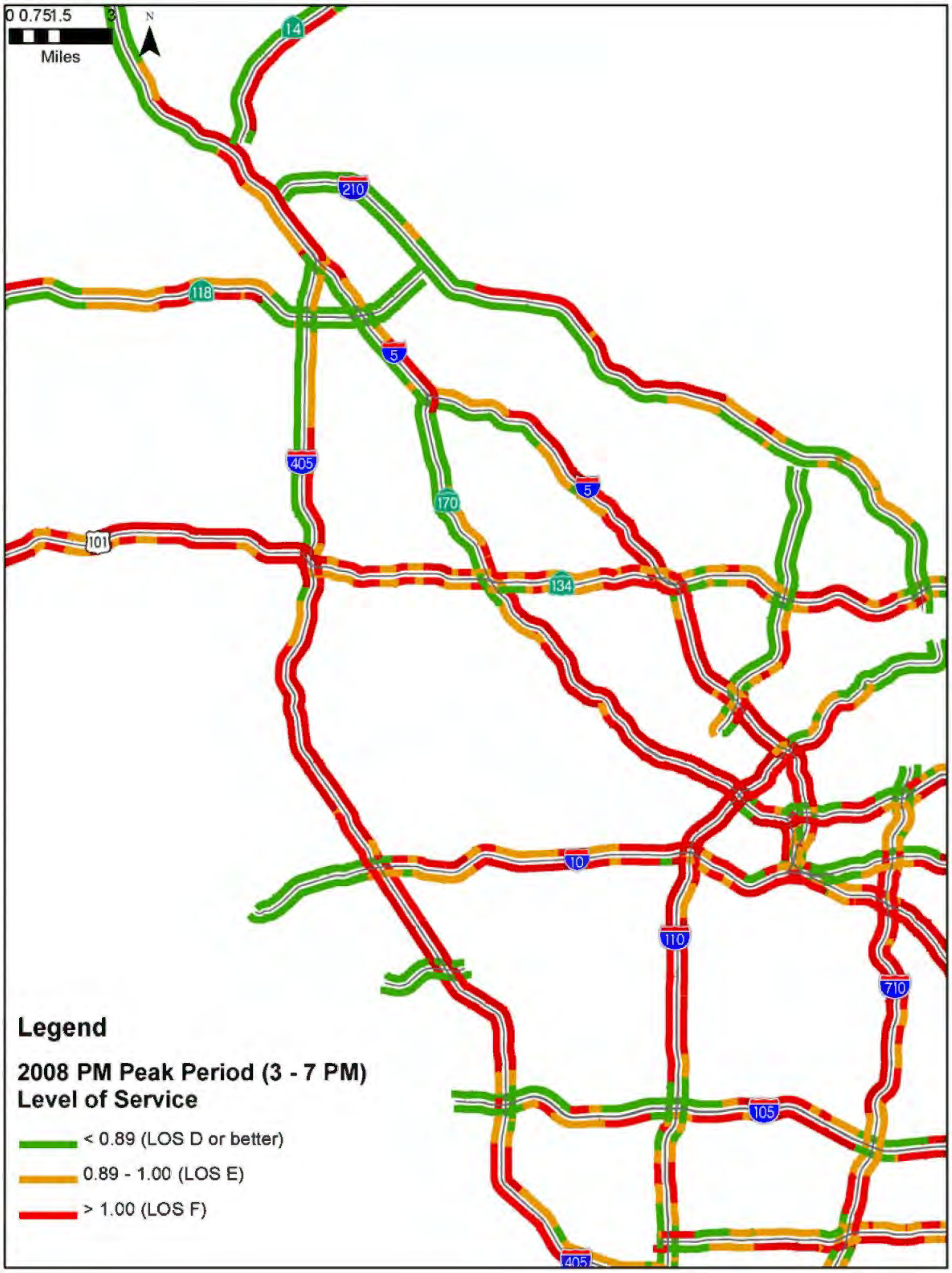
10.4.3 PM Peak Period

Figure 41 depicts PM peak period freeway level of service in both directions in 2008. Traffic approaching the southern end of the study corridor during the PM peak period is unstable and at break-down conditions. North of the I-105 interchange, level of service degrades to break-down conditions (LOS F) that extend, through the Westchester, Fox Hills, Marina del Rey, Culver City, West LA, Santa Monica, Westwood, across the Sepulveda Pass, through the US 101 interchange and into the San Fernando Valley to approximately Roscoe Boulevard. This LOS is not unexpected considering the projected peak hour traffic flows and associated speeds discussed earlier. While the LOS shown in Figure 41 does not show gradations of F, based on projected traffic flows across the Sepulveda Pass, the LOS has reached significant breakdown levels that regularly ripple upstream and through the study corridor. Beyond Roscoe Boulevard, LOS on I-405 is projected at E through the remainder of the valley to its junction with I-5. Exiting the Study Area, I-5 is projected to operate at LOS F to and through the SR 14 interchange and north to Santa Clarita.

In the southbound direction, traffic on I-405 is projected to operate at LOS D or better levels through the San Fernando Valley to the US 101 interchange. Immediately south of the US 101 and accommodating traffic from US 101, operations on I-405 vary widely from F to D to E and back to F again after the Mulholland exit; south of the Mulholland Drive exits LOS is projected to return to break-down operations (LOS F) across the remainder of the pass, through Westwood, Santa Monica, West LA, Culver City, Marina del Rey, Westchester, Fox Hills and the LAX area to I-105 at the very southern end of the study corridor. Essentially half of the 30-mile corridor is projected to be in breakdown conditions during the full PM peak period – clearly indicative of demand levels that are far beyond the available capacity provided by I-405 or the parallel arterials.

As noted previously, the conditions on US 101 impact I-405 as a generator of traffic demand bound for Sepulveda Pass and I-405's ability to off-load traffic to US 101. As can be seen, operating conditions on US 101 are primarily in the LOS F range, displaying the high levels of demand channeling through this interchange and to/from I-405. The I-10 interchange is also experiencing operational challenges, with westbound operations at LOS F approaching I-405, again contributing to the operational challenges on I-405.

Figure 41: Level of Service (LOS), PM Peak Period (2008)



Source: SCAG 2008 RTP base year model

10.5 Freeway Speeds

10.5.1 I-405 Existing Condition AM and PM Peak Period Speeds

The following discussion provides 2008 (Existing Condition) morning and evening peak period speed data for I-405, as extracted from the SCAG 2008 Base Year RTP model which is in the process of being validated for the Study Area. The morning peak period is designated as 6 to 9 am and the PM peak period is designated as 3 to 7 pm.

10.5.2 AM Peak Period Speeds

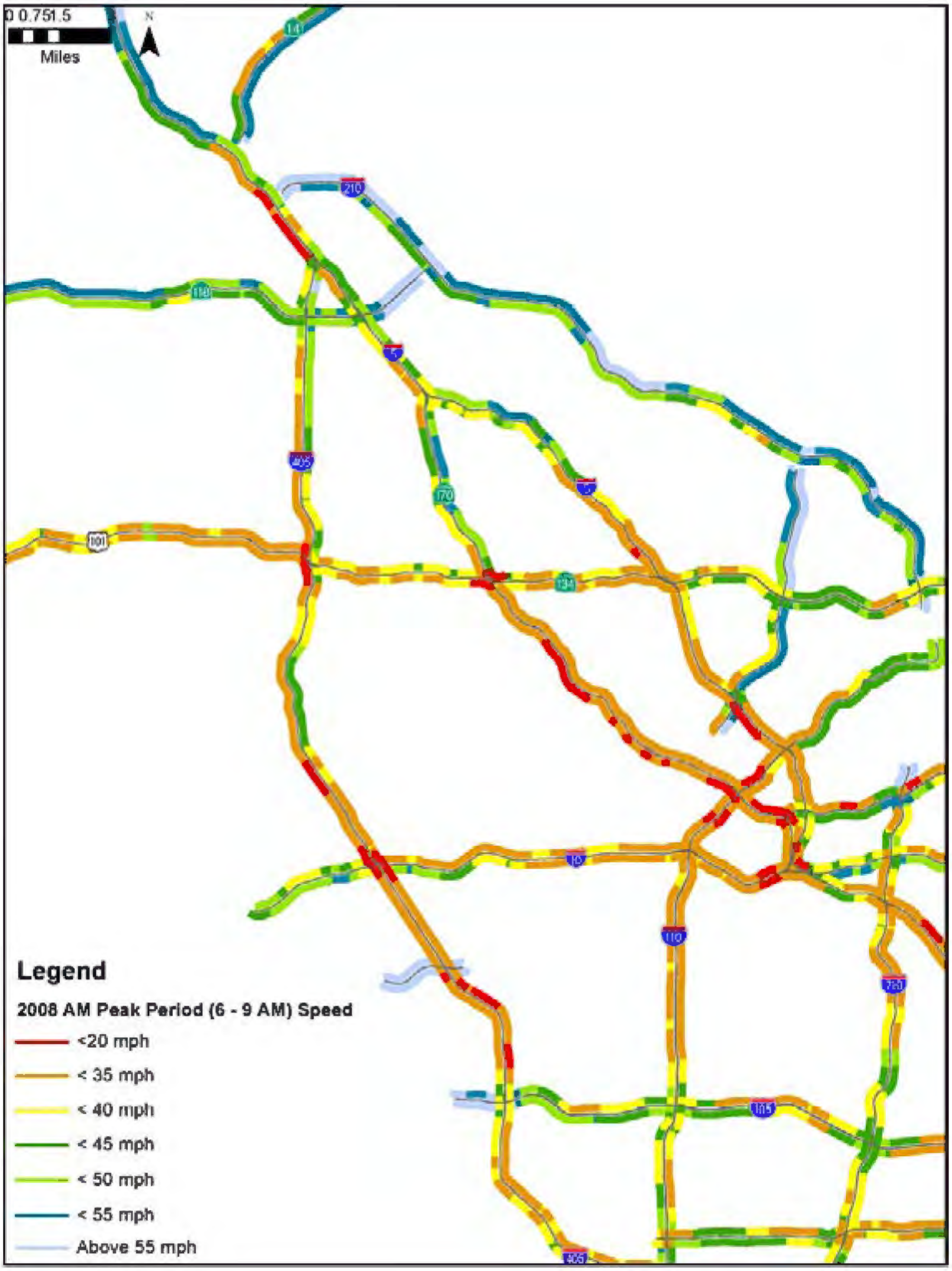
As shown in Figure 42, traffic speeds on I-405 within the study corridor are considerably less than the free-flow speed of 55 mph. In the northbound direction, traffic entering the study corridor south of I-105 is projected to travel at speeds less than 35 mph, but not less than 20 mph. After I-105, projected speeds drop to less than 20 mph near the W Century Boulevard interchange and where the I-105 northbound on-ramps merge onto I-405. Speeds improve slightly after the merge/weave section north of I-105, but then drop back to less than 20mph prior to SR 90. Speeds remain slow (<35mph) through the Culver City, West LA and Santa Monica areas, with areas of increased congestion and slow speeds at the I-10 interchange. Speeds are projected to improve to the 40 to 45 mph range across the pass to the Mulholland interchange area, where speeds slow as traffic approaches US 101. North of the I-405 and US 101 interchange, northbound speeds on I-405 progressively improve to the 45 to 50 mph range, with higher speeds north of the SR 118 interchange.

Speeds in the southbound direction are estimated to be less than 35 mph for nearly the entire study corridor. North of SR 118 speeds are in the 40 to 50 mph range, but drop to 30 to 35 mph from approximately Devonshire Street to US 101 where interchange related merging and congestion reduce speeds to less than 20 mph. Across Sepulveda Pass, speeds in the southbound direction are in the 30 to 35 mph range until the Sunset interchange area, where speeds are reduced to less than 20 mph. Similar to northbound findings, speeds through Santa Monica, West LA, Culver City, and to the Ladera Heights/LAX areas are estimated by the model to be in the 30 to 35 mph range, with areas of increased congestion and slower speeds at the I-10 interchange. Speeds in the southern end of the study corridor are estimated to improve to the 35 to 40 mph range.

Considering the estimated speed projection patterns of increasing congestion moving towards the center of the study corridor in both the north and southbound direction of travel, the employment and activity centers within the study corridor, particularly those in the center of the corridor are significant generators of travel demand, which is in excess of the available freeway capacity on I-405.

Other estimated speeds to note include those for eastbound US 101 (<35 mph) and westbound I-10 (<35 mph) as they approach I-405; these speed levels represent congestion and demand levels that are greater than the available roadway capacity.

Figure 42: Freeways Speeds in the AM Peak Period (2008)



Source: SCAG 2008 RTP base year model

Metro

10.5.3 PM Peak Period Speeds

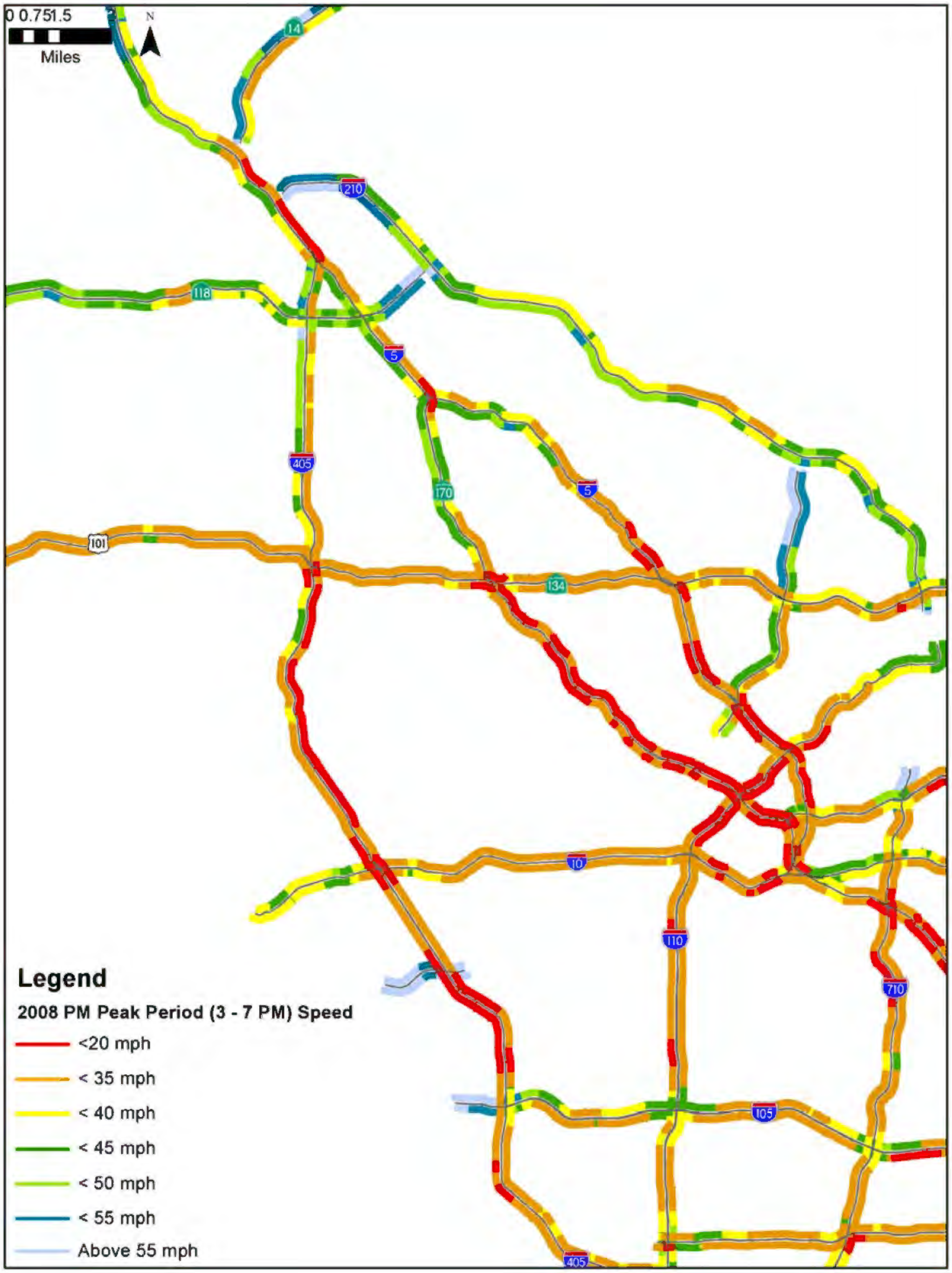
As depicted in Figure 43, Northbound PM peak period speeds on I-405 are significantly congested for a large portion of the study corridor. Similar to the morning peak, speeds approaching the interchange with I-105 are estimated at less than 35 mph and drop to less than 20 mph as the I-105 traffic merges onto northbound I-405 and prior to SR-90 through the Ladera Heights, Westchester and Marina del Rey area interchanges. After SR-90 speeds improve slightly, but again drop back to less than 20 mph near the I-10 interchange. The primary difference between the morning and evening peak period speeds is the considerable degradation in speeds between I-10 and US 101; virtually the entire segment between I-10 and US 101 has estimated speeds of less than 20mph. North of US 101, speeds increase to greater than 20mph, but for the majority of the segment they are projected at less than 35 mph, which indicates unstable and saturated conditions.

Traffic speeds in the southbound direction in the north of US 101 are not free flow conditions, but are roughly in the 40 to 50 mph range, with speeds dropping to the 35 to 40 mph range immediately north of the US 101. Speeds vary from less than 20 mph immediately after the US 101 interchange, and increase to up to 45 mph for a short segment approaching Mulholland. South of Mulholland Drive, the speeds are projected to decrease to less than 35 mph and decrease to less than 20 mph at and surrounding the I-10 interchange. South of the I-10, speeds vary between less than 35 mph and less than 20 mph, with the segment just north of SR-90 through the Marina del Rey, Ladera Heights and Westchester to approximately Century Boulevard estimated at less than 20 mph. South of the I-105 interchange speeds are estimated to be mostly less than 35 mph, again indicating high demand and unstable traffic flows.

The northbound speed estimates and resultant congestion levels display the employment and activity center attractions in the center of the study corridor (TAZs of Santa Monica, Century/Beverly, Westside-A and Westside-B) and the residential population in the San Fernando Valley. The broader congestion levels in the southern portion of the study corridor represent a broad range of activity centers, attractions and productions, all of which generate travel demand in excess of the available freeway capacity on I-405.

Other estimated speeds to note include those for northbound I-5 at the I-405 interchange (<20 mph) and both all directions of US 101 (<35 mph); these speed levels are indicative of demand levels that are greater than the available roadway capacity during the peak periods.

Figure 43: Freeways Speeds in the PM Peak Period (2008)



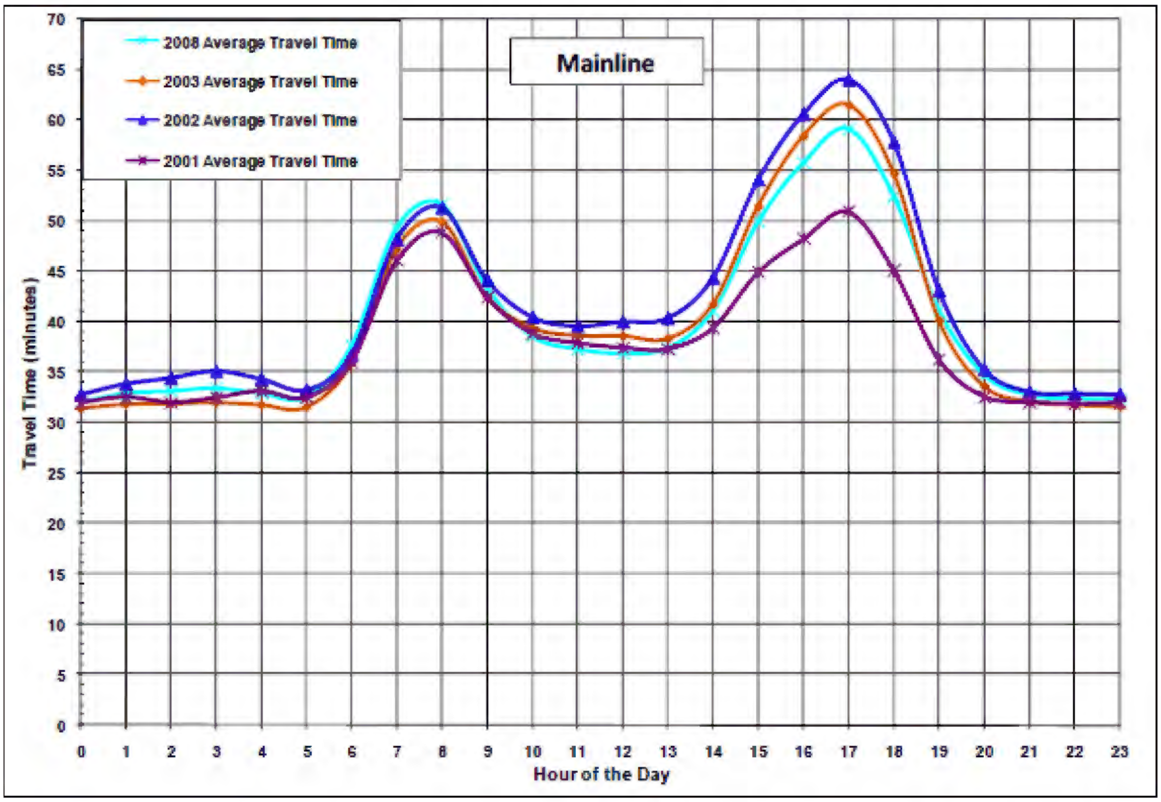
Source: SCAG 2008 RTP base year model

Metro

10.6 Travel Times by Time of Day

Unlike most other highway corridors that experience a directional pattern of congestion, the I-405 is unique in that it experiences the same pattern of congestion irrespective of direction with the longest travel time occurring in the PM peak.[6] In 2008, during the PM peak (5:00 PM) it took a vehicle an average of 59 minutes to travel north on the I-405 corridor (between the I-5 and the I-110). Similarly, in the southbound direction during the PM peak, it took a vehicle 53 minutes to travel the I-405 corridor.[7] Figure 44 depicts northbound mainline travel on the I-405 corridor by time of day from 2001 to 2008. Figure 45 depicts southbound main line travel on the I-405 corridor by time of day from 2001 to 2008.

Figure 44: Northbound I-405 Main Line Travel Time by Time of Day (2001-2003, 2008)

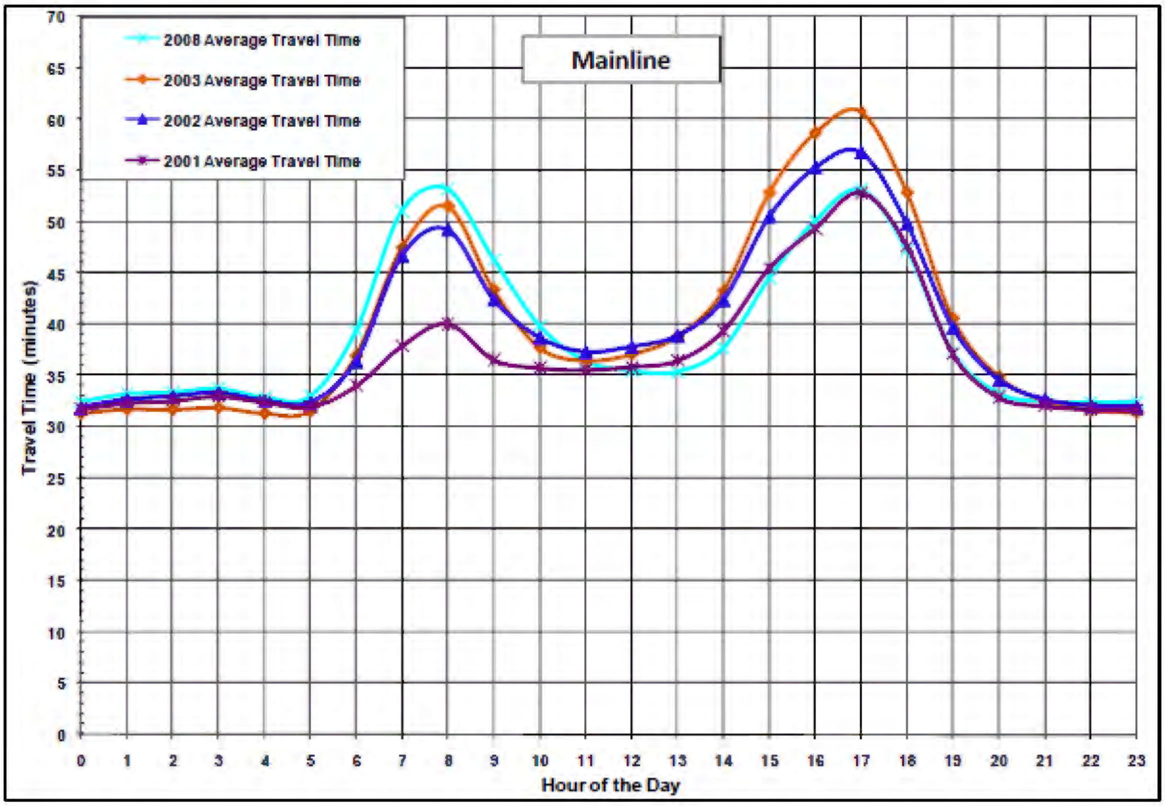


Source: SCAG/Caltrans I-405 Corridor Systems Management Plan, September 2010

[6] I-405 Corridor System Management Plan Comprehensive Performance Assessment. Systems Metric Group, Southern California Association of Governments, and Caltrans. August 2009.

[7] Ibid.

Figure 45: Southbound I-405 Main Line Travel Time by Time of Day (2001-2003, 2008)



Source: SCAG/Caltrans I-405 Corridor Systems Management Plan, September 2010

10.7 I-405 Truck Percentage

Based on 2010 Caltrans data, truck percentages on I-405 within the Study Area varied between roughly 3 and 4 percent, with the southern and northern portions of the study corridor experiencing higher truck percentages than the central portions of the study corridor. South of the I-105 interchange, truck percentages were estimated by Caltrans to be nearly 4 percent. The truck percentage in the central section (between I-105 and I-10) was estimated at 3 percent. Through the Sepulveda Pass the truck percentage was estimated at 3.5. North of the US 101 interchange, the truck percentage was estimated to drop from just over 3 percent to just under 3 percent prior to the SR-118 interchange. After SR-118, the percent of trucks was estimated at 4 percent of the total vehicle AADT.

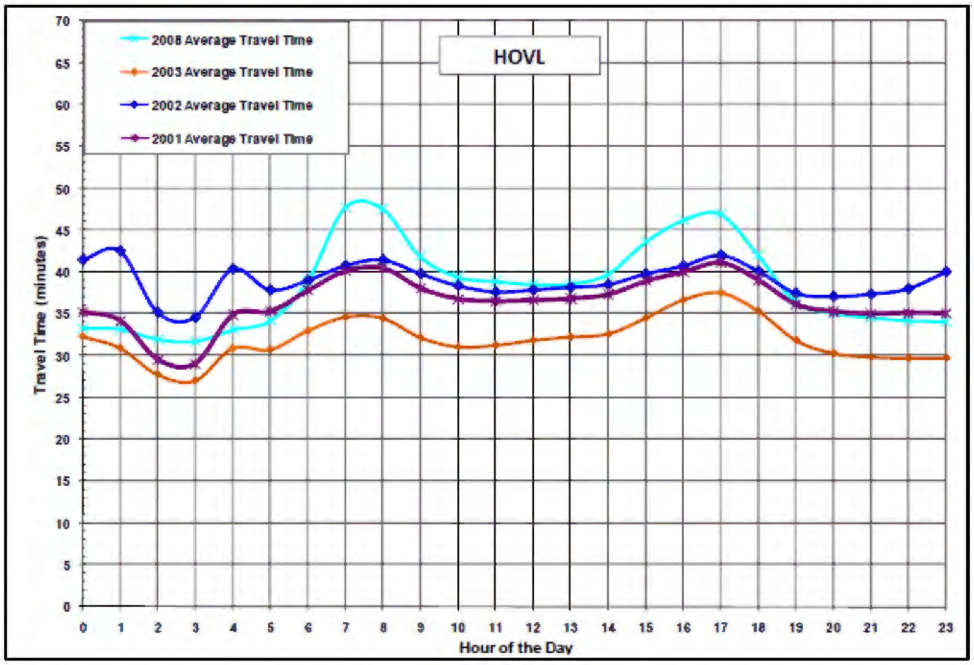
The 2009 truck percentage estimates followed the location and estimated truck percentage patterns discussed above. The 2009 estimates also include a location immediately before and after Manchester Boulevard that had an estimated truck percentage of AADT of nearly 5 percent. The 2008 estimates were generally higher, with 3.5 percent or greater throughout the corridor and estimates of nearly 4 percent trucks across Sepulveda Pass.

Two-axle trucks make up approximately 50 percent of all trucks, regardless of study corridor location. Trucks with 5 or more axles account for roughly 40 percent of all trucks in the northern and southern study corridor and approximately one-third of all trucks in the central portion of the Study Area and across Sepulveda Pass.

11.0 HOV PERFORMANCE

Because HOV facilities only extend on I-405 between I-5 and I-10, comparing travel times on HOV lanes to those of main line travel is not appropriate. In 2008, HOV lane travel time during the AM peak (7:00 AM) in the northbound direction was 48 minutes. In the PM peak (5:00 PM), travel time was 47 minutes. Southbound HOV lane travel time in the AM peak was 52 minutes; in the PM peak travel time was 47 minutes.[8] Figure 46 depicts northbound HOV travel on the I-405 corridor by time of day from 2001 to 2008. Figure 47 depicts southbound HOV travel on the I-405 corridor by time of day from 2001 to 2008.

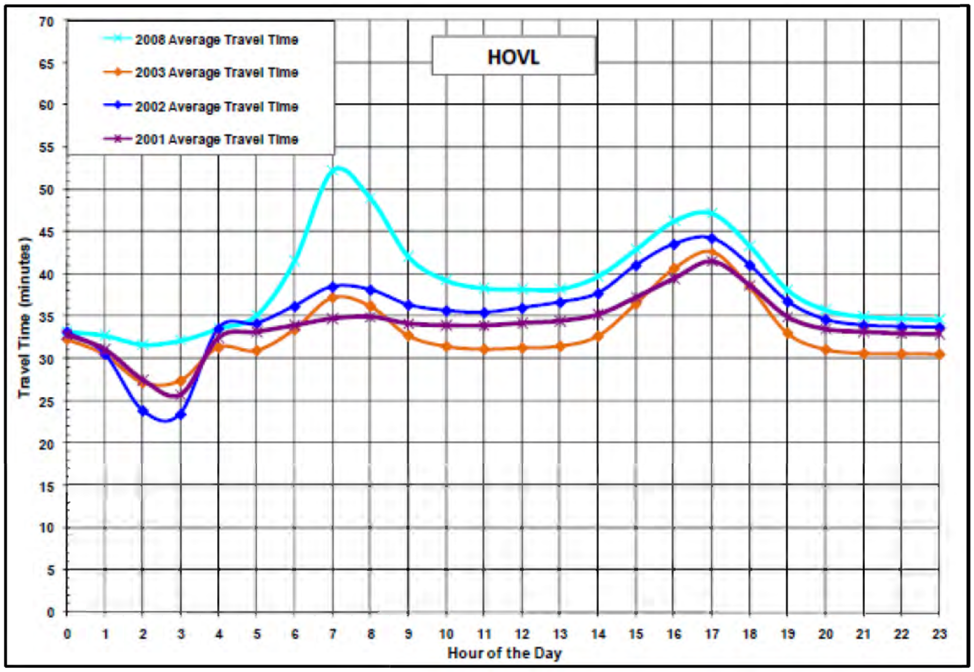
Figure 46: Northbound I-405 HOV Lane Travel Time by Time of Day (2001-2003, 2008)



Source: SCAG/Caltrans I-405 Corridor Systems Management Plan, September 2010

[8] Ibid.

Figure 47: Southbound I-405 HOV Lane Travel Time by Time of Day (2001-2003, 2008)



Source: SCAG/Caltrans I-405 Corridor Systems Management Plan, September 2010

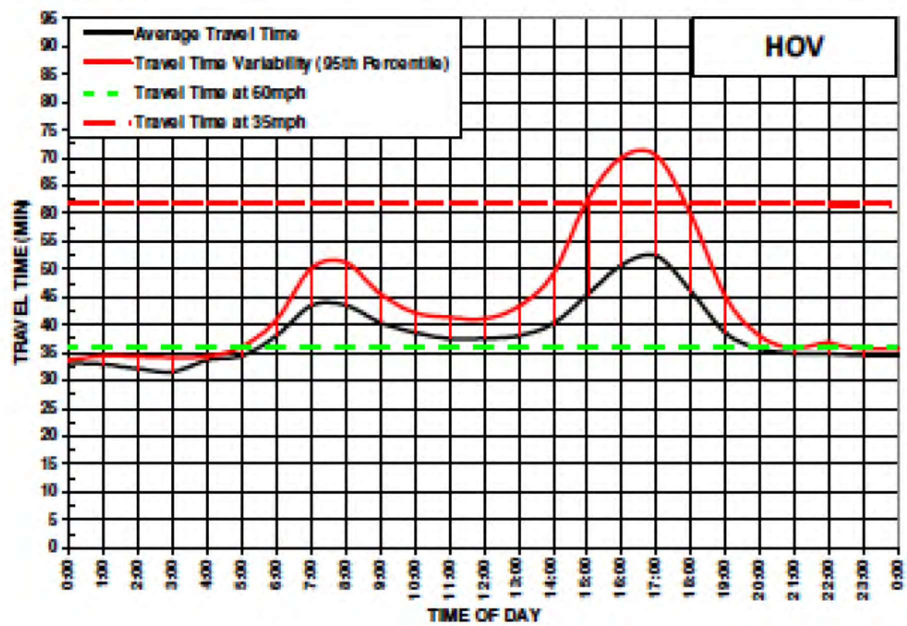
The I-405 Sepulveda Pass Improvements Project, currently underway, will add a 10-mile HOV lane in the northbound direction of the I-405 between the I-10 and the US 101 freeways, and improve supporting infrastructure such as ramps, bridges and soundwalls. When complete, the I-405 will have continuous HOV lanes in both directions from the I-5/I-405 junction in San Fernando in the north to the I-5/I-405 junction in Irvine in the south, a distance of approximately 73 miles.

According to the 2008 Caltrans HOV Annual Report, the performance of the current HOV lanes on I-405 has been positive. North of the US 101 at Burbank Blvd., the HOV lanes are moving approximately 1,150 vehicles and approximately 2,830 persons in the southbound AM peak. In the northbound PM peak direction, the HOV lanes are moving approximately 1,575 vehicles and approximately 3,680 persons. For references, the Caltrans minimum standard for vehicle utilization is 900 vehicles per hour. In terms of average vehicle occupancy (AVO), the AVO for the HOV lane was 2.43 versus 1.12 for the mixed-flow lanes in the southbound direction. For the northbound direction, the AVO for the HOV lane was 2.29 versus 1.11 for the mixed-flow lanes.

At the south end of I-405 at Nomandie Avenue, the HOV lanes are moving approximately 1,340 vehicles and approximately 3,390 persons in the southbound AM peak hour. In the northbound PM peak hour, the HOV lanes are moving approximately 1,170 vehicles and approximately 2,610 persons. The AVO for the HOV lane was 2.22 versus 1.08 for the mixed-flow lanes in the southbound direction. In the northbound direction, the AVO for the HOV lane was 2.29 versus 1.11 for the mixed-flow lanes.

The SCAG/Caltrans I-405 Corridor Systems Management Plan (CSMP) (September 2010) included an in depth analysis of travel time variability on the HOV lanes. Utilizing Caltrans loop detector data collected from 2001-2009, the CSMP found that the travel time variability on the HOV lanes to be high and volatile. In 2009, the average travel time on the HOV facility ranged from 30 to 55 minutes in the southbound direction, with the slowest and most unreliable hour occurring at 5:00 PM. During this hour, the travel time increased to as much as 70 minutes (see Figure 48).

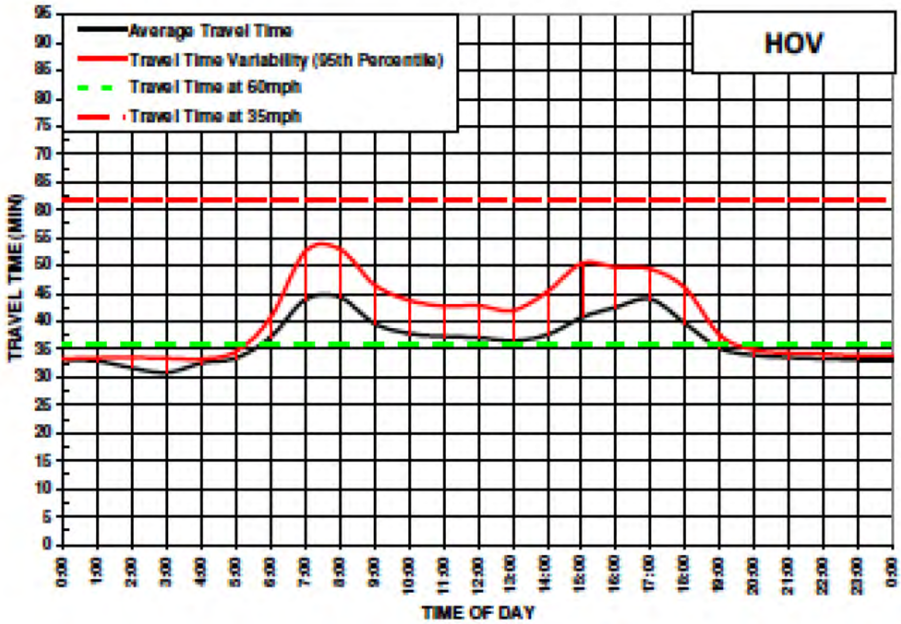
Figure 48: Southbound I-405 HOV Lane Travel Time Variability



Source: SCAG/Caltrans I-405 Corridor Systems Management Plan, September 2010

In the northbound direction, there was not a distinct peak hour as peak periods displayed similar levels of travel times. In 2009, the average travel times during the peak periods ranged between 30 and 45 minutes in the northbound direction. During the AM peak period, the travel time increased to as much as 55 minutes (see Figure 49).

Figure 49: Northbound I-405 HOV Lane Travel Time Variability



Source: SCAG/Caltrans I-405 Corridor Systems Management Plan, September 2010

12.0 TRANSIT SYSTEM PERFORMANCE

12.1 Transit Service Speeds

Table 11 shows the corresponding calculated speeds for each of these segments, for both peak and off-peak travel. Average scheduled route speeds range from 20.6 mph in the off-peak to 11 mph in the peak.

Table 11: Metro Rapid 761 Average Speed, Weekday Peak and Off-peak

Direction	Segment	Approx. Miles	Average speed (mph)	
			Off-peak	Peak
Southbound	Pacoima-Westwood	23.3	18.9	13.7
Southbound	Sherman Oaks-Westwood	12	20.6	14.1
Northbound	Westwood-Pacoima	21.5	15.0	11.0
Northbound	Westwood-Sherman Oaks	12	17.1	11.3

Source: Metro Rapid 761 Timetable

12.2 Transit Service Reliability

Currently, the only transit connection in the Sepulveda Pass that operates throughout the day is Metro Rapid Line 761. Other bus lines were not were not assessed because they operate during the commute hours only, such as LADOT Commuter Express, Santa Clarita Transit, and Antelope Valley Transportation Authority. Metro Rapid 761 connects Westwood with the San Fernando Valley via Sepulveda Boulevard (northbound) and I-405 and Sepulveda

Boulevard (southbound). As the 761 operates entirely in mixed-flow traffic, its speed and reliability is affected by roadway and freeway congestion.

Table 12 is an analysis of the Metro Rapid 761 weekday southbound timetable, which shows that the durations of scheduled trips between San Fernando Valley cities and Westwood vary enormously throughout the day. The travel times are shaded in color, with a spectrum that ranges from green to yellow to pink to red; green shading indicates runs with relatively lower trip times; red shading indicates runs with relatively higher trip times. The concentrated band of red reflects delay caused primarily by roadway congestion (though higher rates of boarding are no doubt a factor, too).

In the southbound direction, a trip between Pacoima and Westwood takes approximately 1 hour and 14 minutes in uncongested early morning hours, but is scheduled to take as long as 1 hour 42 minutes during the morning peak hour, representing a 37 percent increase in travel time.

A similar significant increase in travel time occurs with short peak period trips, as well: southbound trips from Sherman Oaks to Westwood take 33-35 minutes at uncongested times, but up to 51 minutes during the morning peak, a 45-54 percent increase in travel time.

Table 13 is an analysis of the Metro Rapid 761 weekday timetable in the northbound direction. As the table shows, travel between Westwood and Sherman Oaks can take as little as 42 minutes in the off-peak or as much as 1 hour and 4 minutes in the peak, a 52 percent increase in travel time over off-peak. Similarly, travel between Westwood and Pacoima can take as little as 1 hour and 24 minutes in the off-peak to 1 hour and 57 minutes in the peak, a 39 percent increase in travel time over off-peak.

Whereas delay in the southbound direction was concentrated in a fairly short morning interval, delay in the northbound direction (as indicated by red shading) is more diffuse, and spread out throughout the afternoon and early evening hours.

Table 12: Trip Durations (h:mm) and Headways on Southbound Metro Rapid 761, Weekdays

FROM	Pacoima	Panorama City	Van Nuys	Sherman Oaks	Headway
TO	Westwood				
4a - 7a	1:14	0:58	0:49	0:37	
	1:12	0:56	0:47	0:35	0:20
	1:15	0:56	0:47	0:35	0:17
	1:17	0:58	0:49	0:37	0:13
6a - 9a	1:18	0:59	0:50	0:38	0:10
	1:23	1:03	0:54	0:41	0:09
	1:27	1:07	0:57	0:44	0:10
	1:31	1:11	1:01	0:47	0:10
	1:34	1:14	1:04	0:49	0:10
	1:36	1:16	1:05	0:50	0:10
	1:40	1:19	1:08	0:51	0:09
	1:41	1:19	1:08	0:50	0:09
	1:42	1:20	1:07	0:49	0:10
	1:42	1:20	1:07	0:48	0:10
7:30a - 10a	1:41	1:18	1:05	0:47	0:09
	1:39	1:16	1:04	0:46	0:10
	1:39	1:16	1:04	0:46	0:10
	1:38	1:15	1:03	0:45	0:10
	1:36	1:13	1:02	0:44	0:11
	1:33	1:09	0:58	0:43	0:11
8:30a -11:30a	1:31	1:07	0:56	0:41	0:12
	1:30	1:06	0:55	0:40	0:14
	1:27	1:04	0:53	0:38	0:21
	1:28	1:04	0:53	0:38	0:19
	1:28	1:04	0:53	0:38	0:20
	1:28	1:04	0:53	0:38	0:20
10:30a - 2p	1:28	1:04	0:53	0:38	0:20
	1:28	1:05	0:53	0:38	0:21
	1:28	1:05	0:53	0:38	0:20
	1:28	1:05	0:53	0:38	0:20
	1:28	1:05	0:53	0:38	0:20
	1:28	1:05	0:53	0:38	0:20
12:30p - 4p	1:27	1:04	0:52	0:37	0:20
	1:27	1:04	0:52	0:37	0:20
	1:28	1:05	0:53	0:38	0:20
	1:34	1:11	0:59	0:44	0:20
	1:32	1:09	0:57	0:41	0:20
	1:32	1:09	0:57	0:41	0:15
2:30p - 5:30p	1:32	1:09	0:57	0:41	0:15
	1:32	1:09	0:57	0:41	0:12
	1:33	1:09	0:57	0:41	0:11
	1:32	1:08	0:57	0:41	0:12
	1:31	1:07	0:56	0:41	0:12
	1:31	1:07	0:56	0:41	0:12
	1:32	1:09	0:58	0:43	0:13
4p - 6:30p	1:34	1:11	1:00	0:45	0:12
	1:33	1:10	0:59	0:44	0:12
	1:34	1:11	1:00	0:44	0:12
	1:33	1:10	1:00	0:44	0:12
	1:31	1:08	0:58	0:42	0:12
	1:30	1:07	0:57	0:41	0:12
5:15p - 8p	1:27	1:04	0:54	0:38	0:15
	1:26	1:03	0:53	0:38	0:15
	1:25	1:02	0:52	0:38	0:15
	1:23	1:00	0:51	0:37	0:20
	1:20	0:58	0:49	0:36	0:21
	1:16	0:55	0:46	0:33	0:21

Table 13: Trip Durations (h:mm) and Headways on Northbound Metro Rapid 761, Weekdays

FROM	Westwood				Headway
TO	Sherman Oaks	Van Nuys	Panorama City	Pacoima	
5:30a - 8:30a	0:42	0:52	1:00	1:26	
	0:44	0:54	1:03	1:29	0:17
	0:45	0:55	1:04	1:32	0:17
	0:47	0:57	1:06	1:33	0:16
	0:49	0:59	1:08	1:33	0:16
7a-10:30a	0:50	1:00	1:09	1:33	0:17
	0:50	1:00	1:09	1:33	0:18
	0:49	0:59	1:08	1:32	0:19
	0:49	0:59	1:09	1:34	0:17
	0:49	1:00	1:10	1:35	0:17
	0:49	1:00	1:10	1:34	0:18
9a-1p	0:49	1:00	1:11	1:35	0:19
	0:48	0:59	1:10	1:34	0:21
	0:50	1:01	1:12	1:36	0:18
	0:50	1:01	1:12	1:37	0:20
	0:50	1:01	1:12	1:37	0:20
	0:50	1:01	1:13	1:38	0:19
	0:49	1:00	1:12	1:37	0:21
	0:49	1:00	1:12	1:39	0:20
11:30a-3p	0:50	1:01	1:13	1:40	0:19
	0:50	1:02	1:14	1:41	0:19
	0:50	1:02	1:14	1:41	0:20
	0:50	1:02	1:14	1:41	0:20
	0:50	1:02	1:14	1:41	0:20
	0:51	1:03	1:15	1:43	0:19
1:30p-5p	0:55	1:07	1:20	1:49	0:15
	0:57	1:09	1:22	1:51	0:22
	0:58	1:10	1:23	1:52	0:23
	0:57	1:09	1:22	1:51	0:13
	0:57	1:09	1:22	1:50	0:12
	0:57	1:09	1:22	1:50	0:12
	0:57	1:09	1:22	1:50	0:12
3p-6:30p	0:58	1:10	1:23	1:51	0:11
	1:00	1:12	1:25	1:53	0:10
	1:01	1:13	1:26	1:55	0:11
	1:03	1:15	1:28	1:57	0:10
	1:03	1:15	1:28	1:57	0:12
	1:03	1:15	1:28	1:57	0:12
	1:03	1:15	1:27	1:55	0:13
	1:03	1:15	1:27	1:54	0:12
4:45p-7:30p	1:03	1:15	1:27	1:54	0:12
	1:04	1:15	1:27	1:54	0:12
	1:03	1:14	1:25	1:52	0:14
	1:02	1:13	1:24	1:51	0:13
	1:00	1:11	1:22	1:47	0:14
5:45p-8:30p	0:57	1:08	1:19	1:43	0:15
	0:56	1:06	1:17	1:41	0:14
	0:54	1:04	1:13	1:37	0:19
	0:53	1:03	1:12	1:36	0:16
7p-9:30p	0:50	1:00	1:09	1:33	0:18
	0:48	0:58	1:07	1:30	0:17
	0:48	0:58	1:07	1:30	0:15
	0:46	0:56	1:05	1:28	0:24
8p-10:15p	0:43	0:53	1:02	1:24	0:25
	0:43	0:53	1:02	1:24	0:24

12.3 Headways, Trip Lengths, and Cost of Delay

Table 12 and Table 13 also show headways for the Rapid 761. Service is provided most frequently at peak period times, when trip times are longest. The combination of frequent service and lengthy trip times suggest very high operating costs for Metro at this time. In other words, demand compels Metro to offer its most frequent service during periods of the day when congestion makes each bus run long and therefore expensive. Reducing the duration of these peak period trips would produce significant savings in operating costs.

13.0 AIR QUALITY/NON-CONFORMITY

The study corridor is located in the South Coast Air Basin (SCAB). This air basin is classified as non-attainment for Carbon Monoxide (CO) as well as for Particulate Matter less than 10 microns in diameter (PM_{10}) and less than 2.5 microns in diameter (PM 2.5) at the state as well as the federal level and PM. The South Coast Air Quality Management District (SCAQMD) and SCAG, in coordination with local governments and the private sector, have developed the Air Quality Management Plan (AQMP) for the air basin. The AQMP is relevant for the basin because it provides the blueprint for meeting state and federal ambient air quality standards. The AQMP for the basin is included in the State Implementation Plan (SIP) which is the document that demonstrates compliance with the Federal Clean Air Act (FCAA).

The goal of a State Implementation Plan is to secure an attainment designation for the criteria pollutant at a future year. If a pollutant is above National Ambient Air Quality Standards level, it is in non-attainment. Of the six criteria pollutants, two are in attainment: lead and sulfur dioxide. The remaining pollutants have their respective State Implementation Plan to address attainment for future years.

Since the passage of the Federal Clean Air Act and subsequent amendments, the US EPA has established and revised the National Ambient Air Quality Standards (NAAQS). The NAAQS was established for six major pollutants or criteria pollutants. The NAAQS are two tiered: primary, to protect public health, and secondary, to prevent degradation to the environment (i.e., impairment of visibility, damage to vegetation and property). The six criteria pollutants are ozone (O_3), carbon monoxide (CO), particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead (Pb).

The Environmental Protection Agency previously designated the South Coast Air Basin as an extreme non-attainment area for 1-hour ozone. The federal 1-hour ozone standard was revoked by the U.S. EPA on June 15, 2005 and replaced/superseded by the 8-hour average ozone standard to be achieved by November 15, 2010. The basin is also designated as serious nonattainment for PM_{10} and carbon monoxide. Table 14 shows the attainment status for each of the federal criteria pollutants:

Table 14: Project Area Attainment Status

Criteria Pollutant	Federal Attainment Status
Ozone (O_3)	Non-attainment
Carbon Monoxide (CO)	Attainment/Maintenance
Nitrogen Dioxide (NO_2)	Attainment
Sulfur Dioxide ($S0_2$)	Attainment/Maintenance
Lead (Pb)	Attainment/Maintenance
Particulate Matter (PM_{10})	Non-Attainment
Particulate Matter ($PM_{2.5}$)	Non-Attainment

Source: California Air Resources Board

Increasing traffic congestion in the study corridor will decrease speeds on freeways and arterials and, thus, increase vehicle emissions contributing to ozone and PM 2.5/ PM 10. This highlights the need for improved transit, one of the most effective strategies for reducing vehicle emissions.

14.0 KEY FINDINGS AND CONCLUSIONS

14.1 Lack of Alternative Routes to I-405

Travelers making northbound or southbound trips between San Fernando Valley and the West Los Angeles and South Bay areas via the Sepulveda Pass have few travel routes available to them aside from the congested I-405 corridor.

Sepulveda Boulevard is the only arterial providing north and southbound travel across Sepulveda Pass in the immediate vicinity of I-405. Sepulveda Boulevard provides two northbound and southbound through lanes for the majority of the distance across the pass, except at the tunnel under Mulholland Drive, where northbound Sepulveda Boulevard merges into a single through lane. There are also vertical height restrictions through this segment, which prohibits certain heavy vehicles. While Sepulveda Boulevard does provide an alternative route across the pass the roadway constraints noted above limit its ability to accommodate high volumes of traffic and Sepulveda Boulevard typically operates under congested conditions. When I-405 operations deteriorate to induce drivers to seek alternative routes, spillover traffic onto Sepulveda Boulevard pushes operations into over-capacity conditions during the morning and evening peaks.

Existing transit on the I-405 has limited capacity and runs on non-dedicated roadway along with all other vehicles, leading to the same travel time delays as cars traveling on mainline or HOV lanes. Geographic constraints also limit alternative routes to the I-405, as the Sepulveda Pass is dominated by mountainous terrain. Existing roads in the Sepulveda Pass, such as Sepulveda and Laurel Canyon are windy, and circuitous at points.

14.2 Lack of dedicated Lanes for Transit

Transit routes that travel on the I-405 are in the same lanes as regular traffic. As a result, they are subject to the same traffic conditions, which experience congestion that fluctuates based on occupancy, time of day, season, travel direction, accidents/collisions, and weather. If transit vehicles were granted a dedicated lane, like the Metro Orange Line's BRT vehicles, travel speeds, convenience, and connectivity would improve.

14.3 High Congestion and Decreasing Mobility

Travelers on I-405 and major arterials in the Sepulveda Pass Area face high levels of congestion, especially in the AM and PM peaks. Congestion levels affect transit vehicles as well, as the only line in the Sepulveda Pass Area with dedicated roadway is the Metro Orange Line. As explored in section 10.4, levels of service throughout the Sepulveda Pass Corridor are characterized by deteriorating travel flows (LOS D to F) during peak travel times. Across the Sepulveda Pass, through Westwood, Santa Monica, West LA and Culver City, the LOS is at F, indicating traffic demand is far greater than capacity and traffic flows have reached and exceeded breakdown conditions. The high degree of travel time variability makes travel on the I-405 freeway and the HOV lanes highly unreliable. Transit performance is stifled by roadway and freeway congestion, limiting mobility for transit riders, especially those making trips that require connections and/or transfers.

14.4 Limitations to Existing and Future HOV Network

Currently, there is a gap in the HOV network along the entire I-405 corridor in Los Angeles County. HOV lanes are currently operating on southbound I-405 from the US 101 Freeway to the Orange County Line, and on northbound from Orange County Line to I-10. The gap in the northbound direction between the I-10 and the US 101 is currently being closed by Metro/Caltrans as part of the Sepulveda Pass Widening Project. The HOV lanes then continue in the northbound from US 101 to the I-5.

The existing HOV lanes on the I-405 are currently well utilized, ranging from 1,150 to 1,575 vehicles per hour in the peak direction. The Caltrans minimum for vehicle utilization is 900 vehicles per hour. However, the high utilization is beginning to impact the travel time savings and reliability for users of the HOV lanes. Along the I-405, about 20 to 25 percent of the observed vehicles carried two or more occupants, and about 75 percent of those vehicles used the HOV lanes, where available. While the new northbound HOV lane is expected to enhance traffic operations by adding freeway capacity in an area that experiences heavy congestion, it is likely to be a short-term improvement as the HOV lanes will become over-utilized in the future, particularly if the 2+ occupancy requirement is maintained.

14.5 Physical and Financial Constraints for New High Capacity Transportation Options

The Measure R expenditure plan identified only $1 Billion for this project. However these funds may not be available until the third decade of the plan. Geographic constraints limit the available routing options for transit and highway improvements. Furthermore, the process of circumventing these physical constraints may result in high construction costs. Because of high costs to develop new transit and highway improvements in this Corridor, limitations of available Measure R funding, and the increasingly challenging public finance climate, additional sources of revenue for this project must be sought. One primary source to explore is revenues from congestion pricing and tolling opportunities derived from high traffic volumes and transit demand.

APPENDIX

Table 15: Southbound Select Link – Total AM Production & Attraction Trips

	Remainder of Region	West of LA	LA North	External TAZs	South Bay - A	South Bay - B	South Bay - C	Westside - A	Westside - B	LA Central - A	LA Central - B	SFV - A	SFV - B	SFV - C	SFV - D	Santa Monica	Century\Beverly	Brentwood - A	Brentwood - B	Production Total
District	1	13 & 6	12		4-A	4-B	4-C	5-A	5-B	11-A	11-B	15-A	15-B	15-C	15-D	17	18	19-A	19-B	
Remainder of the Region	69	0	0	108	84	40	96	40	48	4	33	0	0	0	0	478	93	2	127	**1,223**
West of LA	273	0	0	145	512	218	565	207	280	16	163	0	0	0	0	521	364	2	39	**3,306**
LA North	31	0	0	246	862	234	699	454	432	5	127	0	0	0	0	1,489	737	5	223	**5,543**
External TAZs	67	0	0	43	43	28	115	16	11	1	9	0	0	0	0	29	11	0	7	**380**
South Bay - A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
South Bay - B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
South Bay - C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Westside - A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Westside - B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LA Central - A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LA Central - B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
SFV - A	134	0	0	68	451	172	476	268	272	19	141	0	0	0	0	884	474	4	108	**3,469**
SFV - B	23	0	0	32	496	88	340	397	247	3	85	0	0	0	0	1,305	316	4	225	**3,562**
SFV - C	1,056	0	0	236	976	498	1,108	547	622	97	464	0	0	0	0	1,466	642	7	156	**7,875**
SFV - D	300	0	0	82	667	219	570	500	305	21	213	0	0	0	0	1,575	177	3	241	**4,874**
Santa Monica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Century/Beverly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Brentwood - A	120	0	0	4	51	28	52	32	23	23	23	0	0	0	0	29	23	0	4	**412**
Brentwood - B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Attraction Total	**2,073**	**0**	**0**	**964**	**4,142**	**1,526**	**4,020**	**2,461**	**2,241**	**188**	**1,257**	**0**	**0**	**0**	**0**	**7,776**	**2,836**	**28**	**1,130**	**30,643**

Trips starting and ending in the Study Districts	59%
Trips starting in the Study Districts and ending outside of the Study Districts	7%
Trips starting outside of the Study Districts and ending in the Study Districts	31%
Trips starting outside of the Study Districts and ending outside of the Study Districts	3%
	100%

Table 16: Northbound Select Link – Total AM Production & Attraction Trips

	Remainder of Region	West of LA	LA North	External TAZs	South Bay - A	South Bay - B	South Bay - C	Westside - A	Westside - B	LA Central - A	LA Central - B	SFV - A	SFV - B	SFV - C	SFV - D	Santa Monica	Century\Beverly	Brentwood - A	Brentwood - B	Productions Total
District	1	13 & 6	12		4-A	4-B	4-C	5-A	5-B	11-A	11-B	15-A	15-B	15-C	15-D	17	18	19-A	19-B	
Remainder of the Region	104	348	31	56	0	0	0	0	0	0	0	188	26	1,139	296	0	0	181	0	**2,369**
West of LA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
LA North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
External TAZs	154	412	401	85	0	0	0	0	0	0	0	118	54	413	129	0	0	12	0	**1,778**
South Bay - A	73	190	162	26	0	0	0	0	0	0	0	152	220	481	333	0	0	37	0	**1,674**
South Bay - B	76	258	154	25	0	0	0	0	0	0	0	216	142	763	306	0	0	45	0	**1,985**
South Bay - C	119	450	360	120	0	0	0	0	0	0	0	360	315	1,111	533	0	0	68	0	**3,437**
Westside - A	220	198	180	9	0	0	0	0	0	0	0	217	333	674	564	0	0	64	0	**2,459**
Westside - B	82	179	149	6	0	0	0	0	0	0	0	188	239	615	346	0	0	48	0	**1,853**
LA Central - A	17	54	21	1	0	0	0	0	0	0	0	62	11	256	57	0	0	60	0	**540**
LA Central - B	60	189	111	9	0	0	0	0	0	0	0	180	94	668	263	0	0	39	0	**1,610**
SFV - A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
SFV - B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
SFV - C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	**2**
SFV - D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Santa Monica	576	298	322	19	0	0	0	0	0	0	0	378	581	1,128	1,045	0	0	97	0	**4,444**
Century/Beverly	292	270	251	11	0	0	0	0	0	0	0	296	340	899	416	0	0	104	0	**2,878**
Brentwood - A	4	1	1	0	0	0	0	0	0	0	0	2	2	6	5	0	0	7	0	**28**
Brentwood - B	243	55	112	9	0	0	0	0	0	0	0	107	194	300	366	0	0	26	0	**1,413**
Attraction Total	**2,021**	**2,904**	**2,254**	**376**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2,464**	**2,552**	**8,453**	**4,657**	**0**	**0**	**795**	**0**	**26,476**

Trips starting and ending in the Study Districts	62%
Trips starting in the Study Districts and ending outside of the Study Districts	23%
Trips starting outside of the Study districts and ending in the Study Districts	10%
Trips starting outside of the Study Districts and ending outside of the Study Districts	6%
	100%

3.0 – POTENTIAL RIDERSHIP/USAGE OF ALTERNATIVE CONCEPTS REPORT

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Sepulveda Pass Corridor Systems Planning Study

Task 2.6
Potential Ridership/Usage of Alternative Concepts

October 2012

Prepared for:

Metro

Prepared by:

AECOM

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1. INTRODUCTION

The Sepulveda Pass Corridor Systems Planning Study (SPCSPS) is a high-level transportation systems planning study to identify a range of conceptual transportation options for improving travel along the Interstate 405/Sepulveda Boulevard corridor, generally between Sylmar and Los Angeles International Airport (LAX). The work will enable the Los Angeles County Metropolitan Transportation Authority (Metro) to identify a range of high-level systems planning concepts that will form the basis for a future environmental clearance and possible solicitations for interest in Public-Private Partnerships.

The study is evaluating multimodal options and considering both highway and transit improvements. For transit, the study is identifying potential connections to other existing and future fixed guideway transit lines that traverse the study area. These include the Ventura and Antelope Valley Metrolink Lines, the Metro Orange Line Busway, the Metro Purple Line Subway, the Exposition Light Rail Line, the Metro Green Line, the Metro Crenshaw/LAX Line and potential connections to the East San Fernando Valley (ESFV) Transit Corridor, which is currently in the draft environmental document phase.

For highway options, the study is considering various systems planning concepts including direct access ramps to the high-occupancy vehicle (HOV) lanes, additional capacity through managed lane toll facilities, and capital improvements including grade-separated guideway/tunnel systems.

The purposes of this Travel Demand Modeling Report are as follows:

1) To document the final travel demand projections for the different systems planning concepts being considered for the Sepulveda Pass, and
2) To evaluate and compare these different concepts through a range of performance indicators, including transit ridership, person throughput, and travel time savings.

2. CONCEPTS UNDER EVALUATION

This section provides a brief description of each highway and transit concept evaluated in the SPCSPS. The key modeling inputs used to generate the ridership, traffic volume, and toll and transit fare revenue projections for each concept are also detailed in this section. Maps of each concept, which have been provided in previous reports, are included in the Appendix.

2.1. CONCEPT 1: SEPULVEDA BRT

Concept 1 envisions a 30-mile Bus Rapid Transit (BRT) system running from Sylmar Metrolink Station at the northern end of the corridor south to the Century and Aviation light rail station on the future Metro Crenshaw line, adjacent to LAX. The buses would operate in several environments: on the freeway shoulders of Interstate 405 during the peak, as median-running BRT on Van Nuys Boulevard[1], and with priority treatment on Sepulveda Boulevard through and south of the Pass. The key modeling inputs for Concept 1 are:

- Headways: 12 minutes peak, 20 minutes off-peak
- Unconstrained parking at Park and Ride lots at Sylmar Metrolink, Van Nuys/Nordhoff, Van Nuys Metrolink, Van Nuys Orange Line Station, Sepulveda Expo Station, Culver City Transit Center, and Century/Aviation (LAX).
- Service is equivalent to Metro Rapid, but with reduced boarding time (represented in the model as slight headway reduction) to account for pre-payment, all-door boarding, and signal synchronization/prioritization.
- Reduced frequency of underlying local service on Van Nuys Boulevard consistent with ESFV study assumption
- All existing I-405 bus routes use shoulder lanes over Sepulveda Pass (Metro, Los Angeles Department of Transportation Commuter Express, Santa Clarita Transit, Antelope Valley Transit Authority)

For a map of Concept 1, see the Appendix.

2.2. Concept 2: At-Grade Freeway Managed Lanes

Concept 2 envisions a 29-mile managed lanes alignment along Interstate 405 from the San Fernando Valley to LAX. Through the Sepulveda Pass, lane/shoulder widths and the existing (or under construction) single HOV lane on Interstate 405 would be re-configured to provide two HOT (High Occupancy Toll) lanes in each direction. South of La Grange Avenue and north of US 101, the existing HOV lane would be converted to a single HOT lane.

Three BRT routes will utilize all or a portion of the managed lanes from the San Fernando Valley to the Westside and LAX. The three routes are:

1) Sylmar Metrolink to LAX, via the managed lanes, with an intermediate stop at the Sepulveda Orange Line station (10/20 minute headways);
2) Sylmar Metrolink to the Westwood/Veterans Administration (VA) Purple Line station via Van Nuys Blvd and the I-405 managed lanes (5/10 minute headways); and
3) Sepulveda Orange Line Station to Sepulveda Expo Station via the I-405 managed lanes), continuing to the Fox Hills Mall/Culver City Transit Center and Century/Aviation (LAX) station via Sepulveda Boulevard.

[1] A separate study for the E ast San Fernando Valley Transit Corridor (from Ventura Boulevard to Sylmar Metrolink) is currently being conducted by Metro to determine a mode for that corridor. Any future Sepulveda Pass transit project – either BRT or LRT – will closely coordinate with any decisions made in this separate study.

The key modeling inputs for Concept 2 are:

- 2 HOT lanes in each direction between US 101 and La Grange Avenue
- 1 HOT lane north of US 101 and south of La Grange Avenue; existing HOV will be converted to HOT 3+
- Direct Access Ramps (DARs) to HOT lanes near the Orange Line Sepulveda Station (bus only) with east and west connections; DARs at La Grange Avenue and Sepulveda, just north of Centinela Avenue
- Flyover ramp into/out of HOT lanes from/to the west on US 101
- Sepulveda Orange Line Station would provide connections among the three BRT services.

For a map of Concept 2, see the Appendix. A summary of toll assumptions used to model Concept 2 can be found in Section 3.3.

2.3. CONCEPT 3: HIGHWAY VIADUCT MANAGED LANES

Concept 3 envisions the construction of a new highway viaduct above the existing Interstate 405 has been examined in the SPCSPS process, but it has not been included in the group of concepts for travel demand/modeling analysis.

For a map of Concept 3, see the Appendix.

2.4. CONCEPT 4: TOLLED HIGHWAY TUNNEL

Concepts 1 and 2 are focused on transit and highway improvements that remain largely within the existing right-of-way of Interstate 405. Concepts 4 through 6, by contrast, assume the construction of an entirely new north-south tunnel through the Santa Monica Mountains that would connect the San Fernando Valley with the Los Angeles basin. Concept 4 includes an approximately 11-mile tolled bus and automobile tunnel through the Sepulveda Pass. The tunnel would have two lanes in each direction with a northern portal south of US 101 and a southern portal near Santa Monica Boulevard. Trucks would be prohibited in the tunnel, and all users would pay a toll (i.e., there would not be HOV exemptions).

The same three BRT routes that are proposed for the Concept 2 managed lanes would also be included in Concept 4. The three routes are:

1) Sylmar Metrolink to LAX, via the managed lanes, with an intermediate stop at the Sepulveda Orange Line station (10/20 minute headways);
2) Sylmar Metrolink to the Westwood/VA Purple Line station via Van Nuys Blvd and the I-405 managed lanes (5/10 minute headways); and
3) Sepulveda Orange Line Station to Sepulveda Expo Station via the I-405 managed lanes), continuing to the Fox Hills Mall/Culver City Transit Center and Century/Aviation (LAX) station via Sepulveda Boulevard.

The key modeling inputs for Concept 4 are:

- Access to tunnel from I-405 just north of US 101,
- Flyover ramp into/out of tunnel from/to the west on US 101
- No direct Orange Line connection
- No HOV exemption (all users must pay toll)
- Tunnel from US 101 to La Grange Avenue with no intermediate access points
- Access to tunnel from both freeway and surface streets at La Grange Avenue (one lane from freeway, one lane from surface street)

For a map of Concept 4, see the Appendix. A summary of toll assumptions used to model Concept 4 can be found in Section 3.3.

2.5. Concept 5: Fixed Guideway Transit in Tunnel

Concept 5 includes a light rail transit (LRT) line operating in a new 6-mile tunnel through the Sepulveda Pass. The entire LRT line would be 28 miles long with 12 stations, and it would connect the Sylmar Metrolink Station with the Century/Aviation station near LAX (similar to Concept 1). Outside of the tunnel, the LRT would operate primarily in a dedicated, median-running right-of-way, and the LRT service would provide transfer locations with the existing Metro Rail system and the Orange Line. The key modeling inputs for Concept 5 are:

- No interlining of the proposed LRT with the Crenshaw/LAX Transit Corridor, but transfers are still possible (transfer time is assumed to be 3 minutes)
- In tunnel, trains operate at average 50 mph speed, comparable to the Metro Red Line through the Santa Monica Mountains
- Outside tunnel, with a mix of at-grade and grade-separated conditions, trains operate at an average of 20 mph, comparable to the Exposition LRT outside of downtown Los Angeles
- Underground stations at tunnel portals (Ventura Boulevard and UCLA Ackerman Union) and at Wilshire/Westwood and Santa Monica/Westwood

After Charrette #2, because of the high transit ridership projected for concept 5, the question was raised whether a heavy rail alternative with the same alignment as the light rail alternative was merited. Accordingly, an additional model run was conducted to reflect the faster in-vehicle travel times of a fully grade-separated heavy rail alternative. Except for these faster travel times (50 mph in tunnel, 27 mph average outside the tunnel, comparable to the Metro Red Line outside of downtown Los Angeles), this model run used the same key inputs as the light rail modeling run. Thus, Concept 5A now refers to the light rail option, and Concept 5B refers to the heavy rail option.

For a map of Concept 5, see the Appendix.

2.6. CONCEPT 6: HIGHWAY AND PRIVATE SHUTTLE TUNNEL

Concept 6 proposes dual tunnels through the Sepulveda Pass serving highway and transit users separately. The 16-mile tolled highway tunnel, with portals at Roscoe Boulevard and Century Boulevard, would have intermediate access points at Ventura Boulevard, La Grange Avenue, and Howard Hughes Parkway. The 21-mile transit tunnel would operate between the Van Nuys Metrolink Station and the Century/Aviation station near LAX. However, rather than operate as part of the existing Metro transit system, a private rail shuttle would operate in the tunnel, and premium fares (relative to the highway tunnel tolls) would be charged. The key modeling inputs for Concept 6 are:

- Transit fare will be 75% of the average highway toll (separate for peak and off-peak)
- Transit headways of 5 minutes in the peak and 10 minutes off-peak
- Average rail transit speed of 50 mph
- Five private shuttle stations (Van Nuys Metrolink, Van Nuys Orange Line, Westwood/Wilshire, Sepulveda Expo Station, and Century/Aviation (LAX))
- Freeway north portal at Roscoe Boulevard, with intermediate access at Ventura Boulevard, La Grange Avenue, and Howard Hughes Parkway (offering a connection to SR 90)
- Freeway tunnel between Roscoe Boulevard and Ventura Boulevard to be one lane in each direction; tunnel between Ventura Boulevard and Century Boulevard to be two lanes in each direction
- Freeway exit from tunnel portal at Century Boulevard is split to allow separate exits to Century Boulevard and I-405

For a map of Concept 6, see the Appendix. A summary of toll assumptions used to model Concept 6 can be found in Section 3.3.

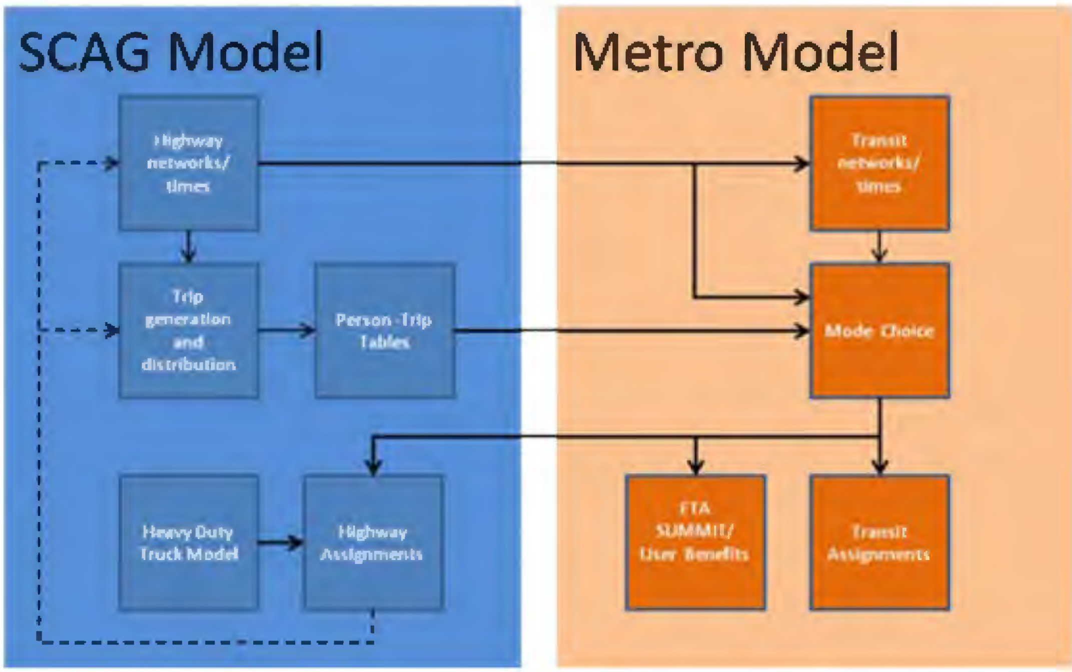
3. TRAVEL DEMAND METHODOLOGY

The following section summarizes the methods used to estimate travel demand for the different systems planning concepts.

3.1. BLENDED MODEL PROCESS

Travel demand and ridership for each concept were evaluated using a travel demand modeling (forecasting) process employing both the Metro model used for forecasting Measure R projects and the Southern California Association of Governments' (SCAG) 2008 Regional Transportation Plan (RTP) regional model. This "blended model" approach is designed to take advantage of the strengths of each tool (transit and highway forecasts, respectively). The SCAG model is used for highway assignments because it has already been validated regionally for this purpose and contains a toll forecasting procedure suitable for systems planning analysis. The Metro model is used because it has already been reviewed by the Federal Transit Administration (FTA) for use in Section 5309 New Starts forecasts and exceeds industry standards. It is consistent with SCAG socioeconomic and transportation network data with additional detail in Los Angeles County and is used in supporting FTA transit New Starts and Measure R projects in Los Angeles County. The current Metro model was reviewed by FTA staff in the summer of 2009, and the model structure, calibration, and validation were found to be acceptable.[2] The blended model process is show in Figure 3-1.

Figure 3-1: Blended Model Process



In addition, the same version of the LAX Air Passenger Model used in Metro's South Bay Metro Green Line Extension Study is used in forecasting each concept.. Transit trips from this model are assigned to the peak and off peak transit networks.

3.2. Corridor Validation Summary

The next step after establishing the model structure was to validate the model output to optimally reflect current highway and transit travel patterns in the Sepulveda Pass Corridor.

For the transit corridor validation, routes were selected and grouped into five categories:

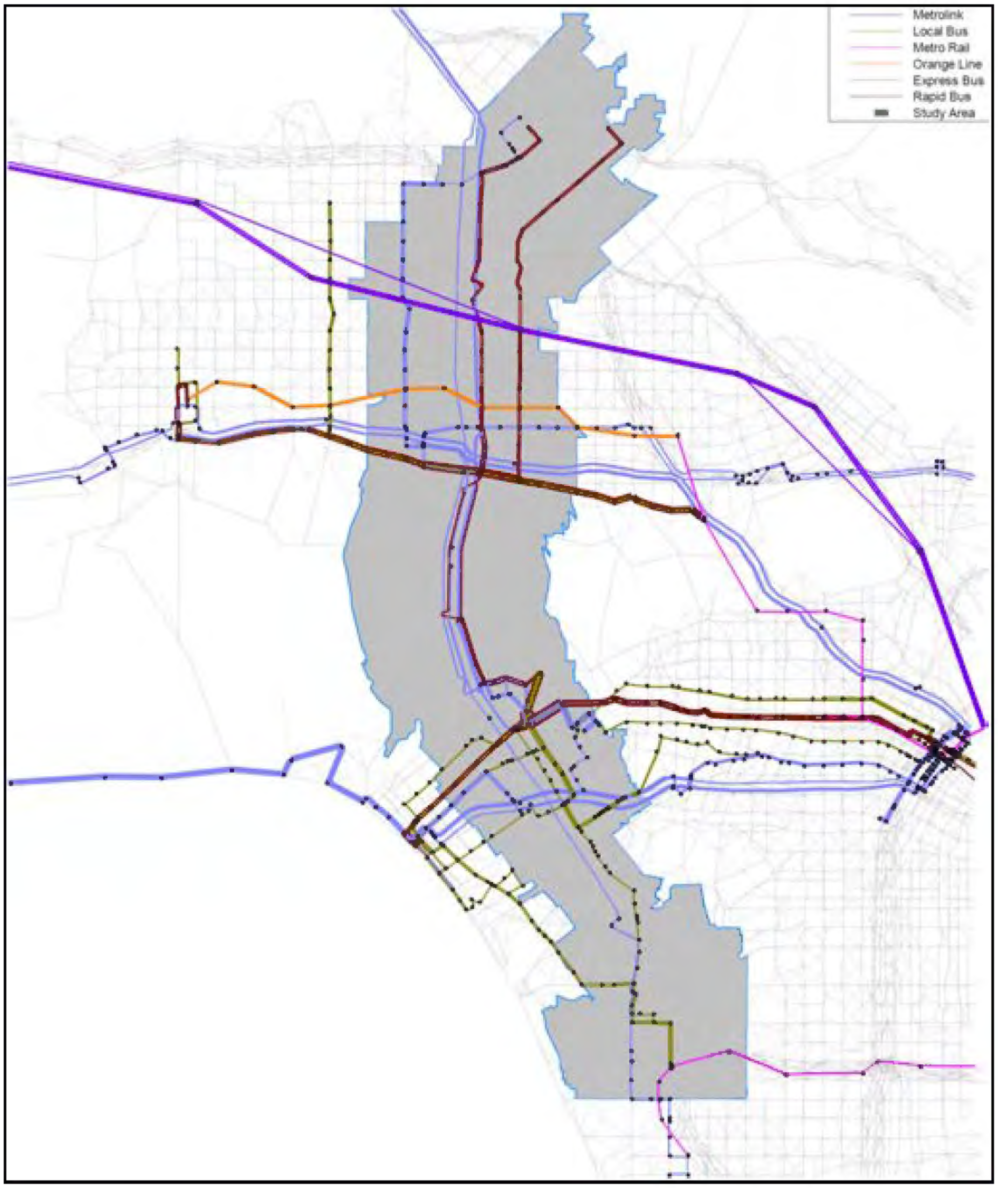
- Rail lines in the I-405 Corridor
- Bus routes over the Sepulveda Pass on I-405 and Sepulveda Boulevard
- Bus routes south of Sepulveda Pass
- Bus routes north of Sepulveda Pass

[2] FTA staff does not formally approve models; they only approve the resulting forecasts.

- Routes not in the previous three groups that serve UCLA

The transit network in the corridor is shown in Figure 3-2

Figure 3-2: Transit Network in Sepulveda Corridor



Refinements were made to run times and route coding that resulted in improved performance of the model in matching observed boarding patterns. Table 3-1 shows modeled versus observed boardings for each of the five route groups. The observed versus modeled boardings show good agreement at the route group level. Depending on the data source, observed boardings are for an average weekday in 2001 or 2006.

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Table 3-1: Observed vs. Modeled Boardings for Corridor Validation

Rail	Route	2001/2006 Observed Peak	2001/2006 Observed Off-Peak	2001/2006 Observed Daily	2006 Validation Peak	2006 Validation Off-Peak	2006 Validation Daily	Difference Peak	Difference Off-Peak	Difference Daily	% Difference Peak	% Difference Off-Peak	% Difference Daily
Metrolink - Ventura	701	-	-	4,206	3,871	264	4,135	-	-	-71	-	-	-2%
Metrolink - AV	702	-	-	6,936	6,243	993	7,236	-	-	300	-	-	4%
Metro Rail - Red/Purple Line	802	86,357	38,798	125,155	79,726	33,709	113,435	-6,631	-5,089	-11,720	-8%	-13%	-9%
Metro Rail - Green Line	803	24,055	10,808	34,863	23,171	9,446	32,617	-884	-1,362	-2,246	-4%	-13%	-6%
	Total Rail in Corridor	110,412	49,606	171,160	113,011	44,412	157,423	2,599	-5,194	-13,737	2%	-10%	-8%

Over the Pass - I405/Sepulveda Blvd.	Route	2001/2006 Observed Peak	2001/2006 Observed Off-Peak	2001/2006 Observed Daily	2006 Validation Peak	2006 Validation Off-Peak	2006 Validation Daily	Difference Peak	Difference Off-Peak	Difference Daily	% Difference Peak	% Difference Off-Peak	% Difference Daily
Metro Rapid*	761	5,951	5,160	11,111	6,004	5,126	11,130	53	-34	19	1%	-1%	0%
LADOT Express	573	-	-	859	498	75	573	-	-	-286	-	-	-33%
LADOT Express	574	327	-	327	351	-	351	24	-	24	7%	-	7%
Santa Clarita Commuter	SCC797	209	-	209	153	-	153	-56	-	-56	-27%	-	-27%
Santa Clarita Commuter	SCC792	24	-	24	442	-	442	418	-	418	1742%	-	1742%
AVTA Commuter	AVTA786	1,401	-	1,401	1,098	-	1,098	-303	-	-303	-22%	-	-22%
	Total Over the Pass	7,912	5,160	13,931	8,546	5,201	13,747	634	41	-184	8%	1%	-1%

Other Route Groups	2001/2006 Observed Peak	2001/2006 Observed Off-Peak	2001/2006 Observed Daily	2006 Validation Peak	2006 Validation Off-Peak	2006 Validation Daily	Difference Peak	Difference Off-Peak	Difference Daily	% Difference Peak	% Difference Off-Peak	% Difference Daily
South of Sepulveda Pass - Wilshire Blvd./ Santa Monica Blvd./I-10/Sunset Blvd.	101,974	61,526	163,500	111,628	54,396	166,024	9,654	-7,130	2,524	9%	-12%	2%
North of Sepulveda Pass - Ventura Blvd./101/Sepulveda Blvd.	32,290	21,325	53,615	31,802	19,365	51,167	-488	-1,960	-2,448	-2%	-9%	-5%
UCLA Routes	21,925	13,977	35,902	22,433	14,448	36,881	508	471	979	2%	3%	3%
TOTAL ALL GROUPS	252,651	137,680	402,269	265,050	123,437	388,424	12,399	-14,243	-13,845	5%	-10%	-3%

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For the highway corridor validation, the existing SCAG model was found to overassign the I-405 and freeways in general in the AM and PM peaks. The SCAG model has four time periods for final highway assignment (AM Peak: 6-9am, Midday: 9am-3pm, PM Peak: 3-7pm; Night: 7pm-6am). Thus, minor modifications were made to the time of day and capacity factors consistent with common practice for corridor highway validation efforts. The capacity factors were reduced for AM peak from 3.0 to 2.7 and for PM peak from 4.0 to 3.6. In addition, free flow speeds were decreased by 5 mph on I-405 over the Sepulveda Pass and increased by 5 mph on I-10 east of I-405

Comparisons of modeled versus observed volumes were made at the project screenlines illustrated in Figure 3-3. Table 3-2 shows modeled versus observed traffic volumes at each project screenline on a daily basis and for each peak period. Corridor validation improvements can be seen for the following comparisons:

- AM Peak: Root Mean Squared Error (RMSE) improved from 24% to 14%; difference on volume from 17% to 5%
- PM Peak: RMSE improved from 38% to 17%; difference on volume from 32% to 8%

Overall percent differences are less than 10% and RMSE's are less than 20%. These differences are within the suggested guidelines in the Federal Highway Administration's *Travel Model Validation and Reasonableness Checking Manual,* Second Edition (September 2010).

Finally, SR 91 was examined as a "peer facility" (to potential improvements in the I-405 corridor) to assess the toll procedures in the SCAG model. As part of this comparison, Metro obtained count data from the Orange County Transportation Authority (OCTA) for SR 91 at the toll plaza near the Weir Canyon Road exit. Since the SCAG model overassigns SR 91, the overall observed share of SR 91 traffic on the express lanes was compared to shares from the SCAG highway assignments, instead of comparing traffic volumes directly. Table 3-3 shows the observed and modeled shares, which compare reasonably well. The shares in bold are the peak direction in each period.

Figure 3-3: Corridor Map and Project Screenlines

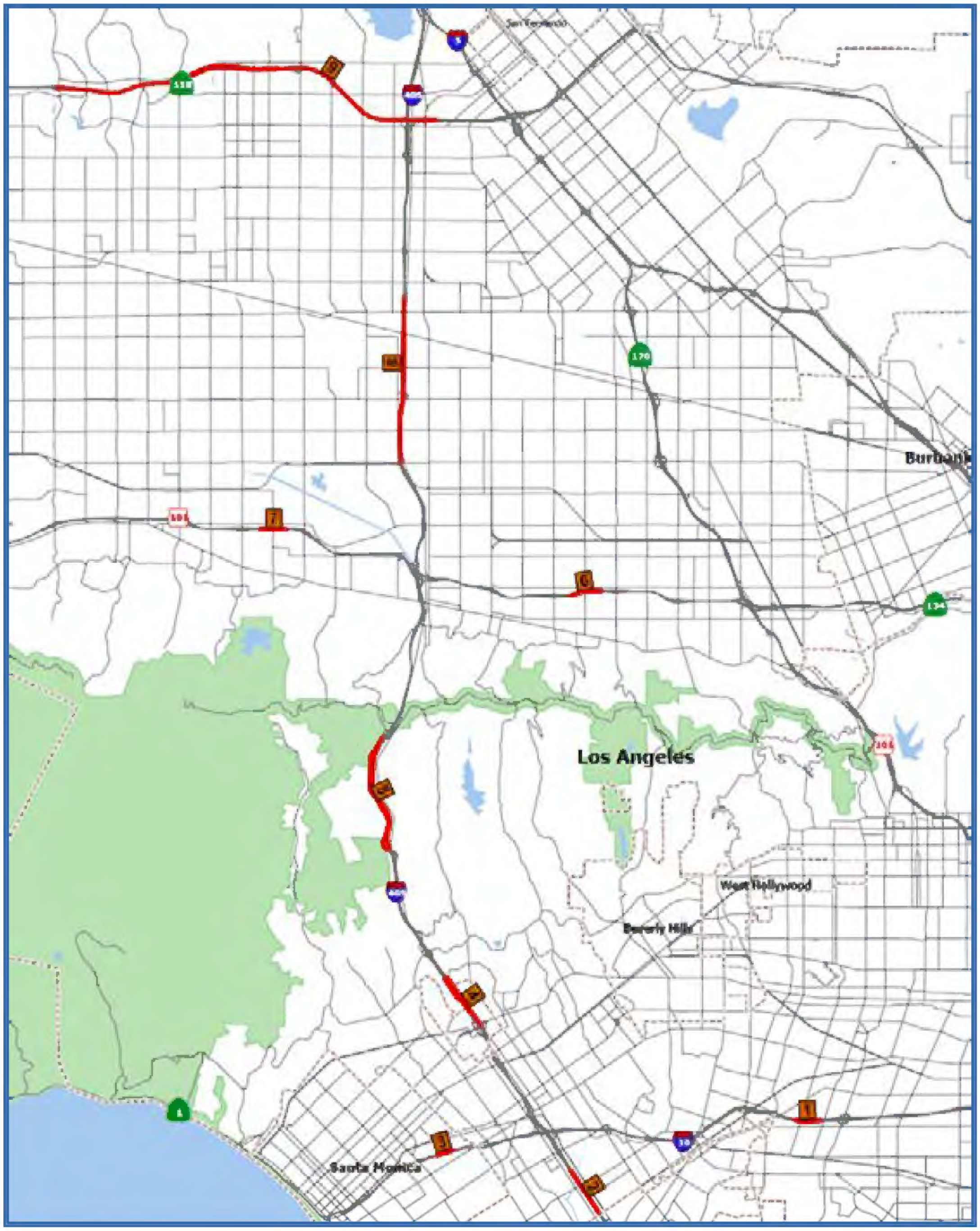

Table 3-2: Project Screenline Comparison

Original SCAG Model

Screenline	Location	Dir	Cross Street	Daily				AM Peak Period				PM Peak Period			
				Model	Traffic Count	Diff.	%Diff	Model	Traffic Count	Diff.	%Diff	Model	Traffic Count	Diff.	%Diff
1	SANTA MONICA FWY	WB	W. of La Brea	129,300	137,500	-8,200	-6%	25,300	20,303	4,997	25%	34,900	30,558	4,342	14%
1	SANTA MONICA FWY	EB	W. of La Brea	137,900	137,500	400	0%	24,300	21,456	2,844	13%	40,300	30,244	10,056	33%
2	SAN DIEGO FWY	SB	North of 187	159,200	150,000	9,200	6%	28,300	24,678	3,622	15%	42,600	34,325	8,275	24%
2	SAN DIEGO FWY	NB	North of 187	155,700	150,000	5,700	4%	28,600	24,419	4,181	17%	40,800	29,942	10,858	36%
3	SANTA MONICA FWY	WB	E . Cloverfield Blvd.	77,800	95,000	-17,200	-18%	16,400	16,270	130	1%	22,000	22,587	-587	-3%
3	SANTA MONICA FWY	EB	E . Cloverfield Blvd.	79,400	95,000	-15,600	-16%	13,900	14,010	-110	-1%	24,100	18,862	5,238	28%
4	SAN DIEGO FWY	NB	N. of Wilshire Blvd.	167,600	137,000	30,600	22%	27,600	23,821	3,779	16%	48,200	32,309	15,891	49%
4	SAN DIEGO FWY	SB	N. of Wilshire Blvd.	154,600	137,000	17,600	13%	31,700	26,107	5,593	21%	39,100	28,873	10,227	35%
4	SEPULVEDA BLVD		N. of Wilshire Blvd.	21,700	23,000	-1,300	-6%	4,800	4,383	417	10%	9,900	4,847	5,053	104%
5	SAN DIEGO FWY	SB	N. of GETTY CENTER DR	146,900	120,206	26,694	22%	28,600	22,116	6,484	29%	34,900	23,781	11,119	47%
5	SAN DIEGO FWY	NB	N. of GETTY CENTER DR	174,700	152,413	22,287	15%	27,300	20,681	6,619	32%	51,600	37,730	13,870	37%
5	N SEPULVEDA BLVD		N. of GETTY CENTER DR	19,600	26,797	-7,197	-27%	5,300	7,421	-2,121	-29%	11,000	7,321	3,679	50%
5	I 405 HOV	SB	N. of GETTY CENTER DR	14,900	18,054	-3,154	-17%	6,100	5,006	1,094	22%	5,600	3,401	2,199	65%
6	VENTURA FWY	WB	W. of COLDWATER CANYON AVE	147,000	145,500	1,500	1%	26,800	23,445	3,355	14%	40,400	32,037	8,363	26%
6	VENTURA FWY	EB	W. of COLDWATER CANYON AVE	147,900	145,500	2,400	2%	27,800	23,928	3,872	16%	39,600	31,142	8,458	27%
7	VENTURA FWY	NB	E. of WHITE OAK AVE	156,400	151,000	5,400	4%	29,500	24,830	4,670	19%	40,000	35,987	4,013	11%
7	VENTURA FWY	SB	E. of WHITE OAK AVE	161,100	151,000	10,100	7%	28,200	24,770	3,430	14%	43,100	35,441	7,659	22%
8	SAN DIEGO FWY	SB	N. of SHERMAN WAY	104,400	107,736	-3,336	-3%	23,200	18,458	4,742	26%	23,200	24,325	-1,125	-5%
8	SAN DIEGO FWY	NB	N. of SHERMAN WAY	110,200	90,219	19,981	22%	16,700	11,501	5,199	45%	32,000	23,240	8,760	38%
8	I 405 HOV	SB	N. of SHERMAN WAY	13,200	8,099	5,101	63%	5,100	3,184	1,916	60%	4,900	1,290	3,611	280%
8	I 405 HOV	NB	N. of SHERMAN WAY	5,900	8,857	-2,957	-33%	100	405	-305	-75%	5,700	4,386	1,314	30%
9	RONALD REAGAN FWY	WB	E. of RESEDA BLVD	106,400	93,472	12,928	14%	21,100	21,689	-589	-3%	34,600	25,015	9,585	38%
9	RONALD REAGAN FWY	EB	E. of RESEDA BLVD	104,900	64,902	39,998	62%	22,700	15,319	7,381	48%	33,000	18,137	14,863	82%
9	SR 118 HOV	WB	E. of RESEDA BLVD	4,200	4,297	-97	-2%	0	1,473	-1,473	-100%	4,200	1,452	2,748	189%
9	SR 118 HOV	EB	E. of RESEDA BLVD	3,900	2,867	1,033	36%	900	779	121	16%	3,000	1,379	1,621	118%
				2,504,800	*2,352,917*	*151,883*	*6%*	*470,300*	*400,451*	*69,849*	*17%*	*708,700*	*538,612*	*170,088*	*32%*
						RMSE	*16%*			*RMSE*	*24%*			*RMSE*	*38%*

Corridor Validation

Screenline	Location	Dir	Cross Street	Daily				AM Peak Period				PM Peak Period			
				Model	Traffic Count	Diff.	%Diff	Model	Traffic Count	Diff.	%Diff	Model	Traffic Count	Diff.	%Diff
1	SANTA MONICA FWY	WB	W. of La Brea	129,000	137,500	-8,500	-6%	22,700	20,303	2,397	12%	28,700	30,558	-1,858	-6%
1	SANTA MONICA FWY	EB	W. of La Brea	137,800	137,500	300	0%	21,700	21,456	244	1%	33,100	30,244	2,856	9%
2	SAN DIEGO FWY	SB	North of 187	158,400	150,000	8,400	6%	25,400	24,678	722	3%	36,300	34,325	1,975	6%
2	SAN DIEGO FWY	NB	North of 187	152,500	150,000	2,500	2%	25,500	24,419	1,081	4%	34,000	29,942	4,058	14%
3	SANTA MONICA FWY	WB	E . Cloverfield Blvd.	75,800	95,000	-19,200	-20%	14,700	16,270	-1,570	-10%	17,700	22,587	-4,887	-22%
3	SANTA MONICA FWY	EB	E . Cloverfield Blvd.	78,100	95,000	-16,900	-18%	12,400	14,010	-1,610	-11%	19,500	18,862	638	3%
4	SAN DIEGO FWY	NB	N. of Wilshire Blvd.	167,100	137,000	30,100	22%	24,900	23,821	1,079	5%	39,700	32,309	7,391	23%
4	SAN DIEGO FWY	SB	N. of Wilshire Blvd.	151,000	137,000	14,000	10%	28,500	26,107	2,393	9%	32,300	28,873	3,427	12%
4	SEPULVEDA BLVD		N. of Wilshire Blvd.	20,300	23,000	-2,700	-12%	4,300	4,383	-83	-2%	7,100	4,847	2,253	46%
5	SAN DIEGO FWY	SB	N. of GETTY CENTER DR	143,500	120,206	23,294	19%	25,800	22,116	3,684	17%	29,600	23,781	5,819	24%
5	SAN DIEGO FWY	NB	N. of GETTY CENTER DR	172,900	152,413	20,487	13%	24,600	20,681	3,919	19%	42,300	37,730	4,570	12%
5	N SEPULVEDA BLVD		N. of GETTY CENTER DR	18,000	26,797	-8,797	-33%	4,700	7,421	-2,721	-37%	7,100	7,321	-221	-3%
5	I 405 HOV	SB	N. of GETTY CENTER DR	15,100	18,054	-2,954	-16%	5,300	5,006	294	6%	3,900	3,401	499	15%
6	VENTURA FWY	WB	W. of COLDWATER CANYON AVE	146,200	145,500	700	0%	24,000	23,445	555	2%	33,900	32,037	1,863	6%
6	VENTURA FWY	EB	W. of COLDWATER CANYON AVE	146,200	145,500	700	0%	25,000	23,928	1,072	4%	33,300	31,142	2,158	7%
7	VENTURA FWY	NB	E. of WHITE OAK AVE	154,600	151,000	3,600	2%	26,300	24,830	1,470	6%	34,000	35,987	-1,987	-6%
7	VENTURA FWY	SB	E. of WHITE OAK AVE	160,000	151,000	9,000	6%	25,300	24,770	530	2%	36,600	35,441	1,159	3%
8	SAN DIEGO FWY	SB	N. of SHERMAN WAY	102,700	107,736	-5,036	-5%	20,800	18,458	2,342	13%	19,400	24,325	-4,925	-20%
8	SAN DIEGO FWY	NB	N. of SHERMAN WAY	112,900	90,219	22,681	25%	15,200	11,501	3,699	32%	27,100	23,240	3,860	17%
8	I 405 HOV	SB	N. of SHERMAN WAY	13,300	8,099	5,201	64%	4,400	3,184	1,216	38%	3,600	1,290	2,311	179%
8	I 405 HOV	NB	N. of SHERMAN WAY	4,100	8,857	-4,757	-54%	100	405	-305	-75%	3,900	4,386	-486	-11%
9	RONALD REAGAN FWY	WB	E. of RESEDA BLVD	107,700	93,472	14,228	15%	18,800	21,689	-2,889	-13%	29,300	25,015	4,285	17%
9	RONALD REAGAN FWY	EB	E. of RESEDA BLVD	104,800	64,902	39,898	61%	20,500	15,319	5,181	34%	27,100	18,137	8,963	49%
9	SR 118 HOV	WB	E. of RESEDA BLVD	2,000	4,297	-2,297	-53%	0	1,473	-1,473	-100%	2,000	1,452	548	38%
9	SR 118 HOV	EB	E. of RESEDA BLVD	1,100	2,867	-1,767	-62%	800	779	21	3%	200	1,379	-1,179	-85%
				2,475,100	*2,352,917*	*122,183*	5%	*421,700*	*400,451*	*21,249*	5%	*581,700*	*538,612*	*43,088*	*8%*
						RMSE	*16%*			*RMSE*	*14%*			*RMSE*	*17%*

Table 3-3: Observed vs. Modeled Share of Traffic on SR 91 Express Lanes

	Eastbound		Westbound	
	Count	Modeled	Count	Modeled
AM Peak	6%	2%	23%	29%
Midday	14%	25%	13%	28%
PM Peak	40%	31%	11%	18%
Night	12%	11%	9%	11%
Daily	18%	20%	14%	22%

3.3. TOLL RATE ASSUMPTIONS

The average toll rates paid per mile that were used to model Concepts 2, 4, and 6 are summarized in Table 3-4. These rates were taken from Alternative B of the "Corridor HOT Concept of Operations: I-10 and I-110 Express Lanes" report. Travel in the Sepulveda Corridor is not expected to be as heavily directional as travel in the I-10 and I-110 corridors in the off-peak period; therefore, an average toll rate of both directions was used in the modeling of the mid-day and nighttime periods.

Table 3-4: Summary of Average Weekday Toll Rates Paid per Mile

	Year 2009(1)		Year 2009 Adjusted(2)		Year 2012	
	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound
AM	$0.25	$0.28	$0.25	$0.28	$0.27	$0.30
MD	$0.26	$0.30	$0.28	$0.28	$0.30	$0.30
PM	$0.30	$0.25	$0.30	$0.25	$0.32	$0.27
NT	$0.26	$0.26	$0.26	$0.26	$0.28	$0.28

Notes: (1) Source: Corridor HOT Concept of Operations: I-10 and I-110 Express Lanes, Table 4-2, I-10 Alternative B
(2) MD and NT are average of both directions. PM Southbound is (PM Northbound – AM difference in dir ectional tolls)

These assumed rates are consistent with current average toll rates on other express/HOT lane facilities in the United States. A summary of current rates and exemptions on 17 comparable toll facilities in the U.S. is presented in Table 3-5 below. The average per-mile toll rate on these facilities (where enough information was available to determine the average) is $0.29 per mile, although this average represents a range from a low of $0.06 to a high of $0.65 per mile.

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Table 3-5: Summary of Average Weekday Toll Rates Paid per Mile

Facility Name	Location	State	Length (miles)	"Average Trip Cost"*	Per Mile Rates			Toll-Exempted Vehicles**
					Average (Derived)	Maximum	Minimum	
91 Express Lanes	Orange County	California	10	$2.37	$ 0.24	$ 0.98	$ 0.13	Reg. HOV 3+, Motorcycles, Zero Emissions Vehicles, Disabled
I-15 Express Lanes	San Diego	California	16			$ 0.50	$ 0.03	HOV 2+, Motorcycles, Registered Clean Air Vehicles
I-580 Express Lanes	Bay Area	California	12				$ 0.03	HOV 2+, Motorcycles, Registered Clean Air Vehicles
I-680 Express Lanes	Bay Area	California	14				$ 0.02	HOV 2+, Motorcycles, Registered Clean Air Vehicles
SR 237 Express Lanes	Bay Area	California	4	$3	$ 0.75			HOV 2+, Motorcycles, Registered Clean Air Vehicles
I-25 HOV Express Lanes	Denver	Colorado	7			$ 0.57	$ 0.07	HOV 2+, Motorcycles
95 Express	Miami	Florida	9	$1.70 to $2.25	$ 0.22	$1		Reg. HOV 3+, Motorcycles, Registered Hybrid Vehicles
I-85 Express Lanes	Atlanta	Georgia	16			$ 0.90	$ 0.01	HOV 3+, Motorcycles, Alternative Fuel Vehicles
Intercounty Connector	Suburban DC	Maryland	16	$3 to $4	$ 0.22	$ 0.25	$ 0.10	No exemptions except emergency vehicles
I-35W Express Lanes	Minneapolis	Minnesota	14	$1 to $4	$ 0.18	$ 0.57	$ 0.02	HOV 2+, Motorcycles
I-394 Express Lanes	Minneapolis	Minnesota	9	$1 to $4	$ 0.28	$ 0.89	$ 0.03	HOV 2+, Motorcycles
Gulf Freeway Metro HOT Lanes	Houston	Texas	15.5			$ 0.29	$ 0.06	HOV 2+, Motorcycles
Katy Freeway Managed Lanes	Houston	Texas	11			$ 0.15	$ 0.04	HOV 2+, Motorcycles
I-15 Express Lanes	Salt Lake City	Utah	40			$ 0.10	$ 0.03	HOV 2+, Motorcycles
495 Express Lanes	Northern VA	Virginia	14	$5 to $6	$ 0.39	$ 1.25	$ 0.20	HOV 3+, Motorcycles
I-95 HOT Lanes	Northern VA	Virginia	29	$5 to $7	$ 0.21	$ 1.00	$ 0.10	HOV 3+, Motorcycles
SR 167 HOT Lanes	Seattle	Washington	10	$0.75 to $1.00	$ 0.09	$ 0.90	$ 0.05	HOV 2+, Motorcycles
AVERAGE			**14.5**		**$ 0.29**	**$ 0.65**	**$ 0.06**	
MAXIMUM			**40**		**$ 0.75**	**$ 1.25**	**$ 0.20**	
MINIMUM			**4**		**$ 0.09**	**$ 0.10**	**$ 0.01**	

Useful list of HOT Lanes in the U.S. (maintained by L.A. Metro):
http://www.metro.net/projects/expresslanes/expresslanes_us/

**No consistent definition*

***Unless noted, HOV includes carpools, vanpools, and transit. Emergency vehicles exempted from tolls on all facilities.*

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4. TRAVEL DEMAND RESULTS

This section documents the results of the travel demand forecasting process for each concept. Included in this section is a description of the types of data used to assess and compare the alternatives, followed by detailed model results for each alternative. The subsequent section presents a comparison of the performance of the concepts across a set of key performance indicators.

An important measure in characterizing the efficiency and utility of a systems planning concept is person throughput—the combination of both transit ridership and personal vehicle traffic volume in the Sepulveda Pass corridor. Transit ridership is evaluated by a range of statistics that depict the ability of a project to attract riders and the ability of the bus and rail system to serve the traveling public. Highway level of service effects are typically evaluated by assessing vehicle throughput in the corridor. Key statistics include:

- ***Boardings***: Boardings (also known as unlinked transit trips) represent the number of times a traveler boards a new transit vehicle. With this statistic, a commuter driving to a train station and taking the train downtown counts as one boarding. A traveler walking from home to a feeder bus who then transfers to another bus or train counts as two boardings. This statistic has the disadvantage that an alternative that adds an extra transfer adds an extra boarding. This effect can result in cases where the inconvenience of the extra transfer can reduce the market share and linked trips while showing an increase in unlinked trips. The advantage of this statistic, however, is that it can be measured at the route or station level and provides the most intuitive understanding of whether a project is able to attract ridership.
- ***Project Boardings***: Project boardings are a subset of the boarding statistic and represent those boardings making use of a new transit project. Project boardings are equal to the number of boardings forecast for a specific new transit service. FTA uses this measure to quantify ridership for New Starts project evaluations.
- ***Station Boardings:*** Station boardings are the number of boardings occurring at each station and can also show the modes of access and egress (e.g., walk, bus, park-and-ride or kiss-and-ride) to and from a station. This statistic provides information on the locations where the project is forecasted to attract demand. It is also useful in understanding the impacts that each station may have on the surrounding community.
- ***Traffic Volumes:*** Vehicle traffic volumes are the number of vehicles expected to travel on a specific segment of highway. These volumes are specified by direction of travel and time of day, as well as type of lane used for travel (mainline, HOV, or HOT). By comparing traffic volumes of different systems planning concepts to the No Build scenario, an analyst can see the effects HOV lanes, toll lanes, and new transit initiatives can have on highway level of service.

The reminder of this section documents the projected transit ridership and highway traffic volumes of each of the Systems Planning Concepts.

4.1. No Build

The No Build scenario analyzed in the following tables assumes that no transit or highway initiative is undertaken in the Sepulveda Pass. However, other projects included in both the Measure R and the Regional Transportation Plan project lists would be constructed.

Table 4-1 summarizes highway traffic volumes expected for year 2035. The results of the No Build scenario are helpful in assessing the relative impact the different systems planning concepts would have on expected conditions.

Table 4-1: Year 2035 No Build Average Weekday Traffic Volumes

	Length (miles)		AM Peak Travel Times (mins.)			AM Peak Volumes			AM Peak Travel Times (mins.)			AM Peak Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	5.00	5.79	-	15,334	2,025	-	10.63	11.35	-	22,916	5,102	-
US-101 to Wilshire Blvd.	8.19	7.72	11.47	8.32	-	23,167	2,436	-	20.84	13.98	-	27,014	5,781	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	6.47	3.92	-	24,257	3,472	-	7.79	5.57	-	24,726	4,757	-
Venice Blvd. to South Terminus	7.94	7.83	16.50	13.00	-	23,752	3,043	-	12.90	10.36	-	21,509	3,897	-
TOTAL	*23.45*	*23.35*	*39.44*	*31.03*	-	**86,510**	**10,976**	-	*52.16*	*41.26*	-	**96,165**	**19,537**	-

	Length (miles)		PM Peak Travel Times (mins.)			PM Peak Volumes			PM Peak Travel Times (mins.)			PM Peak Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	8.42	10.07	-	29,705	6,669	-	6.35	7.55	-	23,212	4,372	-
US-101 to Wilshire Blvd.	8.19	7.72	20.28	13.31	-	41,481	7,284	-	12.76	9.82	-	30,529	5,444	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	7.82	5.10	-	33,904	6,233	-	7.98	5.25	-	34,906	6,852	-
Venice Blvd. to South Terminus	7.94	7.83	16.27	13.66	-	30,669	4,306	-	15.54	12.84	-	31,300	6,536	-
TOTAL	*23.45*	*23.35*	*52.79*	*42.14*	-	**135,759**	**24,492**	-	*42.63*	*35.46*	-	**119,947**	**23,204**	-

	Length (miles)		Midday Travel Times (mins.)			Midday Volumes			Midday Travel Times (mins.)			Midday Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	5.67	5.73	-	40,271	4,144	-	7.79	6.74	-	42,937	5,390	-
US-101 to Wilshire Blvd.	8.19	7.72	12.64	7.94	-	57,487	4,144	-	12.73	8.10	-	51,985	5,395	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	6.48	3.75	-	49,095	7,519	-	6.87	4.09	-	51,496	8,033	-
Venice Blvd. to South Terminus	7.94	7.83	13.97	11.82	-	45,866	7,478	-	11.86	8.92	-	46,179	7,465	-
TOTAL	*23.45*	*23.35*	*38.76*	*29.24*	-	**192,719**	**23,285**	-	*39.25*	*27.85*	-	**192,597**	**26,283**	-

	Length (miles)		Night Travel Times (mins.)			Night Volumes			Night Travel Times (mins.)			Night Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	4.34	4.89	-	41,647	336	-	4.57	5.40	-	30,879	560	-
US-101 to Wilshire Blvd.	8.19	7.72	9.19	7.14	-	52,557	336	-	8.31	7.05	-	39,403	560	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	3.83	3.11	-	45,707	336	-	4.07	3.21	-	44,229	1,538	-
Venice Blvd. to South Terminus	7.94	7.83	8.56	7.61	-	38,442	336	-	8.05	6.34	-	38,683	1,538	-
TOTAL	*23.45*	*23.35*	*25.92*	*22.75*	-	**178,353**	**1,344**	-	*25*	*22*	-	**153,194**	**4,196**	-

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4.2. CONCEPT 1: SEPULVEDA BRT

Concept 1 envisions a 30-mile BRT system running from Sylmar Metrolink Station at the northern end of the corridor south to the Century and Aviation station adjacent to LAX. The concept is described in greater detail in Section 2.1.

Table 4-2 summarizes project transit boardings by proposed station. Total daily project boardings for Concept 1 are 39,466.

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Table 4-2: Year 2035 Concept 1 Average Weekday Station Boardings and Times

Station Name	Southbound (Read Down)			Southbound (P-A Format)						Northbound (Read Up)			Northbound (P-A Format)						Total Boardings		
	Dist (mi)	Time PK (min)	Time OP (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Dist (mi)	Time PK (min)	Time OP (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Peak	Off-Peak	Daily
Sylmar SF Metrolink	-	-	-	1,011	0	640	0	1,651	0	5.1	11.5	15.1	0	676	0	319	0	995	844	480	**1,323**
Van Nuys/Nordhoff St.	5.1	19.1	15.4	2,157	91	1,043	42	3,200	133	2.4	5.1	7.2	82	702	25	678	107	1,380	1,516	894	**2,410**
Sherman Way	2.4	10.4	7.5	3,557	255	1,677	110	5,234	365	1.5	3.1	4.4	104	1,271	105	892	209	2,163	2,594	1,392	**3,986**
Van Nuys/Oxnard	1.5	4.3	4.4	9,270	1,961	8,802	586	18,072	2,547	11.2	25.6	29.1	1,069	1,151	504	950	1,573	2,101	6,726	5,421	**12,147**
Westwood/Wilshire	11.1	54.4	32.3	1,894	7,455	141	6,585	2,035	14,040	2.0	9.0	8.5	1,198	1,062	1,393	405	2,591	1,467	5,805	4,262	**10,067**
Sepulveda Blvd./Expo	2.0	7.8	8.7	170	3,890	62	2,724	232	6,614	4.4	23.4	19.6	1,083	233	385	249	1,468	482	2,688	1,710	**4,398**
Culver City Tc	4.4	18.2	20.0	64	1,858	9	763	73	2,621	3.8	24.0	19.9	245	303	341	78	586	381	1,235	596	**1,831**
Century/Aviation	3.8	14.9	18.3	0	2,613	0	1,564	0	4,177	-	-	-	1,617	0	818	0	2,435	0	2,115	1,191	**3,306**
Total	**30.3**	**129.1**	**106.6**	**18,123**	**18,123**	**12,374**	**12,374**	**30,497**	**30,497**	**30.4**	**101.7**	**103.8**	**5,398**	**5,398**	**3,571**	**3,571**	**8,969**	**8,969**	**23,521**	**15,945**	**39,466**

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Table 4-3 summarizes average weekday station boardings by mode of access and egress. An estimated 98 percent of passengers using the Sepulveda BRT will access the route by a mode other than personal vehicle.

Table 4-3: Year 2035 Concept 1 Average Weekday Station Boardings by Mode of Access/Egress

	By Access			By Egress			Boardings		
Station Name	Walk/Bus/Rail	Drive	Total	Walk/Bus/Rail	Drive	Total	Walk/Bus/Rail	Drive	Total
Sylmar SF Metrolink	1,412	239	1,651	995	-	995	1,204	120	1,323
Van Nuys/Nordhoff St.	3,304	3	3,307	1,513	-	1,513	2,409	2	2,410
Sherman Way	5,425	18	5,443	2,528	-	2,528	3,977	9	3,986
Van Nuys/Oxnard	19,632	13	19,645	4,648	-	4,648	12,140	7	12,147
Westwood/Wilshire	4,381	245	4,626	15,507	-	15,507	9,944	123	10,067
Sepulveda Blvd./Expo	1,606	94	1,700	7,096	-	7,096	4,351	47	4,398
Culver City Transit Center	654	5	659	3,002	-	3,002	1,828	3	1,831
Century/Aviation	2,124	311	2,435	4,177	-	4,177	3,151	156	3,306
Total	38,538	928	39,466	39,466	-	39,466	39,002	464	39,466

Table 4-4 summarizes average weekday traffic volume by segment.

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Table 4-4: Year 2035 Concept 1 Average Weekday Traffic Volumes

	Length (miles)		AM Peak Travel Times (mins.)			AM Peak Volumes			AM Peak Travel Times (mins.)			AM Peak Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	5.00	5.80	-	15,333	2,020	-	10.49	11.21	-	22,789	5,055	-
US-101 to Wilshire Blvd.	8.19	7.73	11.45	8.32	-	23,085	2,435	-	20.34	13.73	-	26,807	5,730	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	6.45	3.92	-	24,294	3,474	-	7.76	5.54	-	24,649	4,744	-
Venice Blvd. to South Terminus	7.94	7.83	16.61	13.04	-	23,744	3,044	-	12.93	10.37	-	21,511	3,914	-
TOTAL	*23.45*	*23.36*	*39.51*	*31.08*	-	**86,456**	**10,973**	-	*51.52*	*40.85*	-	**95,756**	**19,443**	-

	Length (miles)		PM Peak Travel Times (mins.)			PM Peak Volumes			PM Peak Travel Times (mins.)			PM Peak Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	8.32	9.91	-	29,576	6,592	-	6.32	7.55	-	23,138	4,365	-
US-101 to Wilshire Blvd.	8.19	7.73	19.80	13.11	-	41,193	7,215	-	12.68	9.80	-	30,379	5,429	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	7.76	5.05	-	33,752	6,194	-	7.93	5.24	-	34,857	6,855	-
Venice Blvd. to South Terminus	7.94	7.83	16.25	13.64	-	30,675	4,313	-	15.51	12.86	-	31,257	6,547	-
TOTAL	*23.45*	*23.36*	*52.13*	*41.71*	-	**135,196**	**24,314**	-	*42.44*	*35.45*	-	**119,631**	**23,196**	-

	Length (miles)		Midday Travel Times (mins.)			Midday Volumes			Midday Travel Times (mins.)			Midday Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	5.66	5.72	-	40,045	4,108	-	7.70	6.72	-	42,579	5,341	-
US-101 to Wilshire Blvd.	8.19	7.73	12.56	7.93	-	56,977	4,108	-	12.58	8.09	-	51,486	5,346	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	6.46	3.74	-	49,064	7,477	-	6.74	4.08	-	50,996	7,981	-
Venice Blvd. to South Terminus	7.94	7.83	13.98	11.82	-	45,757	7,434	-	11.78	8.88	-	45,341	7,417	-
TOTAL	*23.45*	*23.36*	*38.66*	*29.21*	-	**191,843**	**23,127**	-	*38.8*	*27.77*	-	**190,402**	**26,085**	-

	Length (miles)		Night Travel Times (mins.)			Night Volumes			Night Travel Times (mins.)			Night Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	4.34	4.89	-	41,437	332	-	4.56	5.40	-	30,627	558	-
US-101 to Wilshire Blvd.	8.19	7.73	9.17	7.14	-	52,023	332	-	8.30	7.05	-	38,830	558	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	3.82	3.11	-	45,489	332	-	4.07	3.21	-	44,030	1,538	-
Venice Blvd. to South Terminus	7.94	7.83	8.56	7.61	-	38,433	332	-	8.05	6.34	-	38,602	1,538	-
TOTAL	*23.45*	*23.36*	*25.89*	*22.75*	-	**177,382**	**1,328**	-	*24.98*	*22.00*	-	**152,089**	**4,192**	-

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4.3. CONCEPT 2: AT-GRADE FREEWAY MANAGED LANES

Concept 2 envisions a 29-mile managed lanes alignment along Interstate 405 from the San Fernando Valley to LAX. Three BRT routes will utilize all or a portion of the managed lanes from the Valley to the Westside and LAX as described in Section 2.2.

Table 4-5 summarizes project transit boardings by proposed station. Total daily project boardings for the three BRT lines in Concept 2 are 55,495.

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Table 4-5: Year 2035 Concept 2 Average Weekday Station Boardings and Times

Station Name	Southbound (Read Down)			Southbound (P-A Format)						Northbound (Read Up)			Northbound (P-A Format)						Total Boardings		
	Dist (mi)	Time PK (min)	Time OP (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Dist (mi)	Time PK (min)	Time OP (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Peak	Off-Peak	Daily
Sylmar Metrolink	-	-	-	87	0	16	0	103	0	10.1	33.6	44.1	0	60	0	12	0	72	74	14	**88**
Orange -Sepulveda	10.1	53.6	45.2	6,246	0	2,829	0	9,075	0	18.0	52.2	46.2	0	2,179	0	817	0	2,996	4,213	1,823	**6,036**
Century/Aviation	18.1	40.5	44.9	0	6,333	0	2,845	0	9,178	-	-	-	2,239	0	829	0	3,068	0	4,286	1,837	**6,123**
Total	**28.2**	**94.1**	**90.1**	**6,333**	**6,333**	**2,845**	**2,845**	**9,178**	**9,178**	**28.1**	**85.8**	**90.3**	**2,239**	**2,239**	**829**	**829**	**3,068**	**3,068**	**8,572**	**3,674**	**12,246**

Line 2 - Sylmar Metrolink to Purple Line VA Station

Station Name	Southbound (Read Down)			Southbound (P-A Format)						Northbound (Read Up)			Northbound (P-A Format)						Total Boardings		
	Dist (mi)	Time PK (min)	Time OP (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Dist (mi)	Time PK (min)	Time OP (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Peak	Off-Peak	Daily
Sylmar Metrolink	-	-	-	265	0	179	0	444	0	5.1	28.0	22.8	0	90	0	32	0	122	178	106	**283**
Van Nuys/Nordhoff	5.1	28.0	22.8	1,381	79	498	29	1,879	108	1.9	12.8	8.8	16	181	18	185	34	366	829	365	**1,194**
Van Nuys/Metrolink Station	1.9	12.8	8.8	1,286	16	360	11	1,646	27	3.0	12.8	13.6	27	195	14	128	41	323	762	257	**1,019**
Orange-Sepulveda	3.0	12.8	13.6	5,126	1,361	2,140	296	7,266	1,657	10.9	19.4	20.2	152	1,253	120	484	272	1,737	3,946	1,520	**5,466**
Sepulveda/Wilshire	10.9	19.4	20.2	0	5,068	0	2,224	0	7,292	0.7	10.3	8.1	568	8	575	0	1,143	8	2,822	1,400	**4,222**
Wilshire Purple VA	0.7	10.3	8.1	0	1,534	0	617	0	2,151	-	-	-	964	0	102	0	1,066	0	1,249	360	**1,609**
Total	**21.6**	**83.3**	**73.5**	**8,058**	**8,058**	**3,177**	**3,177**	**11,235**	**11,235**	**21.6**	**83.3**	**73.5**	**1,727**	**1,727**	**829**	**829**	**2,556**	**2,556**	**9,785**	**4,006**	**13,791**

Line 3 - Orange-Sepulveda to Century/Aviation Station

Station Name	Southbound (Read Down)			Southbound (P-A Format)						Northbound (Read Up)			Northbound (P-A Format)						Total Boardings		
	Dist (mi)	Time PK (min)	Time OP (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Dist (mi)	Time PK (min)	Time OP (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Peak	Off-Peak	Daily
Orange-Sepulveda	-	-	-	16,364	0	7,371	0	23,735	0	10.5	17.6	17.5	0	2,264	0	2,240	0	4,504	9,314	4,806	**14,120**
Expo/Sepulveda	10.6	17.4	17.8	192	15,136	65	6,540	257	21,676	4.4	23.4	19.6	2,110	235	1,810	264	3,920	499	8,837	4,340	**13,176**
Culver City TC	4.4	18.2	20.0	64	1,388	14	868	78	2,256	3.8	24.1	19.9	227	306	524	79	751	385	993	743	**1,735**
Century/Aviation	3.8	15.0	18.4	0	96	0	42	0	138	-	-	-	468	0	249	0	717	0	282	146	**428**
Total	**18.8**	**50.6**	**56.2**	**16,620**	**16,620**	**7,450**	**7,450**	**24,070**	**24,070**	**18.7**	**65.1**	**57.0**	**2,805**	**2,805**	**2,583**	**2,583**	**5,388**	**5,388**	**19,425**	**10,033**	**29,458**

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Table 4-6 summarizes average weekday station boardings by mode of access and egress. An estimated 92 percent of passengers using the one of the three BRT lines in Concept 2 will access it by a mode other than personal vehicle.

Table 4-6: Year 2035 Concept 2 Average Weekday Station Boardings by Mode of Access/Egress

Line 1 - Sylmar Metrolink to Century/Aviation Station

	By Access			By Egress			Boardings		
Station Name	Walk/Bus/Rail	Drive	Total	Walk/Bus/Rail	Drive	Total	Walk/Bus/Rail	Drive	Total
Sylmar Metrolink	70	33	103	72	-	72	71	17	88
Orange -Sepulveda	8,437	638	9,075	2,996	-	2,996	5,717	319	6,036
Century/Aviation	2,937	131	3,068	9,178	-	9,178	6,058	66	6,123
Total	**11,444**	**802**	**12,246**	**12,246**	**-**	**12,246**	**11,845**	**401**	**12,246**

Line 2 - Sylmar Metrolink to Purple Line VA Station

	By Access			By Egress			Boardings		
Station Name	Walk/Bus/Rail	Drive	Total	Walk/Bus/Rail	Drive	Total	Walk/Bus/Rail	Drive	Total
Sylmar Metrolink	363	81	444	122	-	122	243	41	283
Van Nuys/Nordhoff	1,519	394	1,913	474	-	474	997	197	1,194
Van Nuys/Metrolink	1,426	261	1,687	350	-	350	888	131	1,019
Orange-Sepulveda	6,813	725	7,538	3,394	-	3,394	5,104	363	5,466
Sepulveda/Wilshire	1,038	105	1,143	7,300	-	7,300	4,169	53	4,222
Wilshire Purple VA	1,031	35	1,066	2,151	-	2,151	1,591	18	1,609
Total	**12,190**	**1,601**	**13,791**	**13,791**	**-**	**13,791**	**12,991**	**801**	**13,791**

Line 3 - Orange-Sepulveda to Century/Aviation Station

	By Access			By Egress			Boardings		
Station Name	Walk/Bus/Rail	Drive	Total	Walk/Bus/Rail	Drive	Total	Walk/Bus/Rail	Drive	Total
Sepulveda	22,147	1,588	23,735	4,504	-	4,504	13,326	794	14,120
Expo/Sepulveda	3,965	212	4,177	22,175	-	22,175	13,070	106	13,176
Fox Hills Mall/Transit Cente	754	75	829	2,641	-	2,641	1,698	38	1,735
Century/Aviation	646	71	717	138	-	138	392	36	428
Total	**27,512**	**1,946**	**29,458**	**29,458**	**-**	**29,458**	**28,485**	**973**	**29,458**

Table 4-7 summarizes average weekday traffic volume by segment.

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Table 4-7: Year 2035 Concept 2 Average Weekday Traffic Volumes

	Length (miles)		AM Peak Travel Times (mins.)			AM Peak Volumes			AM Peak Travel Times (mins.)			AM Peak Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Rinaldi to Sherman Way Ingress/Egress	7.38	7.22	6.82	5.99	5.99	8,585	182	720	11.76	11.80	11.80	21,716	2,890	2,088
Sherman Way Ingress/Egress to US 101	1.54	1.67	3.33	1.74	1.74	15,465	182	720	5.34	3.62	3.62	18,732	2,965	2,121
US 101 to Wilshire Blvd.	8.15	8.00	12.42	9.43	9.43	15,605	1,917	1,853	19.72	14.32	14.32	33,425	6,962	3,143
Wilshire Blvd. to SM DAR	1.15	1.00	1.73	1.32	1.32	21,821	2,378	1,517	3.08	1.84	1.84	27,173	5,812	2,841
SM DAR to Venice Ingress/Egress	2.78	3.04	5.15	6.03	6.03	24,364	3,798	1,819	6.05	5.59	5.59	18,235	2,571	2,434
Venice Ingress/Egress to HH Pkwy DAR	2.38	2.35	6.12	3.84	3.84	18,466	660	3,894	6.79	3.42	3.42	23,100	817	3,242
HH Pkwy DAR to El Segundo	5.18	5.66	13.39	7.90	7.90	24,449	304	3,814	11.37	6.58	6.58	20,921	0	3,008
TOTAL	*28.56*	*28.95*	*48.96*	36.25	*36.25*	**128,755**	**9,421**	**14,337**	*64.11*	47.17	*47.17*	**163,302**	**22,017**	**18,877**

	Length (miles)		PM Peak Travel Times (mins.)			PM Peak Volumes			PM Peak Travel Times (mins.)			PM Peak Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Rinaldi to Sherman Way Ingress/Egress	7.38	7.22	10.10	8.14	8.14	22,166	2,154	3,148	7.57	7.15	7.15	22,224	538	1,481
Sherman Way Ingress/Egress to US 101	1.54	1.67	5.61	3.24	3.24	29,871	2,192	3,205	3.57	1.96	1.96	20,210	551	1,500
US 101 to Wilshire Blvd.	8.15	8.00	19.68	13.15	13.15	29,952	5,775	5,592	13.57	11.10	11.10	33,430	4,351	3,565
Wilshire Blvd. to SM DAR	1.15	1.00	2.75	1.83	1.83	39,060	7,111	3,943	2.12	1.43	1.43	36,407	2,431	3,016
SM DAR to Venice Ingress/Egress	2.78	3.04	5.90	5.66	5.66	35,273	3,695	3,588	6.55	6.28	6.28	25,540	2,942	3,304
Venice Ingress/Egress to HH Pkwy DAR	2.38	2.35	6.49	4.55	4.55	24,813	335	5,394	7.66	6.10	6.10	33,005	545	5,514
HH Pkwy DAR to El Segundo	5.18	5.66	12.59	8.78	8.78	32,365	64	5,292	13.97	7.72	7.72	31,119	0	5,393
TOTAL	*28.56*	*28.95*	*63.12*	45.35	*45.35*	**213,500**	**21,326**	**30,162**	*55.01*	41.74	*41.74*	**201,935**	**11,358**	**23,773**

	Length (miles)		Midday Travel Times (mins.)			Midday Volumes			Midday Travel Times (mins.)			Midday Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Rinaldi to Sherman Way Ingress/Egress	7.38	7.22	7.91	6.40	6.40	28,044	971	3,191	8.76	7.61	7.61	40,272	1,563	3,440
Sherman Way Ingress/Egress to US 101	1.54	1.67	3.90	1.87	1.87	38,989	969	3,193	4.08	2.18	2.18	35,506	1,562	3,442
US 101 to Wilshire Blvd.	8.15	8.00	13.88	11.28	11.28	38,968	4,642	6,537	14.05	11.15	11.15	60,449	7,809	7,019
Wilshire Blvd. to SM DAR	1.15	1.00	1.94	1.57	1.57	54,039	3,317	4,398	2.20	1.43	1.43	54,024	5,876	6,088
SM DAR to Venice Ingress/Egress	2.78	3.04	4.92	4.86	4.86	51,926	5,999	5,109	5.34	5.65	5.65	38,484	3,669	5,642
Venice Ingress/Egress to HH Pkwy DAR	2.38	2.35	5.43	4.69	4.69	36,063	745	8,975	6.51	5.57	5.57	49,486	1,074	5,145
HH Pkwy DAR to El Segundo	5.18	5.66	10.62	7.67	7.67	48,342	0	8,860	11.29	5.98	5.98	45,098	0	4,712
TOTAL	*28.56*	*28.95*	*48.60*	38.34	*38.34*	**296,371**	**16,643**	**40,263**	*52.23*	39.57	*39.57*	**323,319**	**21,553**	**35,488**

	Length (miles)		Night Travel Times (mins.)			Night Volumes			Night Travel Times (mins.)			Night Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Rinaldi to Sherman Way Ingress/Egress	7.38	7.22	6.32	5.72	5.72	29,154	0	0	6.10	6.57	6.57	30,398	0	0
Sherman Way Ingress/Egress to US 101	1.54	1.67	2.85	1.66	1.66	41,622	0	0	2.60	1.81	1.81	21,621	0	0
US 101 to Wilshire Blvd.	8.15	8.00	9.83	8.63	8.63	41,560	450	469	8.98	8.44	8.44	39,160	1,856	939
Wilshire Blvd. to SM DAR	1.15	1.00	1.37	1.20	1.20	52,154	496	349	1.40	1.09	1.09	44,597	124	93
SM DAR to Venice Ingress/Egress	2.78	3.04	2.98	2.73	2.73	47,398	1,309	469	3.16	3.21	3.21	33,165	1,234	509
Venice Ingress/Egress to HH Pkwy DAR	2.38	2.35	3.08	2.53	2.53	34,882	0	2,158	3.19	2.40	2.40	38,697	50	422
HH Pkwy DAR to El Segundo	5.18	5.66	5.93	5.51	5.51	38,385	0	2,158	6.00	5.19	5.19	38,734	0	406
TOTAL	*28.56*	*28.95*	*32.36*	27.98	*27.98*	**285,155**	**2,255**	**5,603**	*31.43*	28.71	*28.71*	**246,372**	**3,264**	**2,369**

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4.4. Concept 3: Highway Viaduct Managed Lanes

Concept 3, which envisioned the construction of a new highway viaduct above the existing Interstate 405, was examined earlier in the SPCSPS process, but has not been included in the modeling process.

4.5. Concept 4: Tolled Highway Tunnel

Concept 4 includes an approximately 11-mile tolled bus and automobile tunnel through the Sepulveda Pass. The concept is described in greater detail in Section 2.4.

Table 4-8 summarizes project transit boardings by proposed station. Total daily project boardings for the three BRT lines in Concept 4 are 56,973.

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Table 4-8: 2035 Concept 4 Average Weekday Station Boardings and Times

Line 1 - Sylmar Metrolink to Century/Aviation Station

Station Name	Southbound (Read Down)			Southbound (P-A Format)						Northbound (Read Up)			Northbound (P-A Format)						Total Boardings		
	Dist (mi)	Time PK (min)	Time OP (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Dist (mi)	Time PK (min)	Time OP (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Peak	Off-Peak	Daily
Sylmar Metrolink	-	-	-	877	0	148	0	1,025	0	10.1	33.6	50.9	0	185	0	51	0	236	531	100	**631**
Orange -Sepulveda	10.1	53.6	45.2	2,212	533	1,856	98	4,068	631	18.0	66.0	44.1	101	1,215	11	201	112	1,416	2,031	1,083	**3,114**
Century/Aviation	18.1	51.4	49.6	0	2,556	0	1,906	0	4,462	-	-	-	1,299	0	241	0	1,540	0	1,928	1,074	**3,001**
Total	**28.2**	**105.0**	**94.8**	**3,089**	**3,089**	**2,004**	**2,004**	**5,093**	**5,093**	**28.1**	**99.6**	**95.0**	**1,400**	**1,400**	**252**	**252**	**1,652**	**1,652**	**4,489**	**2,256**	**6,745**

Line 2 - Sylmar Metrolink to Purple Line VA Station

Station Name	Southbound (Read Down)			Southbound (P-A Format)						Northbound (Read Up)			Northbound (P-A Format)						Total Boardings		
	Dist (mi)	Time PK (min)	Time OP (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Dist (mi)	Time PK (min)	Time OP (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Peak	Off-Peak	Daily
Sylmar Metrolink	-	-	-	71	0	134	0	205	0	5.1	16.9	22.2	0	75	0	35	0	110	73	85	**158**
Van Nuys/Nordhoff	5.1	28.0	22.8	1,322	59	496	29	1,818	88	1.9	6.0	8.4	17	175	18	189	35	364	787	366	**1,153**
Van Nuys/Metrolink Station	1.9	12.8	8.8	1,311	19	380	9	1,691	28	3.0	10.8	13.5	25	190	14	133	39	323	773	268	**1,041**
Orange-Sepulveda	3.0	12.8	13.6	5,344	1,155	2,228	247	7,572	1,402	9.7	18.7	18.8	113	1,328	124	520	237	1,848	3,970	1,560	**5,530**
Sepulveda/Wilshire	9.7	17.8	18.6	0	5,179	0	2,311	0	7,490	0.7	10.7	8.8	632	8	612	0	1,244	8	2,910	1,462	**4,371**
Wilshire Purple VA	0.7	9.9	8.0	0	1,636	0	642	0	2,278	-	-	-	989	0	109	0	1,098	0	1,313	376	**1,688**
Total	**20.4**	**81.3**	**71.8**	**8,048**	**8,048**	**3,238**	**3,238**	**11,286**	**11,286**	**20.4**	**63.1**	**71.7**	**1,776**	**1,776**	**877**	**877**	**2,653**	**2,653**	**9,824**	**4,115**	**13,939**

Line 3 - Orange-Sepulveda to Century/Aviation Station

Station Name	Southbound (Read Down)			Southbound (P-A Format)						Northbound (Read Up)			Northbound (P-A Format)						Total Boardings		
	Dist (mi)	Time PK (min)	Time OP (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Dist (mi)	Time PK (min)	Time OP (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Peak	Off-Peak	Daily
Orange-Sepulveda	-	-	-	20,609	0	8,660	0	29,269	0	9.4	16.1	16.0	0	2,819	0	2,994	0	5,813	11,714	5,827	**17,541**
Expo/Sepulveda	9.4	15.8	16.2	191	16,590	64	7,494	255	24,084	4.4	23.4	19.6	2,577	229	1,947	257	4,524	486	9,794	4,881	**14,675**
Culver City TC	4.4	18.2	20.0	64	1,604	13	891	77	2,495	3.8	24.0	19.9	319	309	539	80	858	389	1,148	762	**1,910**
Century/Aviation	3.8	14.9	18.3	0	2,670	0	352	0	3,022	-	-	-	461	0	845	0	1,306	0	1,566	599	**2,164**
Total	**17.6**	**48.9**	**54.5**	**20,864**	**20,864**	**8,737**	**8,737**	**29,601**	**29,601**	**17.6**	**63.5**	**55.5**	**3,357**	**3,357**	**3,331**	**3,331**	**6,688**	**6,688**	**24,221**	**12,068**	**36,289**

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Table 4-9 summarizes average weekday station boardings by mode of access and egress. An estimated 92 percent of passengers using the one of the three BRT lines in Concept 4 will access it by a mode other than personal vehicle.

Table 4-9: Year 2035 Concept 4 Average Weekday Station Boardings by Mode of Access/Egress

Line 1 - Sylmar Metrolink to Century/Aviation Station

	By Access			By Egress			Boardings		
Station Name	Walk/Bus/Rail	Drive	Total	Walk/Bus/Rail	Drive	Total	Walk/Bus/Rail	Drive	Total
Sylmar Metrolink	846	179	1,025	236	-	236	541	90	631
Orange -Sepulveda	4,170	10	4,180	2,047	-	2,047	3,109	5	3,114
Century/Aviation	1,447	93	1,540	4,462	-	4,462	2,955	47	3,001
Total	6,463	282	6,745	6,745	-	6,745	6,604	141	6,745

Line 2 - Sylmar Metrolink to Purple Line VA Station

	By Access			By Egress			Boardings		
Station Name	Walk/Bus/Rail	Drive	Total	Walk/Bus/Rail	Drive	Total	Walk/Bus/Rail	Drive	Total
Sylmar Metrolink	170	35	205	110	-	110	140	18	158
Van Nuys/Nordhoff	1,468	385	1,853	452	-	452	960	193	1,153
Van Nuys/Metrolink	1,467	263	1,730	351	-	351	909	132	1,041
Orange-Sepulveda	7,051	758	7,809	3,250	-	3,250	5,151	379	5,530
Sepulveda/Wilshire	1,136	108	1,244	7,498	-	7,498	4,317	54	4,371
Wilshire Purple VA	1,064	34	1,098	2,278	-	2,278	1,671	17	1,688
Total	12,356	1,583	13,939	13,939	-	13,939	13,148	792	13,939

Line 3 - Orange-Sepulveda to Century/Aviation Station

	By Access			By Egress			Boardings		
Station Name	Walk/Bus/Rail	Drive	Total	Walk/Bus/Rail	Drive	Total	Walk/Bus/Rail	Drive	Total
Sepulveda	27,012	2,257	29,269	5,813	-	5,813	16,413	1,129	17,541
Expo/Sepulveda	4,556	223	4,779	24,570	-	24,570	14,563	112	14,675
Fox Hills Mall/Transit Cente	845	90	935	2,884	-	2,884	1,865	45	1,910
Century/Aviation	1,217	89	1,306	3,022	-	3,022	2,120	45	2,164
Total	33,630	2,659	36,289	36,289	-	36,289	34,960	1,330	36,289

Table 4-10 summarizes average weekday traffic volume by segment.

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Table 4-10: Year 2035 Concept 4 Average Weekday Traffic Volumes

	Length (miles)		AM Peak Travel Times (mins.)			AM Peak Volumes			AM Peak Travel Times (mins.)			AM Peak Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll (1)	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll (1)	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	1.54	1.67	4.93	5.54	-	15,247	1,601	5,519	10.33	9.43	-	23,678	4,341	10,501
US-101 to Wilshire Blvd.	5.22	5.05	10.50	8.72	8.56	19,914	2,028	5,519	14.94	13.58	14.39	24,309	4,917	10,501
Wilshire Blvd. to Venice Blvd.	4.08	3.93	6.60	3.10	-	24,915	2,604	5,519	8.30	4.71	-	25,518	4,392	10,501
Venice Blvd. to South Terminus	2.78	3.04	16.43	12.62	-	23,861	2,401	-	12.81	7.80	-	21,783	3,749	-
TOTAL	*13.62*	*13.68*	*38.46*	*29.98*	*8.56*	**83,937**	**8,634**	**16,557**	*46.38*	*35.52*	*14.39*	**95,288**	**17,399**	**31,503**

	Length (miles)		PM Peak Travel Times (mins.)			PM Peak Volumes			PM Peak Travel Times (mins.)			PM Peak Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll (1)	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll (1)	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	1.54	1.67	8.13	8.48	-	30,694	5,888	12,414	6.21	6.78	-	23,346	3,478	9,676
US-101 to Wilshire Blvd.	5.22	5.05	15.06	11.93	11.45	38,558	6,201	12,414	10.87	10.75	10.78	27,307	4,196	9,676
Wilshire Blvd. to Venice Blvd.	4.08	3.93	8.37	3.95	-	34,913	5,404	12,414	8.17	4.65	-	35,522	6,272	9,676
Venice Blvd. to South Terminus	2.78	3.04	16.56	13.28	-	31,224	3,460	-	15.21	10.55	-	31,545	6,351	-
TOTAL	*13.62*	*13.68*	*48.12*	*37.64*	*11.45*	**135,389**	**20,953**	**37,242**	*40.46*	*32.73*	*10.78*	**117,720**	**20,297**	**29,028**

	Length (miles)		Midday Travel Times (mins.)			Midday Volumes			Midday Travel Times (mins.)			Midday Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll (1)	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll (1)	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	1.54	1.67	5.65	5.50	-	40,491	3,358	15,434	7.51	6.22	-	43,622	3,975	18,398
US-101 to Wilshire Blvd.	5.22	5.05	10.89	8.52	9.26	48,146	3,896	15,434	10.50	9.56	11.50	44,371	4,280	18,398
Wilshire Blvd. to Venice Blvd.	4.08	3.93	6.49	2.93	-	51,762	4,150	15,434	6.94	3.51	-	53,953	4,322	18,398
Venice Blvd. to South Terminus	2.78	3.04	14.10	11.25	-	46,766	4,125	-	10.95	5.66	-	47,127	4,100	-
TOTAL	*13.62*	*13.68*	*37.13*	*28.20*	*9.26*	**187,165**	**15,529**	**46,302**	*35.9*	*24.95*	*11.50*	**189,073**	**16,677**	**55,194**

	Length (miles)		Night Travel Times (mins.)			Night Volumes			Night Travel Times (mins.)			Night Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll (1)	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll (1)	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	1.54	1.67	4.34	4.88	-	41,364	276	2,189	4.56	5.38	-	30,594	393	1,735
US-101 to Wilshire Blvd.	5.22	5.05	9.11	7.72	7.20	50,221	276	2,189	8.27	8.63	7.53	37,253	393	1,735
Wilshire Blvd. to Venice Blvd.	4.08	3.93	3.82	2.51	-	45,646	276	2,189	4.04	3.09	-	44,894	393	1,735
Venice Blvd. to South Terminus	2.78	3.04	8.56	7.61	-	38,474	276	-	7.97	4.71	-	39,490	393	-
TOTAL	*13.62*	*13.68*	*25.83*	*22.72*	*7.20*	**175,705**	**1,104**	**6,567**	*24.84*	*21.81*	*7.53*	**152,231**	**1,572**	**5,205**

Note: (1) The toll segment time is calculated based on approximate distance from US-101 to Wilshire Blvd.

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4.6. CONCEPT 5A: FIXED GUIDEWAY LIGHT RAIL TRANSIT IN TUNNEL

Concept 5A includes an LRT line operating in a new 6-mile tunnel through the Sepulveda Pass. The concept is described in greater detail in Section 2.5.

Table 4-11 summarizes project transit boardings by proposed station. Total daily project boardings for Concept 5A are 90,232.

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Table 4-11: Year 2035 Concept 5A Average Weekday Station Boardings and Times

Station Name	Southbound (Read Down)		Southbound (P-A Format)						Northbound (Read Up)		Northbound (P-A Format)						Total Boardings		
	Dist (mi)	Time (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Dist (mi)	Time (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Peak	Off-Peak	Daily
Sylmar SF Metrolink	-	-	3,942	0	3,258	0	7,200	0	3.7	11.0	0	1,172	0	592	0	1,764	2,557	1,925	**4,482**
Van Nuys/Arleta	3.7	11.0	3,666	141	1,463	73	5,129	214	1.6	4.8	336	306	197	222	533	528	2,225	978	**3,202**
Van Nuys/Nordhoff St.	1.6	4.8	5,365	858	1,624	331	6,989	1,189	1.7	5.0	332	1,103	194	643	526	1,746	3,829	1,396	**5,225**
Van Nuys Metrolink	1.7	5.0	5,412	567	2,085	490	7,497	1,057	2.2	6.7	492	998	446	640	938	1,638	3,735	1,831	**5,565**
Van Nuys/Oxnard	2.2	6.7	11,628	4,489	1,822	2,305	13,450	6,794	2.0	5.9	867	4,940	478	1,795	1,345	6,735	10,962	3,200	**14,162**
Van Nuys/Ventura Blvd.	2.0	5.9	5,801	1,759	1,778	760	7,579	2,519	6.0	7.2	1,271	3,142	562	794	1,833	3,936	5,987	1,947	**7,934**
Westwood/Ackerman Union	6.0	7.2	782	1,216	417	688	1,199	1,904	0.8	1.0	161	4,454	111	965	272	5,419	3,307	1,091	**4,397**
Westwood/Wilshire	0.8	1.0	5,886	12,063	665	2,970	6,551	15,033	0.8	0.9	7,242	3,440	1,053	1,482	8,295	4,922	14,316	3,085	**17,401**
Westwood/Santa Monica	0.8	0.9	607	2,471	347	890	954	3,361	1.1	2.6	1,824	602	990	329	2,814	931	2,752	1,278	**4,030**
Westwood/Expo	1.1	2.6	503	7,500	294	1,684	797	9,184	1.8	5.3	2,321	655	1,143	275	3,464	930	5,490	1,698	**7,188**
Overland/Venice	1.8	5.3	735	2,168	440	623	1,175	2,791	1.3	3.8	1,493	611	674	232	2,167	843	2,504	985	**3,488**
Overland/Jefferson	1.3	3.8	197	1,395	122	548	319	1,943	1.7	5.0	561	674	304	264	865	938	1,414	619	**2,033**
Sepulveda Blvd./I-405	1.7	5.0	184	1,512	109	509	293	2,021	3.5	10.5	861	575	449	195	1,310	770	1,566	631	**2,197**
Century/Aviation	3.5	10.5	0	8,569	0	2,553	0	11,122	-	-	4,911	0	1,827	0	6,738	0	6,740	2,190	**8,930**
Total	**28.0**	**69.5**	**44,708**	**44,708**	**14,424**	**14,424**	**59,132**	**59,132**	**28.0**	**69.5**	**22,672**	**22,672**	**8,428**	**8,428**	**31,100**	**31,100**	**67,380**	**22,852**	**90,232**

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Table 4-12 summarizes average weekday station boardings by mode of access and egress. The light rail line will be accessed most commonly by other transit (42 percent), followed by walking (33 percent), using Park-n-Ride (22 percent), and using a Kiss-n-Ride (4 percent).

Table 4-12: Year 2035 Concept 5A Average Weekday Station Boardings by Mode of Access/Egress

	By Access						By Egress						Boardings					
Station Name	Walk	Bus	PNR	KNR	Rail	Total	Walk	Bus	PNR	KNR	Rail	Total	Walk	Bus	PNR	KNR	Rail	Total
Sylmar SF Metrolink	1,029	992	3,392	233	1,553	7,200	1,260	494	-	-	10	1,764	1,145	743	1,696	116	782	4,482
Van Nuys/Arleta	1,933	964	2,462	303	0	5,662	402	340	-	-	0	742	1,167	652	1,231	152	0	3,202
Van Nuys/Nordhoff St.	2,721	1,529	2,899	367	0	7,515	946	1,989	-	-	0	2,935	1,833	1,759	1,449	184	0	5,225
Van Nuys Metrolink	5,282	248	1,759	401	745	8,435	2,413	189	-	-	93	2,695	3,847	219	879	201	419	5,565
Van Nuys/Oxnard	4,862	6,319	3,083	531	0	14,795	9,289	4,240	-	-	0	13,529	7,075	5,280	1,542	266	0	14,162
Van Nuys/Ventura Blvd.	2,731	2,940	3,191	550	0	9,412	811	5,644	-	-	0	6,455	1,771	4,292	1,596	275	0	7,934
UCLA/Ackerman Union	1,183	13	196	78	0	1,471	6,687	636	-	-	0	7,323	3,935	325	98	39	0	4,397
Westwood/Wilshire	817	8,318	321	78	5,311	14,846	8,962	2,197	-	-	8,796	19,955	4,890	5,257	161	39	7,054	17,401
Westwood/Santa Monica	2,470	624	561	114	0	3,768	1,504	2,788	-	-	0	4,292	1,987	1,706	281	57	0	4,030
Westwood/Expo	1,678	159	422	115	1,886	4,261	912	1,137	-	-	8,065	10,114	1,295	648	211	58	4,976	7,188
Overland/Venice	1,830	770	574	168	0	3,342	2,291	1,343	-	-	0	3,634	2,060	1,057	287	84	0	3,488
Overland/Jefferson	959	2	170	53	0	1,184	2,848	33	-	-	0	2,881	1,903	18	85	26	0	2,033
Sepulveda Blvd./I-405	988	115	411	90	0	1,603	2,284	507	-	-	0	2,791	1,636	311	205	45	0	2,197
Century/Aviation	1,315	158	335	91	4,839	6,738	690	892	-	-	9,540	11,122	1,002	525	168	46	7,189	8,930
Total	**29,798**	**23,151**	**19,776**	**3,172**	**14,335**	**90,232**	**41,297**	**22,431**	**-**	**-**	**26,504**	**90,232**	**35,548**	**22,791**	**9,888**	**1,586**	**20,419**	**90,232**

Table 4-13 summarizes average weekday traffic volume by segment.

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Table 4-13: Year 2035 Concept 5A Average Weekday Traffic Volumes

	Length (miles)		AM Peak Travel Times (mins.)			AM Peak Volumes			AM Peak Travel Times (mins.)			AM Peak Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	5.00	5.79	-	15,325	2,012	-	10.44	11.09	-	22,753	5,019	-
US-101 to Wilshire Blvd.	8.19	7.73	11.42	8.32	-	22,979	2,428	-	20.05	13.61	-	26,652	5,699	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	6.42	3.92	-	24,234	3,460	-	7.77	5.53	-	24,614	4,744	-
Venice Blvd. to South Terminus	7.94	7.83	16.62	13.04	-	23,736	3,032	-	12.94	10.37	-	21,512	3,927	-
TOTAL	*23.45*	*23.36*	*39.46*	*31.07*	-	**86,274**	**10,932**	**-**	*51.2*	*40.60*	-	**95,531**	**19,389**	**-**

	Length (miles)		PM Peak Travel Times (mins.)			PM Peak Volumes			PM Peak Travel Times (mins.)			PM Peak Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	8.28	9.82	-	29,490	6,541	-	6.32	7.53	-	23,140	4,346	-
US-101 to Wilshire Blvd.	8.19	7.73	19.57	13.01	-	41,132	7,176	-	12.64	9.78	-	30,365	5,402	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	7.77	5.04	-	33,732	6,173	-	7.93	5.23	-	34,840	6,845	-
Venice Blvd. to South Terminus	7.94	7.83	16.26	13.63	-	30,556	4,331	-	15.55	12.84	-	31,284	6,542	-
TOTAL	*23.45*	*23.36*	*51.88*	*41.50*	-	**134,910**	**24,221**	**-**	*42.44*	*35.38*	-	**119,629**	**23,135**	**-**

	Length (miles)		Midday Travel Times (mins.)			Midday Volumes			Midday Travel Times (mins.)			Midday Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	5.64	5.72	-	39,907	4,116	-	7.70	6.71	-	42,563	5,302	-
US-101 to Wilshire Blvd.	8.19	7.73	12.56	7.93	-	56,934	4,116	-	12.65	8.08	-	51,893	5,307	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	6.45	3.75	-	49,260	7,495	-	6.85	4.07	-	51,316	7,954	-
Venice Blvd. to South Terminus	7.94	7.83	13.96	11.80	-	45,573	7,453	-	11.82	8.89	-	45,857	7,428	-
TOTAL	*23.45*	*23.36*	*38.61*	*29.20*	-	**191,674**	**23,180**	**-**	*39.02*	*27.75*	-	**191,629**	**25,991**	**-**

	Length (miles)		Night Travel Times (mins.)			Night Volumes			Night Travel Times (mins.)			Night Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	4.33	4.89	-	41,310	332	-	4.56	5.40	-	30,470	558	-
US-101 to Wilshire Blvd.	8.19	7.73	9.17	7.14	-	51,971	332	-	8.30	7.05	-	38,766	558	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	3.82	3.11	-	45,464	332	-	4.06	3.21	-	43,996	1,538	-
Venice Blvd. to South Terminus	7.94	7.83	8.56	7.61	-	38,446	332	-	8.05	6.34	-	38,642	1,538	-
TOTAL	*23.45*	*23.36*	*25.88*	*22.75*	-	**177,191**	**1,328**	**-**	*24.97*	*22.00*	-	**151,874**	**4,192**	**-**

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4.7. CONCEPT 5B: FIXED GUIDEWAY HEAVY RAIL TRANSIT IN TUNNEL

Concept 5B has the same rail alignment as 5A, but it proposes heavy rail instead of light rail. The concept is described in greater detail in Section 2.5

Table 4-14 summarizes project transit boardings by proposed station. Total daily project boardings for Concept 5B are 106,620.

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Table 4-14: Year 2035 Concept 5B Average Weekday Station Boardings and Times

Station Name	Southbound (Read		Southbound (P-A Format)						Northbound (Read		Northbound (P-A Format)						Total Boardings		
	Dist (mi)	Time (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Dist (mi)	Time (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Peak	Off-Peak	Daily
Sylmar SF Metrolink	-	-	6,175	0	4,376	0	10,551	0	3.7	8.1	0	1,535	0	785	0	2,320	3,855	2,581	**6,436**
Van Nuys/Arleta	3.7	8.1	4,410	148	1,909	82	6,319	230	1.6	3.6	371	482	213	270	584	752	2,706	1,237	**3,943**
Van Nuys/Nordhoff St.	1.6	3.6	6,233	851	1,928	356	8,161	1,207	1.7	3.7	355	1,326	211	799	566	2,125	4,383	1,647	**6,030**
Van Nuys Metrolink	1.7	3.7	6,179	619	2,391	527	8,570	1,146	2.2	5.0	541	1,116	478	768	1,019	1,884	4,228	2,082	**6,310**
Van Nuys/Oxnard	2.2	5.0	12,776	5,108	2,075	2,501	14,851	7,609	2.0	4.4	997	6,493	528	2,131	1,525	8,624	12,687	3,618	**16,305**
Van Nuys/Ventura Blvd.	2.0	4.4	5,649	2,064	1,889	928	7,538	2,992	6.0	7.2	1,263	2,403	593	897	1,856	3,300	5,690	2,154	**7,843**
Westwood/Ackerman Union	6.0	7.2	807	1,315	444	780	1,251	2,095	0.8	1.0	169	4,685	117	1,049	286	5,734	3,488	1,195	**4,683**
Westwood/Wilshire	0.8	1.0	6,903	12,043	872	3,185	7,775	15,228	0.8	0.9	7,314	4,088	1,046	1,688	8,360	5,776	15,174	3,396	**18,570**
Westwood/Santa Monica	0.8	0.9	839	2,273	476	963	1,315	3,236	1.1	1.5	1,816	831	987	468	2,803	1,299	2,880	1,447	**4,327**
Westwood/Expo	1.1	1.5	716	7,329	383	2,108	1,099	9,437	1.8	3.9	2,443	1,761	1,260	492	3,703	2,253	6,125	2,122	**8,246**
Overland/Venice	1.8	3.9	855	2,010	507	587	1,362	2,597	1.3	2.8	1,714	794	786	276	2,500	1,070	2,687	1,078	**3,765**
Overland/Jefferson	1.3	2.8	221	2,105	137	767	358	2,872	1.7	3.7	641	752	352	346	993	1,098	1,860	801	**2,661**
Sepulveda Blvd./I-405	1.7	3.7	202	1,784	124	632	326	2,416	3.5	7.8	1,013	690	533	219	1,546	909	1,845	754	**2,599**
Century/Aviation	3.5	7.8	0	14,316	0	4,095	0	18,411	-	-	8,319	0	3,084	0	11,403	0	11,318	3,590	**14,907**
Total	**28.0**	**53.6**	**51,965**	**51,965**	**17,511**	**17,511**	**69,476**	**69,476**	**28.0**	**53.6**	**26,956**	**26,956**	**10,188**	**10,188**	**37,144**	**37,144**	**78,921**	**27,699**	**106,620**

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Table 4-15 summarizes average weekday station boardings by mode of access and egress. The heavy rail line will be accessed most commonly by other transit (43 percent), followed by walking (32 percent), using Park-n-Ride (22 percent), and using a Kiss-n-Ride (4 percent).

Table 4-15: Year 2035 Concept 5B Average Weekday Station Boardings by Mode of Access/Egress

	By Access						By Egress						Boardings					
Station Name	Walk	Bus	PNR	KNR	Rail	Total	Walk	Bus	PNR	KNR	Rail	Total	Walk	Bus	PNR	KNR	Rail	Total
Sylmar SF Metrolink	1,391	1,466	4,581	332	2,781	10,551	1,581	703	-	-	37	2,320	1,486	1,084	2,291	166	1,409	6,436
Van Nuys/Arleta	2,282	1,106	3,123	391	0	6,903	459	523	-	-	0	982	1,371	815	1,562	196	0	3,943
Van Nuys/Nordhoff St.	3,193	1,746	3,338	449	0	8,727	1,042	2,290	-	-	0	3,332	2,117	2,018	1,669	225	0	6,030
Van Nuys Metrolink	5,882	244	2,015	462	986	9,589	2,680	224	-	-	126	3,030	4,281	234	1,007	231	556	6,310
Van Nuys/Oxnard	5,324	7,028	3,422	602	0	16,376	10,413	5,820	-	-	0	16,233	7,869	6,424	1,711	301	0	16,305
Van Nuys/Ventura Blvd.	2,863	2,778	3,185	568	0	9,394	886	5,406	-	-	0	6,292	1,874	4,092	1,593	284	0	7,843
Westwood/Sunset Blvd.	1,234	14	206	83	0	1,537	7,148	681	-	-	0	7,829	4,191	347	103	41	0	4,683
Westwood/Wilshire	859	9,091	354	84	5,747	16,135	9,419	2,416	-	-	9,169	21,004	5,139	5,754	177	42	7,458	18,570
Westwood/Santa Monica	2,685	694	613	126	0	4,118	1,682	2,853	-	-	0	4,535	2,183	1,773	307	63	0	4,327
Westwood/Expo	1,891	172	449	127	2,164	4,802	1,041	1,561	-	-	9,089	11,690	1,466	866	225	63	5,626	8,246
Overland/Venice	2,115	878	667	202	0	3,862	2,027	1,640	-	-	0	3,667	2,071	1,259	333	101	0	3,765
Overland/Jefferson	1,089	2	194	65	0	1,351	3,949	21	-	-	0	3,970	2,519	12	97	33	0	2,661
Sepulveda Blvd./I-405	1,149	130	483	109	0	1,872	2,688	637	-	-	0	3,325	1,919	384	242	55	0	2,599
Century/Aviation	1,732	201	431	129	8,910	11,403	882	1,239	-	-	16,291	18,411	1,307	720	216	65	12,600	14,907
Total	**33,690**	**25,551**	**23,061**	**3,730**	**20,587**	**106,620**	**45,895**	**26,015**	**-**	**-**	**34,710**	**106,620**	**39,793**	**25,783**	**11,531**	**1,865**	**27,649**	**106,620**

Table 4-16 summarizes average weekday traffic volumes by segment.

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Table 4-16: Year 2035 Concept 5B Average Weekday Traffic Volumes

	Length (miles)		AM Peak Travel Times (mins.)			AM Peak Volumes			AM Peak Travel Times (mins.)			AM Peak Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	5.00	5.79	-	15,325	2,012	-	10.44	11.09	-	22,753	5,019	-
US-101 to Wilshire Blvd.	8.19	7.73	11.42	8.32	-	22,979	2,428	-	20.05	13.61	-	26,652	5,699	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	6.42	3.92	-	24,234	3,460	-	7.77	5.53	-	24,614	4,744	-
Venice Blvd. to South Terminus	7.94	7.83	16.62	13.04	-	23,736	3,032	-	12.94	10.37	-	21,512	3,927	-
TOTAL	*23.45*	*23.36*	*39.46*	*31.07*	-	**86,274**	**10,932**	-	*51.2*	*40.60*	-	**95,531**	**19,389**	-

	Length (miles)		PM Peak Travel Times (mins.)			PM Peak Volumes			PM Peak Travel Times (mins.)			PM Peak Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	8.28	9.82	-	29,490	6,541	-	6.32	7.53	-	23,140	4,346	-
US-101 to Wilshire Blvd.	8.19	7.73	19.57	13.01	-	41,132	7,176	-	12.64	9.78	-	30,365	5,402	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	7.77	5.04	-	33,732	6,173	-	7.93	5.23	-	34,840	6,845	-
Venice Blvd. to South Terminus	7.94	7.83	16.26	13.63	-	30,556	4,331	-	15.55	12.84	-	31,284	6,542	-
TOTAL	*23.45*	*23.36*	*51.88*	*41.50*	-	**134,910**	**24,221**	-	*42.44*	*35.38*	-	**119,629**	**23,135**	-

	Length (miles)		Midday Travel Times (mins.)			Midday Volumes			Midday Travel Times (mins.)			Midday Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	5.64	5.72	-	39,907	4,116	-	7.70	6.71	-	42,563	5,302	-
US-101 to Wilshire Blvd.	8.19	7.73	12.56	7.93	-	56,934	4,116	-	12.65	8.08	-	51,893	5,307	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	6.45	3.75	-	49,260	7,495	-	6.85	4.07	-	51,316	7,954	-
Venice Blvd. to South Terminus	7.94	7.83	13.96	11.80	-	45,573	7,453	-	11.82	8.89	-	45,857	7,428	-
TOTAL	*23.45*	*23.36*	*38.61*	*29.20*	-	**191,674**	**23,180**	-	*39.02*	*27.75*	-	**191,629**	**25,991**	-

	Length (miles)		Night Travel Times (mins.)			Night Volumes			Night Travel Times (mins.)			Night Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	4.02	4.21	4.33	4.89	-	41,310	332	-	4.56	5.40	-	30,470	558	-
US-101 to Wilshire Blvd.	8.19	7.73	9.17	7.14	-	51,971	332	-	8.30	7.05	-	38,766	558	-
Wilshire Blvd. to Venice Blvd.	3.30	3.59	3.82	3.11	-	45,464	332	-	4.06	3.21	-	43,996	1,538	-
Venice Blvd. to South Terminus	7.94	7.83	8.56	7.61	-	38,446	332	-	8.05	6.34	-	38,642	1,538	-
TOTAL	*23.45*	*23.36*	*25.88*	*22.75*	-	**177,191**	**1,328**	-	*24.97*	*22.00*	-	**151,874**	**4,192**	-

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4.8. CONCEPT 6: HIGHWAY AND PRIVATE SHUTTLE IN TUNNEL

Concept 6 proposes dual tunnels through the Sepulveda Pass serving highway and transit users separately. The concept is described in greater detail in Section 2.6.

Table 4-17 below summarizes project transit boardings by proposed station. Total daily project boardings for Concept 6 are 58,465.

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Table 4-17: Year 2035 Concept 6 Average Weekday Station Boardings and Times

Station Name	Southbound		Southbound (P-A Format)						Northbound		Northbound (P-A Format)						Total Boardings		
	Dist (mi)	Time (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Dist (mi)	Time (min)	Peak ONS	Peak OFFS	Off-Peak ONS	Off-Peak OFFS	Total ONS	Total OFFS	Peak	Off-Peak	Daily
Van Nuys Metrolink	-	-	11,997	0	3,926	0	15,923	0	2.2	2.6	0	1,402	0	553	0	1,955	6,700	2,240	**8,939**
Van Nuys/Oxnard	2.2	2.6	16,103	4,988	2,769	1,927	18,872	6,915	9.0	10.8	1,007	5,189	423	1,280	1,430	6,469	13,644	3,200	**16,843**
Westwood/Wilshire	9.0	10.8	6,257	9,417	728	1,622	6,985	11,039	1.7	2.0	3,696	2,725	350	1,035	4,046	3,760	11,048	1,868	**12,915**
Sepulveda Blvd./Expo	1.7	2.0	850	7,536	753	1,310	1,603	8,846	7.8	9.4	1,936	2,243	991	655	2,927	2,898	6,283	1,855	**8,137**
Century/Aviation	7.8	9.4	0	13,266	0	3,317	0	16,583	-	-	4,920	0	1,759	0	6,679	0	9,093	2,538	**11,631**
Total	**20.7**	**24.8**	**35,207**	**35,207**	**8,176**	**8,176**	**43,383**	**43,383**	**20.7**	**24.8**	**11,559**	**11,559**	**3,523**	**3,523**	**15,082**	**15,082**	**46,766**	**11,699**	**58,465**

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Table 4-18 summarizes average weekday station boardings by mode of access and egress. The shuttle will be accessed most commonly by other transit (48 percent), followed by Park-n-Rides (25 percent), walking (24 percent), and using a Kiss-n-Ride (3 percent).

Table 4-18: Year 2035 Concept 6 Average Weekday Station Boardings by Mode of Access/Egress

	By Access						By Egress						Boardings					
Station Name	Walk	Bus	PNR	KNR	Rail	Total	Walk	Bus	PNR	KNR	Rail	Total	Walk	Bus	PNR	KNR	Rail	Total
Van Nuys Metrolink	5,672	2,876	5,737	766	872	15,923	1,283	640	-	-	32	1,955	3,478	1,758	2,868	383	452	8,939
Van Nuys/Oxnard	4,148	8,702	6,822	630	0	20,302	6,547	6,837	-	-	0	13,384	5,348	7,770	3,411	315	0	16,843
Westwood/Wilshire	792	8,444	515	68	1,211	11,031	6,233	6,236	-	-	2,330	14,799	3,513	7,340	258	34	1,771	12,915
Sepulveda Blvd./Expo	2,335	305	991	170	729	4,530	1,725	2,161	-	-	7,859	11,744	2,030	1,233	495	85	4,294	8,137
Century/Aviation	1,196	175	655	138	4,515	6,679	567	1,119	-	-	14,897	16,583	882	647	328	69	9,706	11,631
Total	**14,143**	**20,503**	**14,720**	**1,772**	**7,327**	**58,465**	**16,356**	**16,992**	**-**	**-**	**25,118**	**58,465**	**15,249**	**18,747**	**7,360**	**886**	**16,222**	**58,465**

Table 4-19 summarizes the average weekday traffic volumes by segment.

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Table 4-19: Year 2035 Concept 6 Average Weekday Traffic Volumes

	Length (miles)		AM Peak Travel Times (mins.)			AM Peak Volumes			AM Peak Travel Times (mins.)			AM Peak Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll (1)	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll (1)	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	1.54	1.67	4.87	5.53	4.63	14,623	1,578	1,867	9.36	10.60	8.55	21,715	4,421	3,917
US-101 to Wilshire Blvd.	5.22	5.05	10.79	8.97	8.79	21,080	1,909	5,310	16.56	11.18	12.44	25,235	4,868	9,914
Wilshire Blvd. to Venice Blvd.	4.08	3.93	5.44	3.64	4.69	23,378	2,019	6,217	6.51	4.98	5.15	22,814	4,012	8,128
Venice Blvd. to South Terminus	2.78	3.04	15.13	11.57	11.38	21,899	1,811	6,721	12.04	10.69	11.49	18,998	3,371	7,102
TOTAL	*13.62*	*13.68*	*36.23*	*29.71*	*29.49*	**80,980**	**7,317**	**20,115**	*44.47*	*37.45*	*37.63*	**88,762**	**16,672**	**29,061**

	Length (miles)		PM Peak Travel Times (mins.)			PM Peak Volumes			PM Peak Travel Times (mins.)			PM Peak Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll (1)	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll (1)	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	1.54	1.67	7.27	8.06	8.17	28,418	5,502	5,496	6.18	6.74	4.81	22,256	3,378	2,721
US-101 to Wilshire Blvd.	5.22	5.05	16.30	10.39	11.26	39,531	5,777	12,365	11.51	10.90	9.91	28,335	4,410	10,337
Wilshire Blvd. to Venice Blvd.	4.08	3.93	6.31	4.34	4.84	32,089	4,408	11,023	6.52	4.66	5.22	33,387	5,438	11,489
Venice Blvd. to South Terminus	2.78	3.04	14.91	11.82	10.65	28,081	2,755	9,645	13.89	13.34	14.28	27,271	5,694	12,112
TOTAL	*13.62*	*13.68*	*44.79*	*34.61*	*34.92*	**128,119**	**18,442**	**38,529**	*38.1*	*35.64*	*34.22*	**111,249**	**18,920**	**36,659**

	Length (miles)		Midday Travel Times (mins.)			Midday Volumes			Midday Travel Times (mins.)			Midday Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll (1)	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll (1)	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	1.54	1.67	5.34	5.42	6.30	37,166	3,009	6,043	7.18	6.03	5.34	40,208	3,254	6,980
US-101 to Wilshire Blvd.	5.22	5.05	11.42	9.69	9.06	51,135	3,154	15,001	11.34	10.58	9.60	47,290	3,351	17,471
Wilshire Blvd. to Venice Blvd.	4.08	3.93	5.20	3.44	4.23	46,153	3,183	14,950	5.59	3.56	4.62	48,126	3,351	17,147
Venice Blvd. to South Terminus	2.78	3.04	12.90	10.08	9.57	41,592	3,183	13,498	10.55	10.93	10.45	41,174	3,247	16,386
TOTAL	*13.62*	*13.68*	*34.86*	*28.63*	*29.16*	**176,046**	**12,529**	**49,492**	*34.66*	*31.1*	*30.01*	**176,798**	**13,203**	**57,984**

	Length (miles)		Night Travel Times (mins.)			Night Volumes			Night Travel Times (mins.)			Night Volumes		
Segment	NB	SB	NB Mainline	NB HOV	NB Toll (1)	NB Mainline	NB HOV	NB Toll	SB Mainline	SB HOV	SB Toll (1)	SB Mainline	SB HOV	SB Toll
Roscoe Blvd. to US-101	1.54	1.67	4.33	4.88	4.10	41,042	274	605	4.56	5.38	4.27	30,588	393	118
US-101 to Wilshire Blvd.	5.22	5.05	9.15	7.13	6.87	51,178	274	1,546	8.28	7.04	6.77	37,465	393	1,878
Wilshire Blvd. to Venice Blvd.	4.08	3.93	3.80	3.10	3.13	44,488	274	1,512	4.02	3.19	3.25	43,412	393	1,857
Venice Blvd. to South Terminus	2.78	3.04	8.55	7.60	6.94	38,212	274	720	7.96	6.20	6.95	38,055	393	1,968
TOTAL	*13.62*	*13.68*	*25.83*	*22.71*	*21.04*	**174,920**	**1,096**	**4,383**	*24.82*	*21.81*	*21.24*	**149,520**	**1,572**	**5,821**

Note: (1) Toll Times are split based on distance. South Terminus is Century Blvd. unlike Mainlines/HOV where El Segundo Blvd. is the terminus.

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5. KEY PERFORMANCE INDICATORS

The following section summarizes the key performance indicators of the different Systems Planning Concepts.

5.1. AVERAGE WEEKDAY PROJECT BOARDINGS

The estimated average weekday transit boardings for the concepts are summarized in Figure 5-1 and Table 5-1. Ridership for Metro's route 761 is also included in the analysis. This route is currently the only bus service over the Sepulveda Pass.

Figure 5-1: Average Weekday Project Boardings

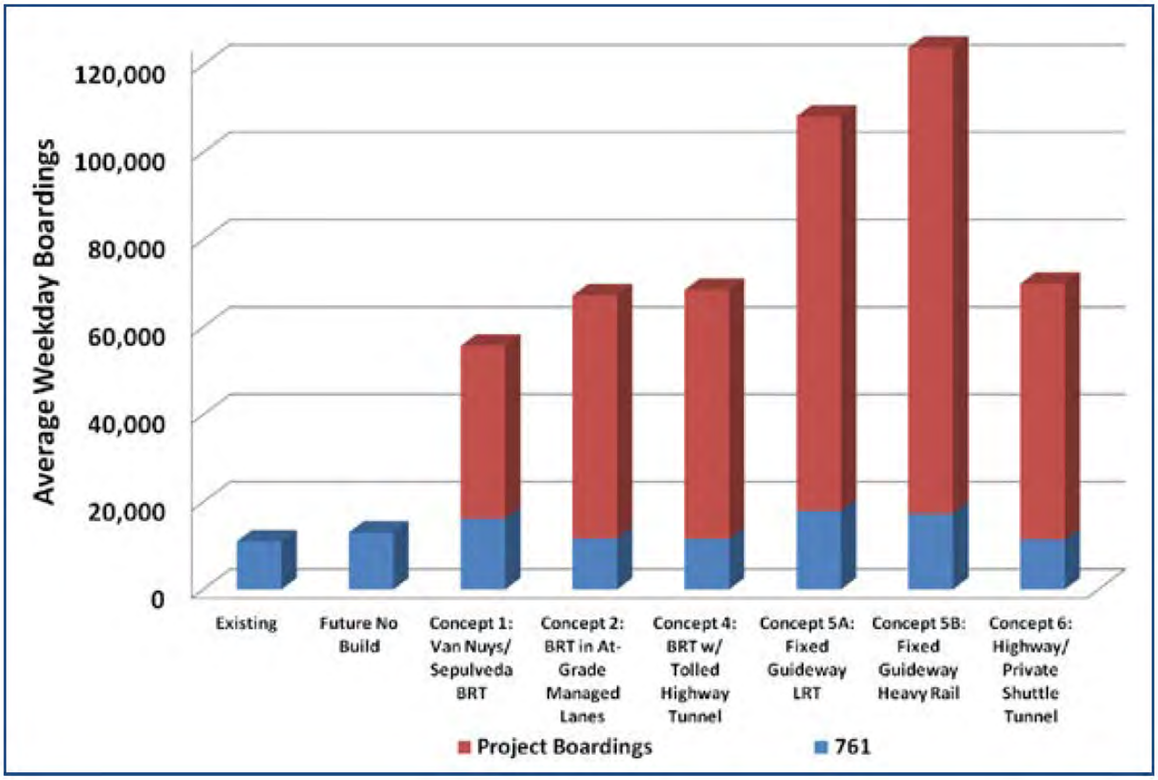


Table 5-1: Average Weekday Project Boardings

Boardings	Existing	Future No Build	Concept 1	Concept 2	Concept 4	Concept 5A	Concept 5B	Concept 6
Metro Route 761	11,000	13,000	16,300	11,700	11,600	18,000	17,300	11,400
Project Boardings	-	-	39,400	55,500	56,900	90,200	106,600	58,500
Total	11,000	13,000	55,700	67,200	68,500	108,200	123,900	69,900

5.2. AVERAGE WEEKDAY TRAFFIC "OVER THE PASS"

The estimated average weekday traffic volumes over the Sepulveda Pass are summarized in Figure 5-2 and Table 5-2. Traffic volumes are broken out by the type of lane they use "over the Pass" ("free" HOV lanes, tolled lanes, or mainline lanes).

Figure 5-2: Average Weekday Traffic "Over the Pass"

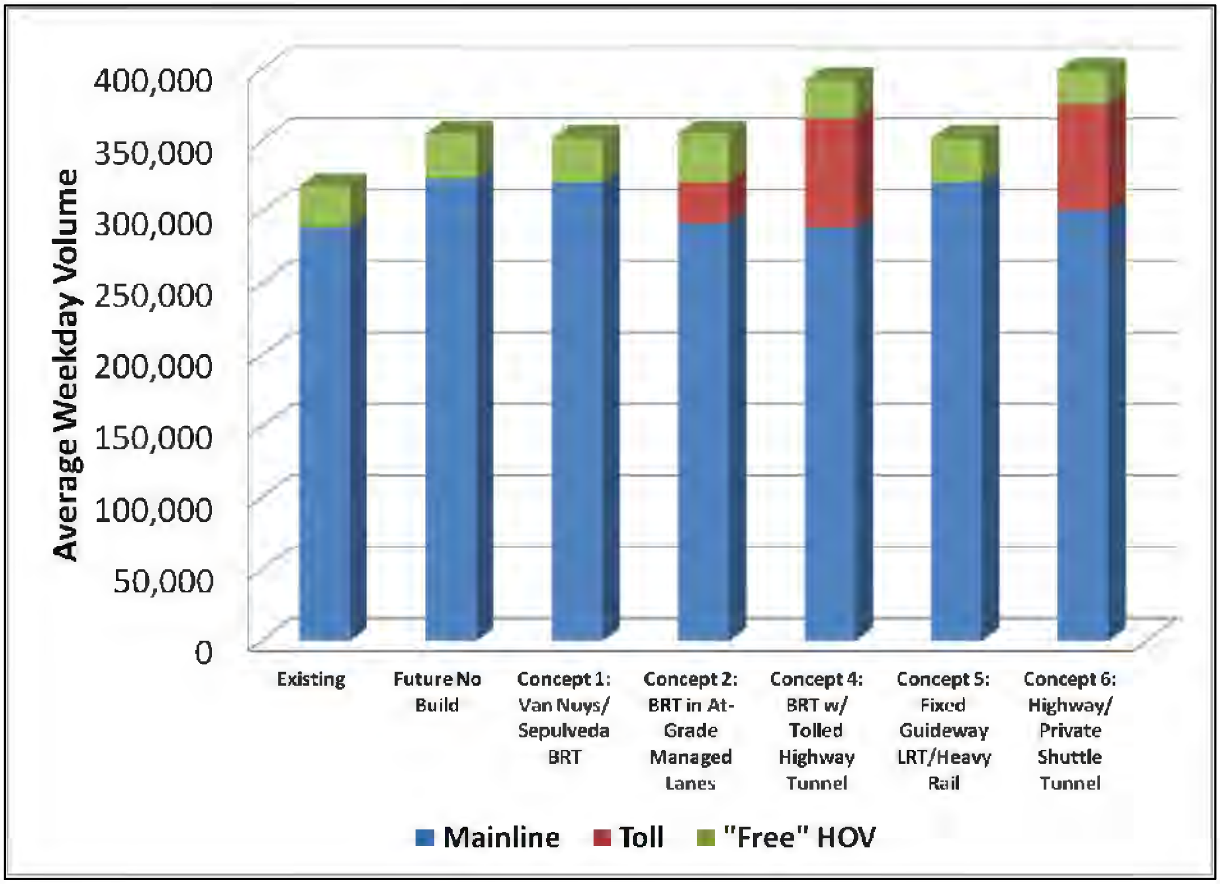


Table 5-2: Average Weekday Traffic "Over the Pass"

Traffic Type	Existing	Future No Build	Concept 1	Concept 2	Concept 4	Concept 5	Concept 6
Mainline	290,000	323,600	320,800	292,500	290,000	320,700	301,300
Toll	-	-	-	29,000	76,000	-	73,800
"Free" HOV	28,200	31,400	31,100	33,800	26,200	31,000	24,100
Total	**318,200**	**355,000**	**351,900**	**355,300**	**392,200**	**351,700**	**399,200**

5.3. AVERAGE WEEKDAY VEHICLE MILES TRAVELED AND VEHICLE HOURS TRAVELED

Vehicle miles traveled for the No Build scenario and the Systems Planning Concepts are summarized in Figure 5-3 and Table 5-3. These are the average weekday totals for the entire region.

Figure 5-3: Average Weekday Vehicle Miles Traveled

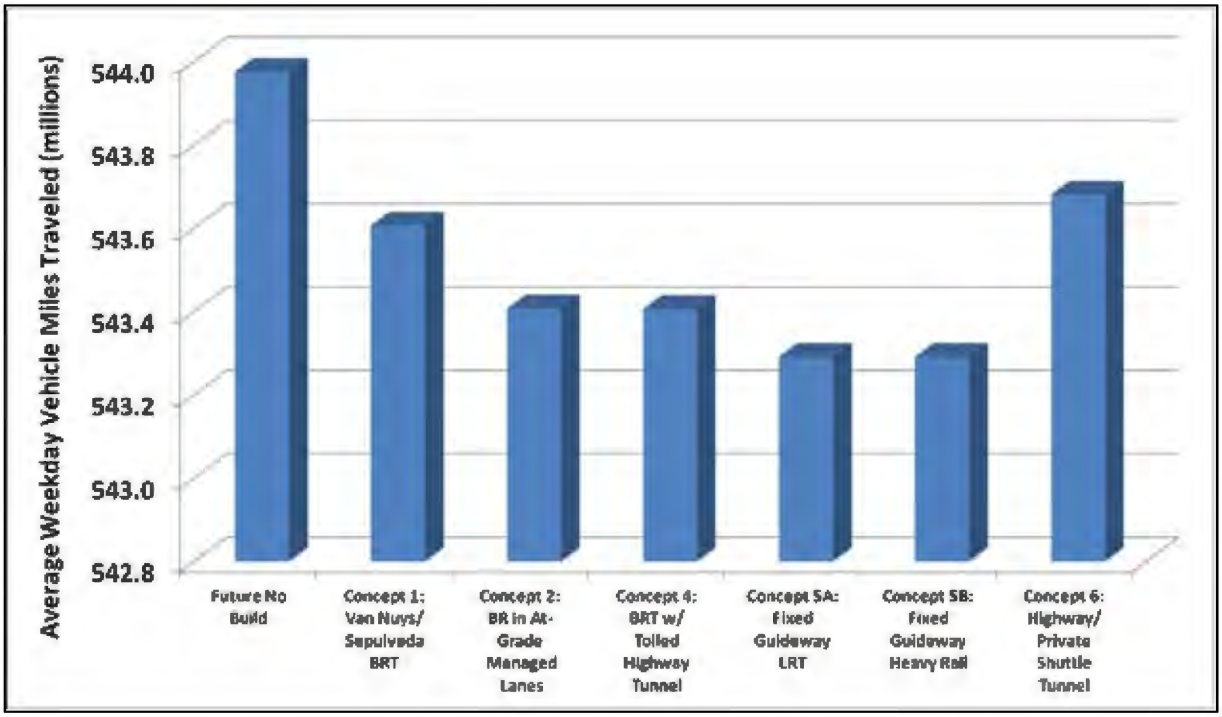


Table 5-3: Average Weekday Vehicle Miles Traveled

Future No Build	Concept 1	Concept 2	Concept 4	Concept 5A	Concept 5B	Concept 6
543,975,400	543,606,300	543,407,100	543,405,200	543,291,000	543,291,000	543,680,400

Vehicle hours traveled for the No Build scenario and the Systems Planning Concepts are summarized in Figure 5-4 and Table 5-4. Again, these are the average weekday totals for the entire region.

Figure 5-4: Average Weekday Vehicle Hours Traveled

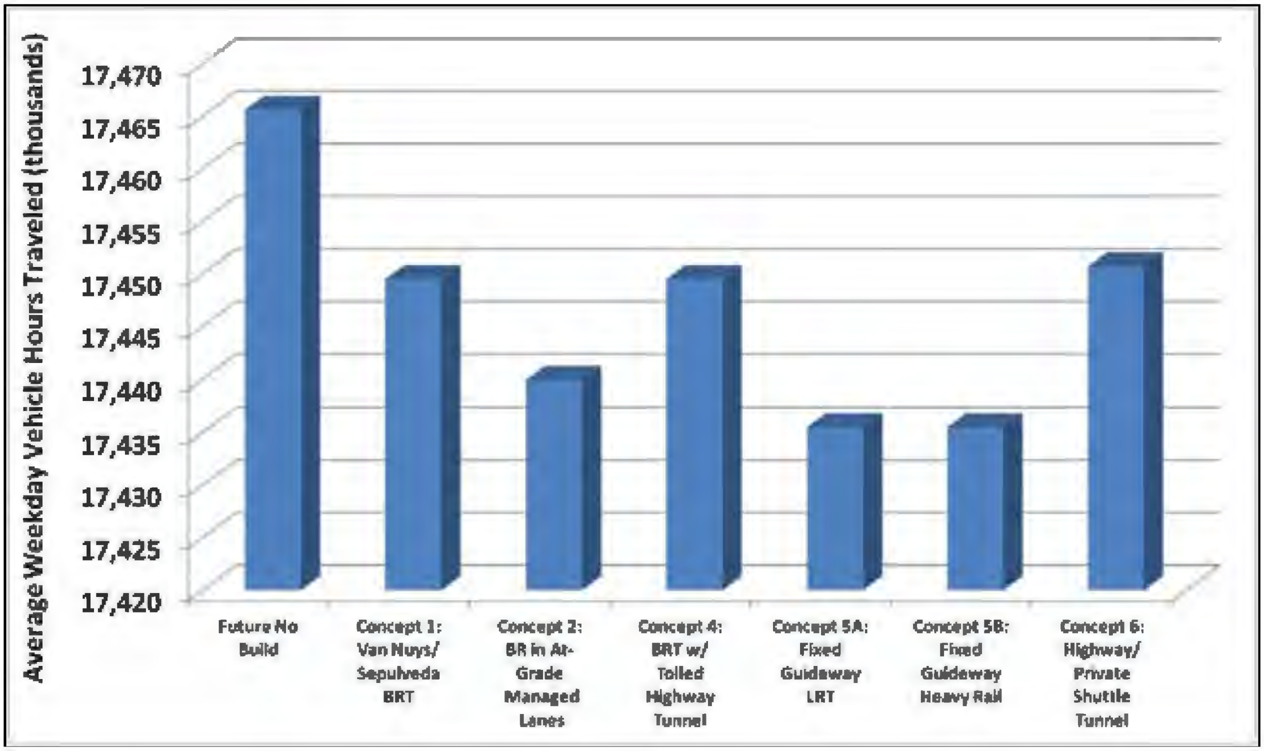


Table 5-4: Average Weekday Vehicle Hours Traveled

Future No Build	Concept 1	Concept 2	Concept 4	Concept 5A	Concept 5B	Concept 6
17,465,600	17,449,500	17,439,900	17,449,500	17,435,500	17,435,500	17,450,700

5.4. AVERAGE WEEKDAY PERSON THROUGHPUT "OVER THE PASS"

The estimated average weekday person throughput over the Sepulveda Pass is summarized in Figure 5-5 and Table 5-5. This summary includes both passengers in automobiles—taking into account average persons per vehicle—and transit ridership levels. The last row in Table 4-3shows the total increase in person throughput over the No Build alternative.

Figure 5-5: Average Weekday Person Throughput "Over the Pass"

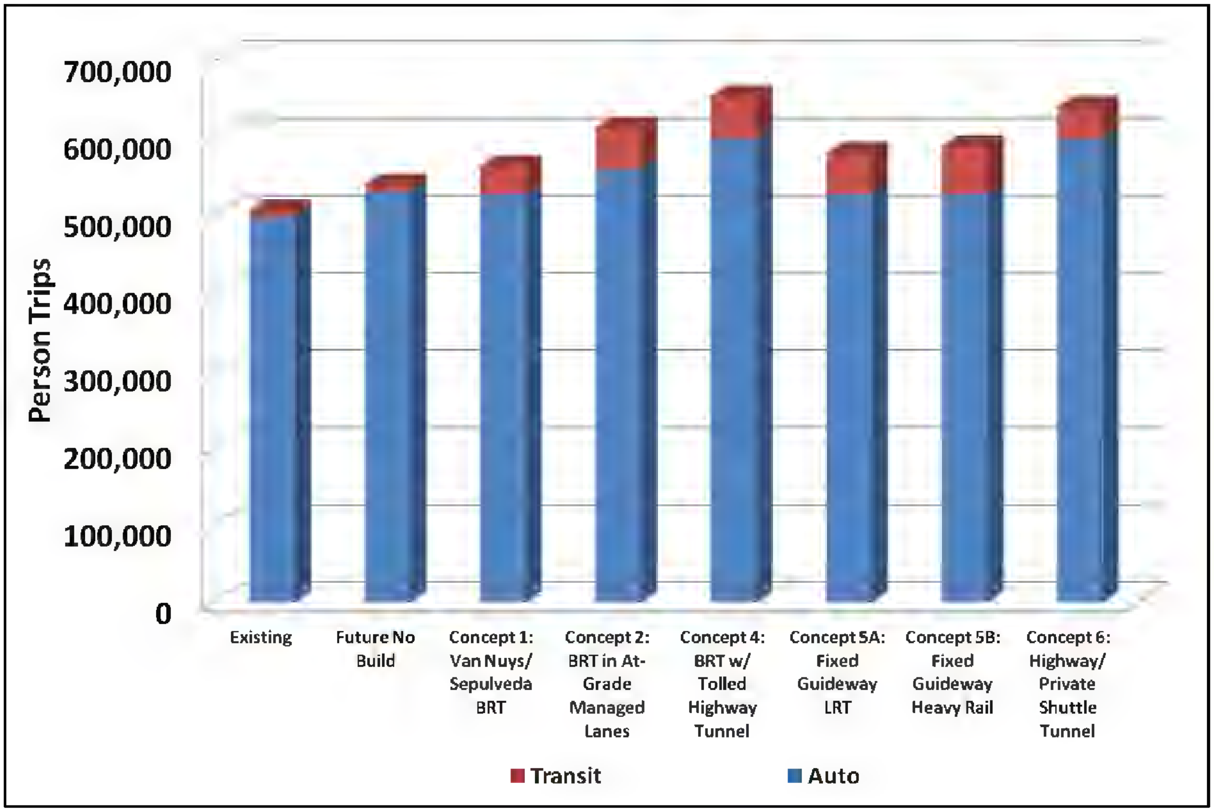


Table 5-5: Average Weekday Person Throughput "Over the Pass"

Mode	Existing	Future No Build	Concept 1	Concept 2	Concept 4	Concept 5A	Concept 5B	Concept 6
Auto	498,600	532,000	528,100	560,700	600,500	528,000	528,000	599,600
Transit	8,500	8,100	35,400	53,100	54,100	52,900	61,800	41,000
Total	507,100	540,100	563,500	613,800	654,600	580,900	589,800	640,600
Change from No Build			23,400	73,700	114,500	40,800	49,700	100,500

5.5. AVERAGE WEEKDAY TRANSIT MODE SHARE "OVER THE PASS"

The estimated average weekday transit mode shares over the Sepulveda Pass are summarized in Figure 5-6 and Table 5-6. These mode shares are not model-based. It was calculated after the model runs as the average weekday transit person throughput over the pass divided by the average weekday total person throughput over the pass.

Figure 5-6: Average Weekday Transit Mode Share "Over the Pass"

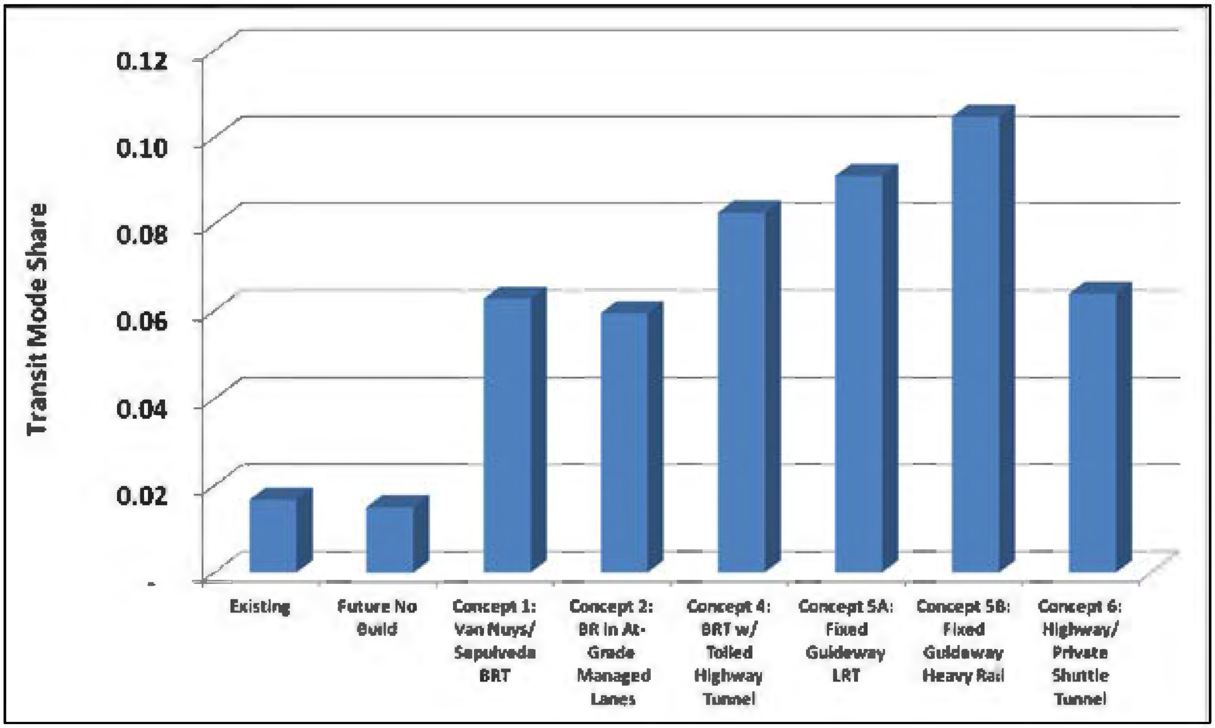


Table 5-6: Average Weekday Transit Mode Share "Over the Pass"

Existing	Future No Build	Concept 1	Concept 2	Concept 4	Concept 5A	Concept 5B	Concept 6
0.02	0.01	0.06	0.06	0.08	0.09	0.10	0.06

5.6. AVERAGE WEEKDAY AUTO TRAVEL TIMES "OVER THE PASS"

Average weekday auto travel time over the Sepulveda Pass for the different concepts are summarized in Figures 5-7 through 5-10 and Tables 5-7 through 5-10. These are the projected average times it would take for a vehicle to travel "over the Pass" between US 101 to Wilshire Boulevard in both directions and in both the AM and PM peaks. Travel times are shown for the different types of lanes being considered in the analysis (mainline lanes, toll lanes, and "free" HOV lanes).

Figure 5-7: Average Weekday Auto Travel Times "Over the Pass" (minutes)
(AM peak southbound from US 101 to Wilshire Blvd.)

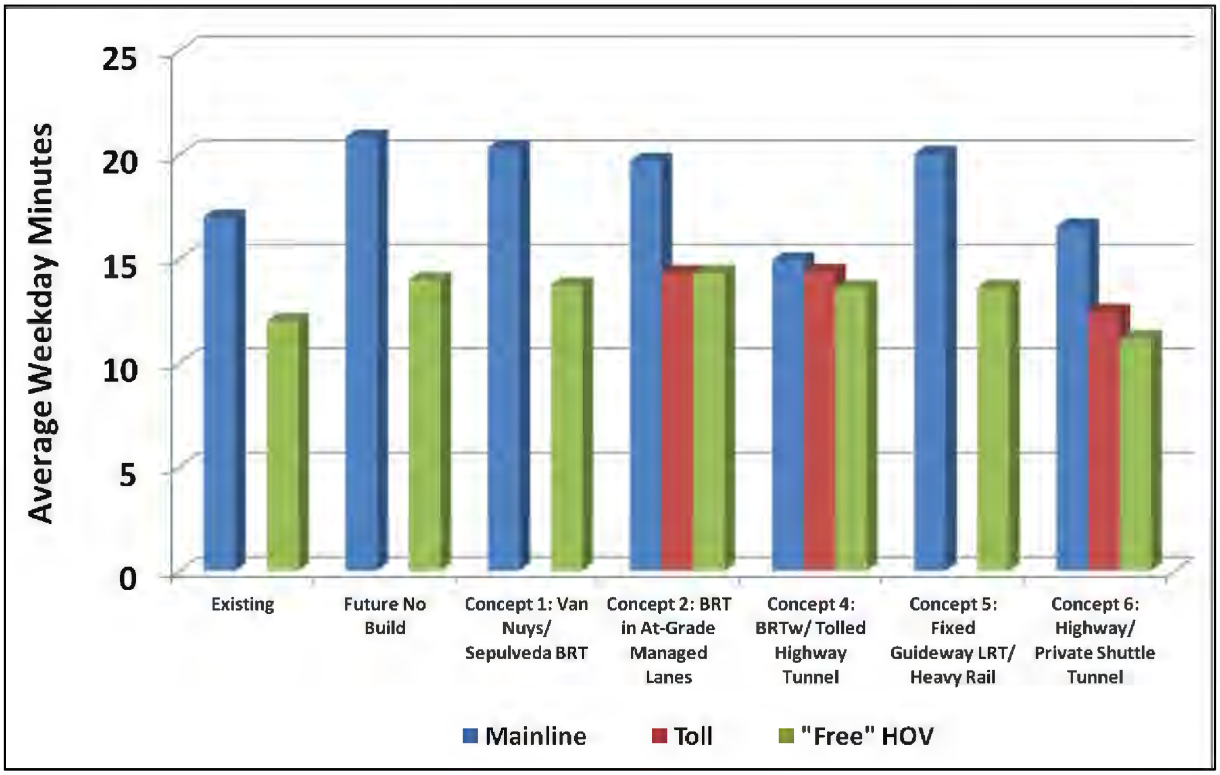


Table 5-7: Average Weekday Auto Travel Times "Over the Pass" (minutes)
(AM peak southbound from US 101 to Wilshire Blvd.)

Traffic Type	Existing	Future No Build	Concept 1	Concept 2	Concept 4	Concept 5	Concept 6
Mainline	17	21	20	20	15	20	17
Toll	-	-	-	14	14	-	12
"Free" HOV	12	14	14	14	14	14	11

Concept 4 improves mainline travel times the most because it adds the greatest amount of available capacity over the Pass. Concept 4 adds two lanes of capacity in each direction, while preserving the existing HOV lanes. Concept 2 adds only one lane of capacity in each direction and converts the existing HOV lanes to HOT lanes. Concept 6 adds the same amount of capacity as Concept 4 over the Pass as does Concept 4, but it also attracts a greater number of new drivers to the corridor because it also adds capacity north and south of the Pass. Although the magnitude of the change in total daily mainline volume over the Pass (shown in Table 5-2 and Figure 5-2) is relatively small, the magnitude of the change during peak periods is substantially larger, as more drivers are drawn into the corridor during off-peak periods.

Figure 5-8: Average Weekday Auto Travel Times "Over the Pass" (minutes)
(AM peak northbound from Wilshire Blvd. to US 101)

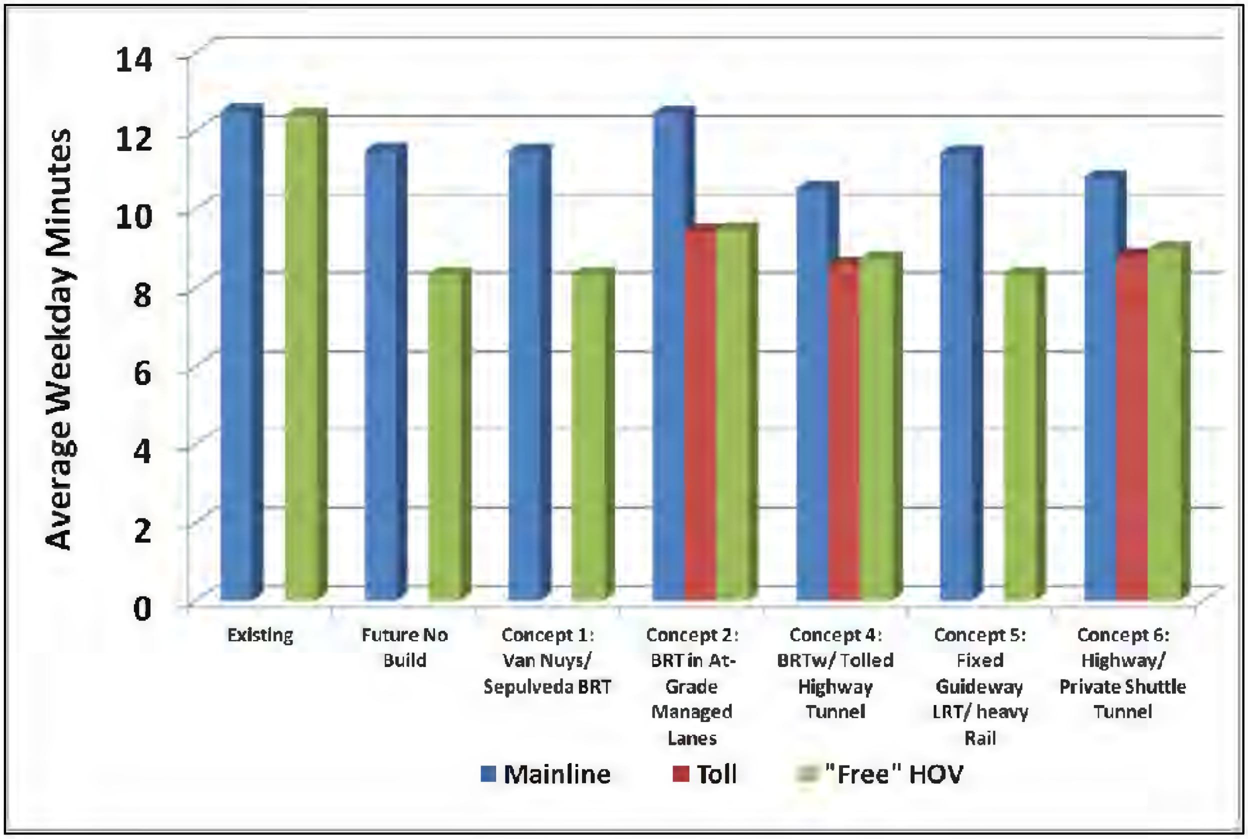


Table 5-8: Average Weekday Auto Travel Times "Over the Pass" (minutes)
(AM peak northbound from Wilshire Blvd. to US 101)

Traffic Type	Existing	Future No Build	Concept 1	Concept 2	Concept 4	Concept 5	Concept 6
Mainline	12	11	11	12	11	11	11
Toll	-	-	-	9	9	-	9
"Free" HOV	12	8	8	9	9	8	9

Figure 5-9: Average Weekday Auto Travel Times "Over the Pass" (minutes)
(PM peak southbound from US 101 to Wilshire Blvd.)

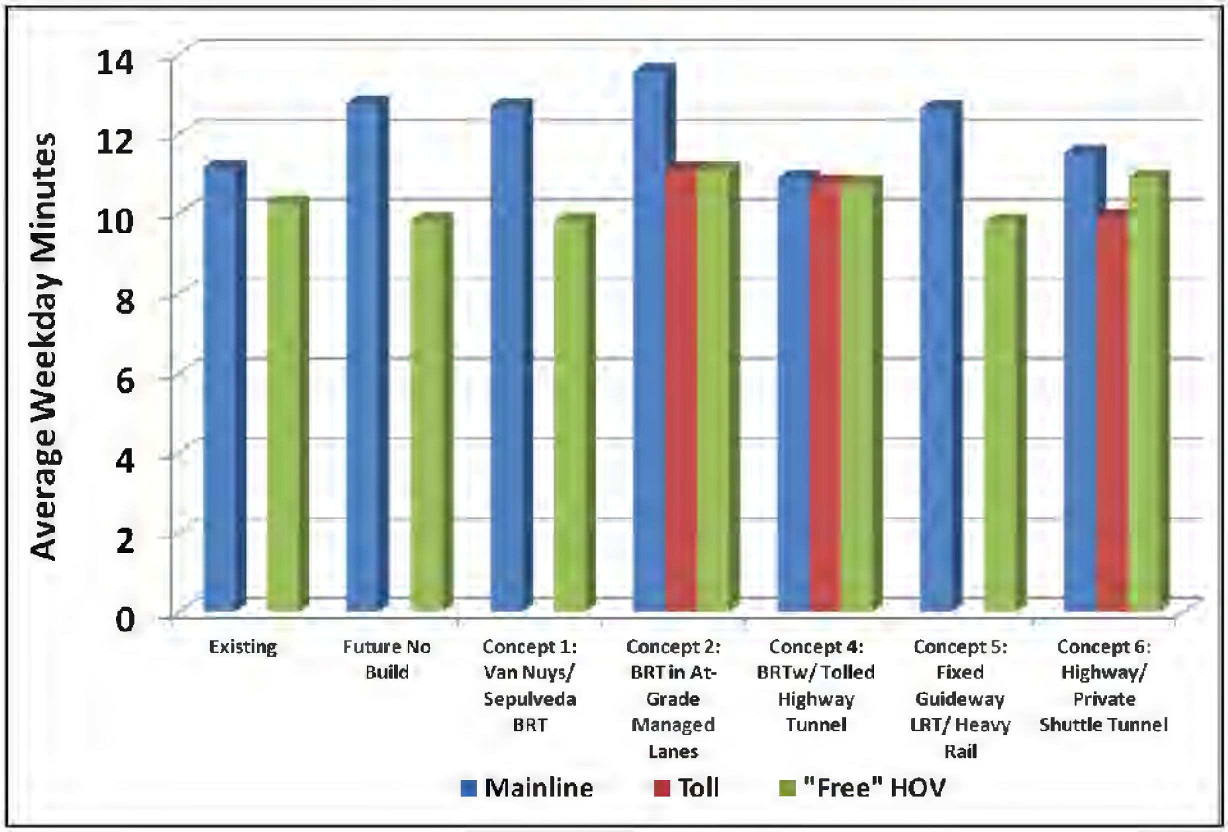


Table 5-9: Average Weekday Auto Travel Times "Over the Pass" (minutes)
(PM peak southbound from US 101 to Wilshire Blvd.)

Traffic Type	Existing	Future No Build	Concept 1	Concept 2	Concept 4	Concept 5	Concept 6
Mainline	11	13	13	14	11	13	12
Toll	-	-	-	11	11	-	10
"Free" HOV	10	10	10	11	11	10	11

Figure 5-10: Average Weekday Auto Travel Times "Over the Pass" (minutes)
(PM peak northbound from Wilshire Blvd. to US 101)

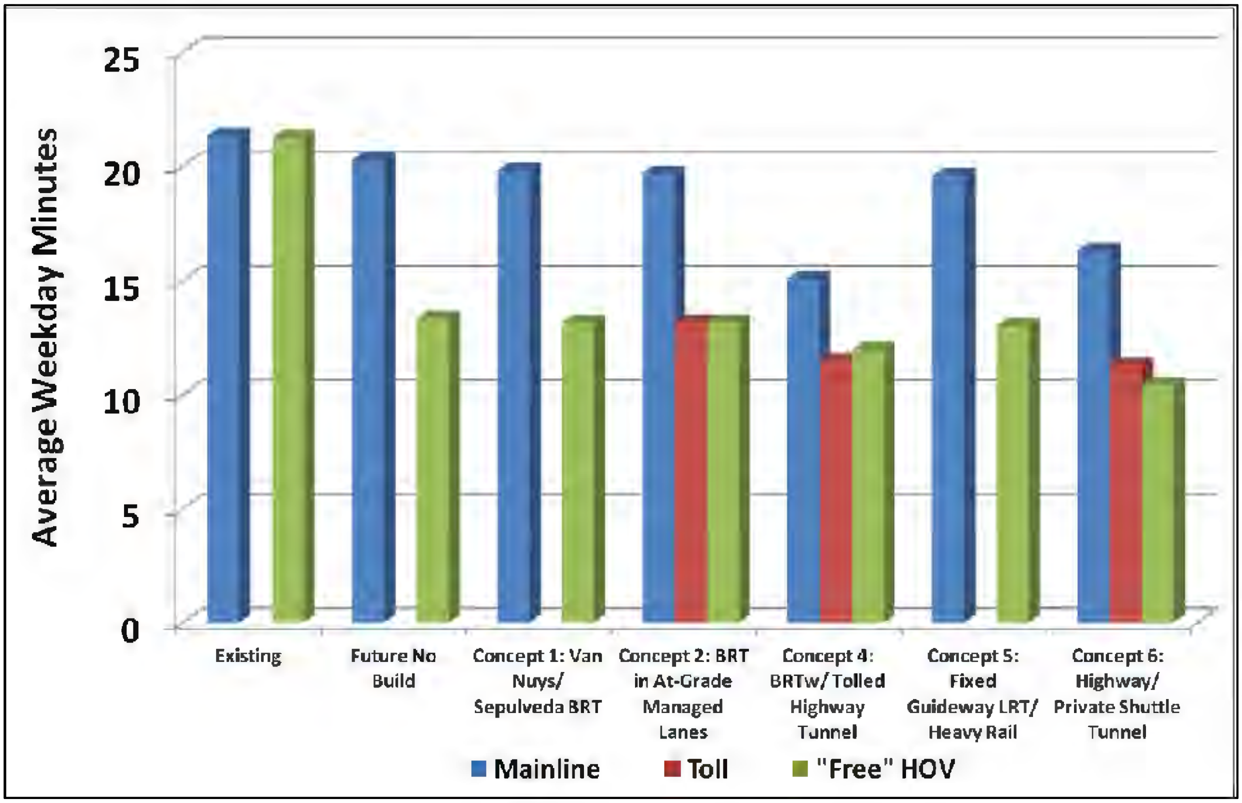


Table 5-10: Average Weekday Auto Travel Times "Over the Pass" (minutes)
(PM peak northbound from Wilshire Blvd. to US 101)

Traffic Type	Existing	Future No Build	Concept 1	Concept 2	Concept 4	Concept 5	Concept 6
Mainline	21	20	20	20	15	20	16
Toll	-	-	-	13	11	-	11
"Free" HOV	21	13	13	13	12	13	10

5.7. AVERAGE WEEKDAY TRANSIT TRAVEL TIMES

Changes in the estimated average weekday transit travel time over the Sepulveda Pass are summarized in Figures 5-11 and 5-12 and Tables 5-11 and 5-12. These are the projected average times it would take to travel over the Pass southbound or northbound in the peak period between the Sylmar Metrolink Station and LAX.

Figure 5-11: Average Weekday Transit Travel Times (minutes)
(Peak Period Southbound from Sylmar Metrolink Station to LAX)

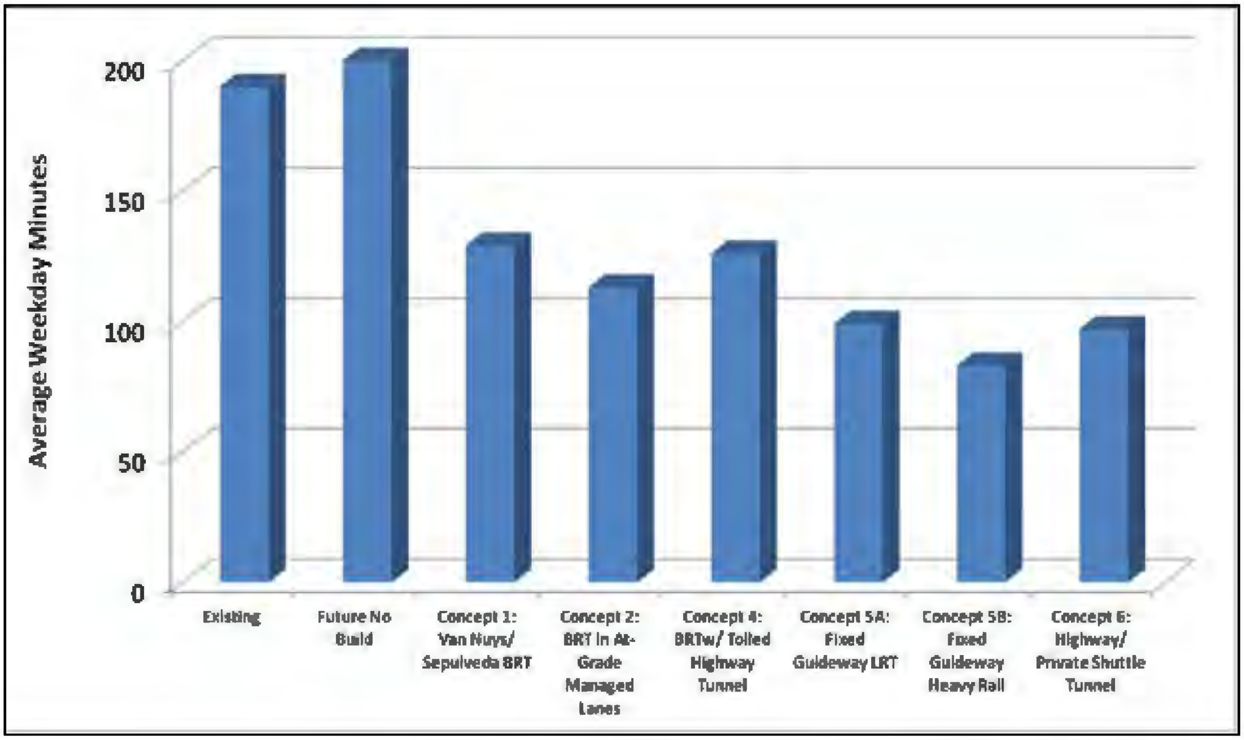


Table 5-11: Average Weekday Transit Travel Times (minutes)
(Peak Period Southbound from Sylmar Metrolink Station to LAX)

Existing	Future No Build	Concept 1	Concept 2	Concept 4	Concept 5A	Concept 5B	Concept 6
190	210	129	113	126	99	83	97

[1]The Metro model uses a single peak period to represent both the AM and PM peak periods.

Figure 5-12: Average Weekday Transit Travel Times (minutes)
(Peak Period Northbound from LAX to Sylmar Metrolink Station)

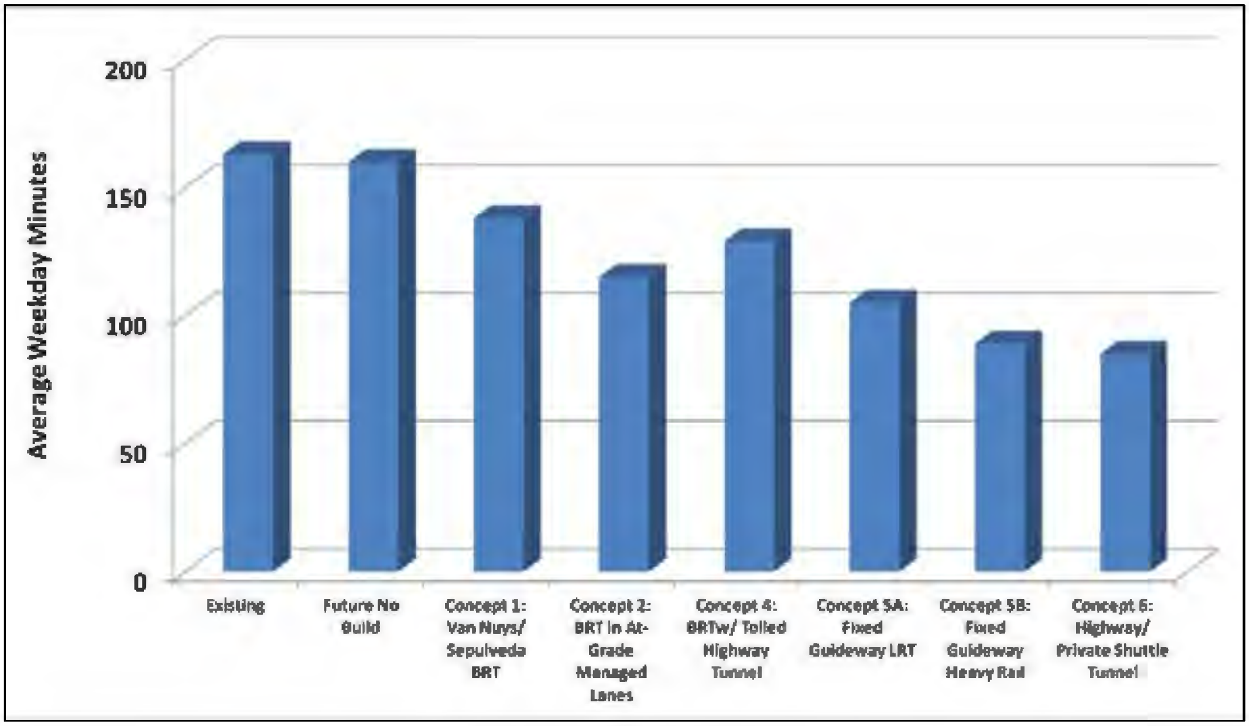


Table 5-12: Average Weekday Transit Travel Times (minutes)
(Peak Period[1] Northbound from LAX to Sylmar Metrolink Station)

Existing	Future No Build	Concept 1	Concept 2	Concept 4	Concept 5A	Concept 5B	Concept 6
163	160	138	115	129	105	89	85

[1]The Metro model uses a single peak period to represent both the AM and PM peak periods.

5.8. Average Weekday Travel Times Savings

The estimated travel time savings created by the different Systems Planning Concepts are summarized in Figures 5-13 and 5-14 and Tables 5-13 and 5-14. Shown here are the travel times saved traveling in the AM peak southbound or the PM peak northbound on I-405 between US 101 and Wilshire Blvd. The analysis is broken out by the type of lane used for travel (mainline, toll, or "free" HOV). Mainline and "free" HOV time savings are calculated by comparing their estimated travel times to the No Build travel times for mainline and "free" HOV, respectively. Because there are no toll lane travel times in the No Build scenario, the travel time savings for the toll lanes were determined by comparing estimated toll travel times with the mainline No Build estimate.

Figure 5-13: Average Weekday Auto Travel Time Savings (minutes)
(AM Peak Period Southbound from US 101 to Wilshire Blvd.)

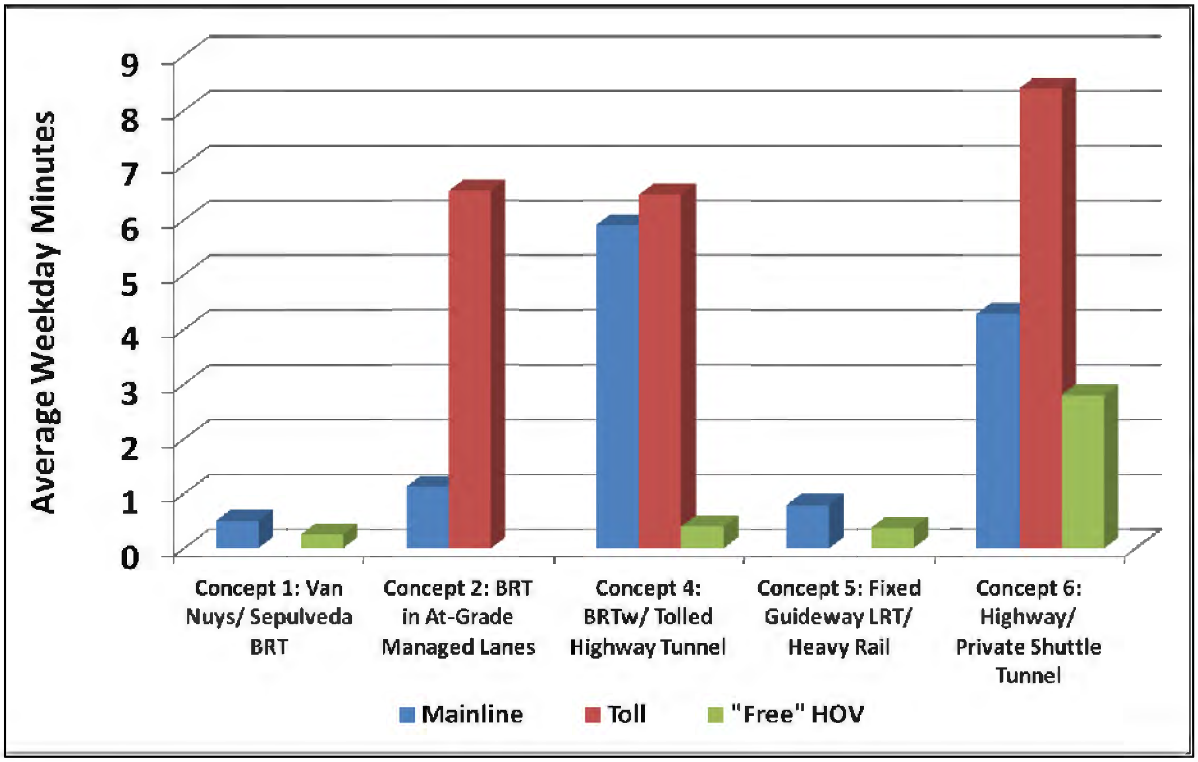


Table 5-13: Average Weekday Auto Travel Time Savings (minutes)
(AM Peak Period Southbound from US 101 to Wilshire Blvd.)

Traffic Type	Concept 1	Concept 2	Concept 4	Concept 5	Concept 6
Mainline	1	1	6	1	4
Toll	-	7	6	-	8
"Free" HOV	0	-	0	0	3

Figure 5-14: Average Weekday Auto Travel Time Savings (minutes)
(PM Peak Period Northbound from Wilshire Blvd. to US 101)

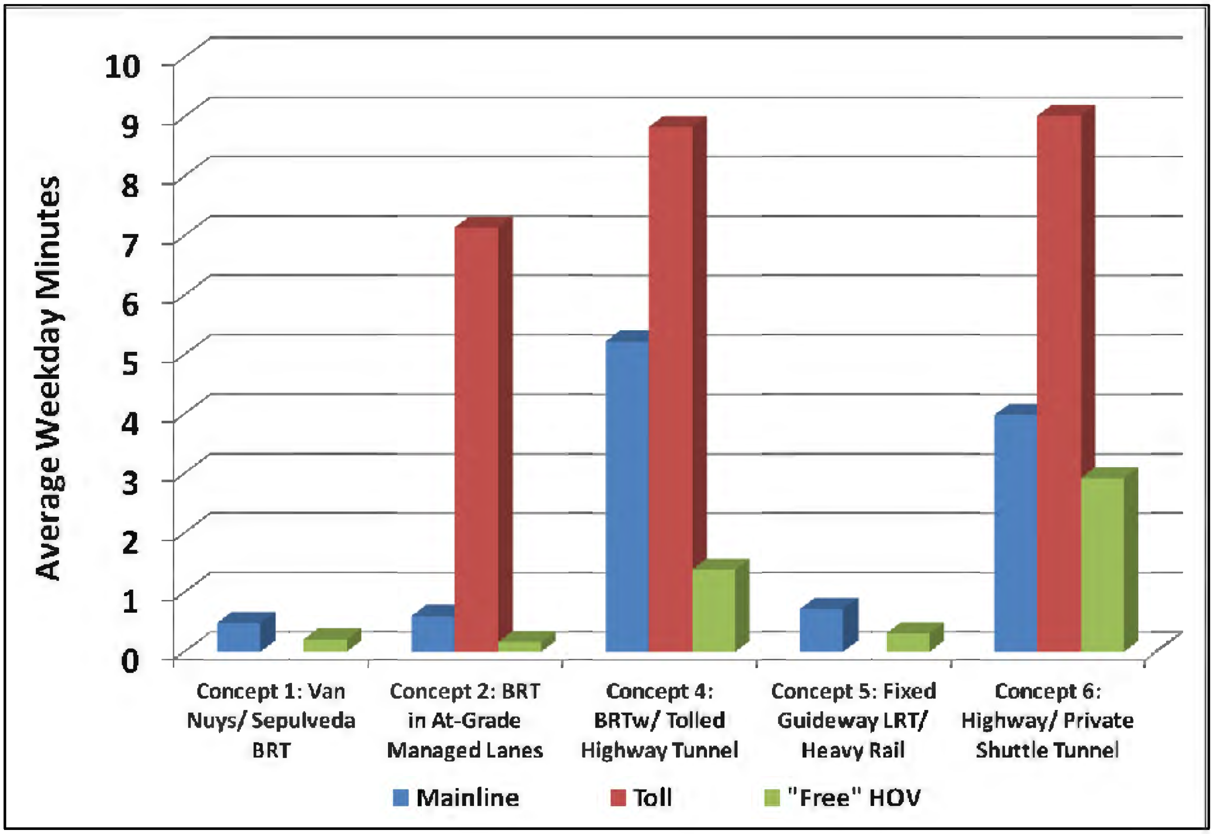


Table 5-14: Average Weekday Auto Travel Time Savings (minutes)
(PM Peak Period Northbound from Wilshire Blvd. to US 101)

Traffic Type	Concept 1	Concept 2	Concept 4	Concept 5	Concept 6
Mainline	0	1	5	1	4
Toll	-	7	9	-	9
"Free" HOV	0	0	1	0	3

The estimated transit travel time savings for the different concepts compared to the No Build scenario are summarized in Figures 5-15 and 5-16 and Tables 5-15 and 5-16. Shown here are expected times savings for a passenger traveling in the peak period southbound or northbound between the Sylmar Metrolink Station and LAX.

Figure 5-15: Average Weekday Transit Travel Time Savings (minutes)
(Peak Period Southbound from Sylmar Metrolink Station to LAX)

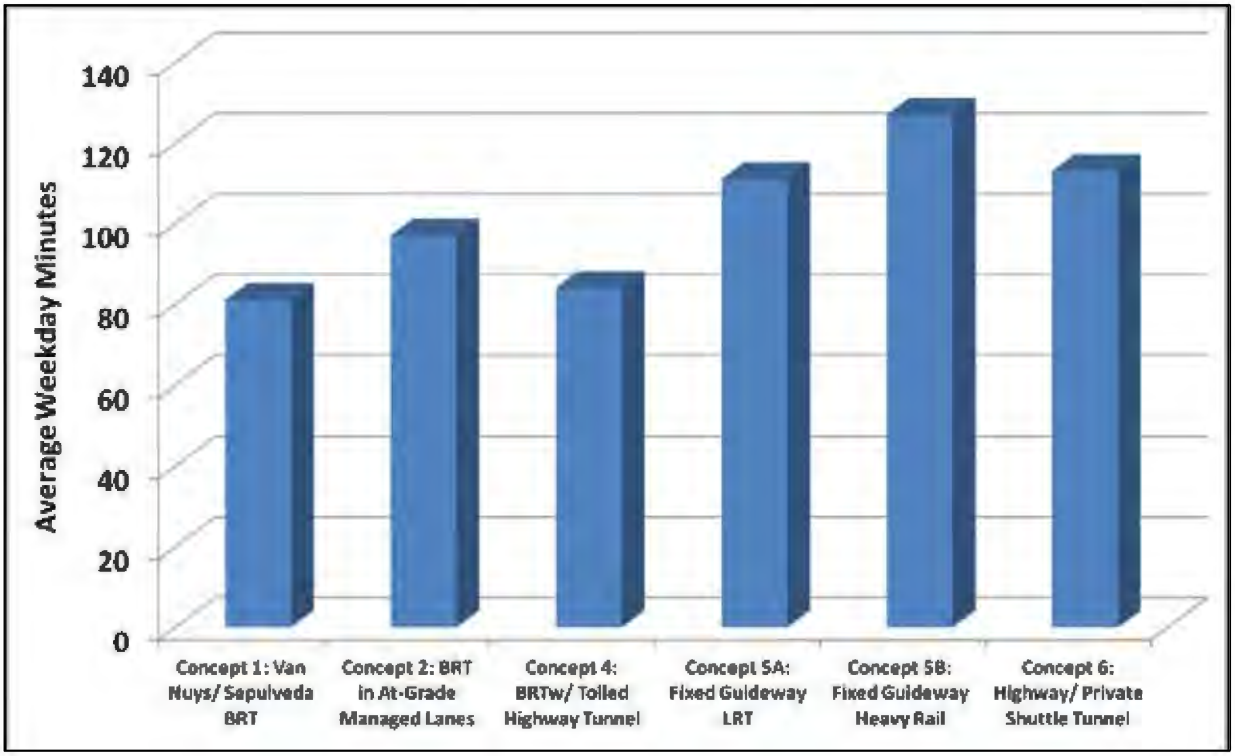


Table 5-15: Average Weekday Transit Travel Time Savings (minutes)
(Peak Period[1] Southbound from Sylmar Metrolink Station to LAX)

Concept 1	Concept 2	Concept 4	Concept 5A	Concept 5B	Concept 6
81	97	84	111	127	113

[1]The Metro model uses a single peak period to represent both the AM and PM peak periods.

Figure 5-16: Average Weekday Transit Travel Time Savings (minutes)
(PM Peak Period Northbound from LAX to Sylmar Metrolink Station)

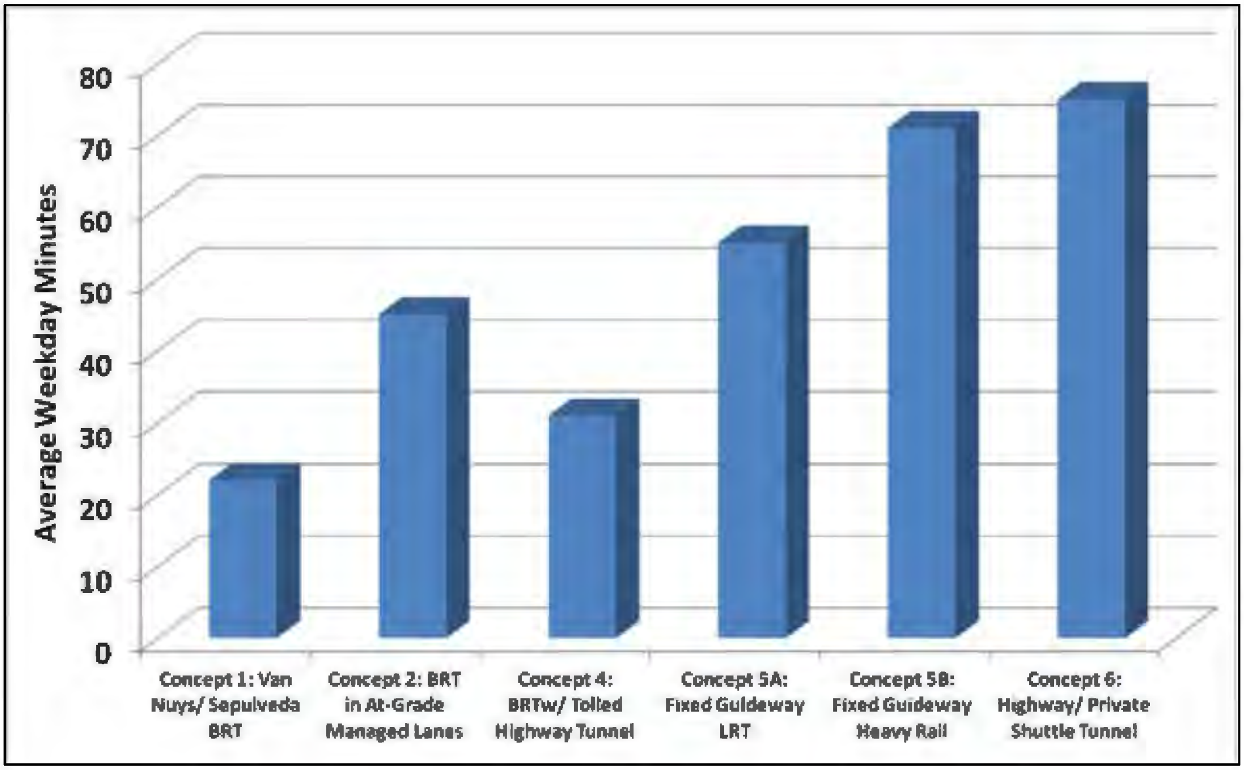


Table 5-16: Average Weekday Transit Travel Time Savings (minutes)
(PM Peak Period Northbound from LAX to Sylmar Metrolink Station)

Concept 1	Concept 2	Concept 4	Concept 5A	Concept 5B	Concept 6
22	45	31	55	71	75

6. CONCLUSIONS

The results of the Travel Demand Modeling task can be helpful in evaluating and comparing the different conceptual transportation improvement concepts being considered in the Sepulveda Pass Corridor Systems Planning Study. The following conclusions can be reached based on the key performance indicators presented in the previous section:

- There is strong demand for transit in the Sepulveda Pass Corridor, particularly over the Pass itself. Concept 1, improved bus service on existing facilities, attracts nearly 40,000 daily boardings. Concept 5B, a heavy rail transit system, attracts over 100,000 daily boardings. The number of riders over the Pass itself varies from over 35,000 in Concept 1 to over 60,000 in Concept 5B.
- Existing transit service in the Sepulveda Pass Corridor (primarily Metro Rapid 761) is able to tap only a small fraction of the existing demand because of its slow speed. The concepts evaluated in this study offer travel time savings of 38 to 60 percent compared to existing transit services.
- The greatest transit demand in the 30-mile study corridor is found in the approximately 11 miles from the Metro Orange Line to the Metro Expo Line. In Concepts 5A and 5B, approximately 60 percent of project boardings occur at stations in this segment. In Concept 2, approximately 80 percent of project boardings occur at stops in this segment, although some of these are transfers among the three services. Transit time savings are greatest on this segment as well, because of the slow operating speeds of the only existing transit route over the Pass, Metro Rapid 761.
- There is strong demand for additional vehicular capacity in the Sepulveda Pass Corridor, but the demand is not unlimited. Concepts 2 and 4, which add 2 and 4 lanes to I-405, respectively, increase person throughout in automobiles by 5 and 13 percent, respectively. The increase in persons moved is not proportional to the amount of capacity added, indicating that the new lanes will not “fill up” to the same extent as the existing lanes. However, the additional capacity does improve mainline travel times, particularly in Concept 4.
- Precisely because demand for automobile travel is not unlimited, the concepts that add automobile capacity are able to reduce travel times for all road users. The addition of tolled lanes reduces congestion in the untolled lanes.
- Concept 5B: Fixed Guideway Heavy Rail is projected to have the highest transit ridership, at about 107,000 passengers per average weekday.
- Concept 5B is also expected to carry the most passengers over the Pass, with about 62,000 riders daily. Concepts 2, 4, and 6 are projected to carry roughly equal numbers of passengers over the Pass per weekday (all between 52,000 and 54,000 passengers).
- Concept 4: BRT with a Tolled Highway Tunnel is projected to have the greatest person throughput over the Sepulveda Pass because it combines four additional travel lanes and a high-quality transit service. At nearly 655,000 people per average weekday, Concept 4 will allow roughly 115,000 additional people to travel over the Pass everyday compared to the No Build scenario.

7. NEXT STEPS

The Sepulveda Pass Corridor Systems Planning Study (SPCSPS) has been a high-level transportation systems planning study to identify a range of conceptual transportation options for improving travel along the Interstate 405/Sepulveda Boulevard corridor. The travel demand and ridership forecasting has been based on high-level concepts, relying on approximate alignments and station locations, transit operating speeds based on comparable projects, and toll rates established for other projects. The primary tool for evaluating tolled freeway concepts has been the 2008 RTP model, which has limitations in its ability to model toll facilities.

Typically, the next step in the planning process would be an Alternatives Analysis or similar effort that would screen alternatives based on established performance measures for the corridor and then develop conceptual engineering plans for a smaller set of alternatives. For this Study, we chose to model a very robust transit service plan with a very high frequency of service over the Pass. Future studies will need to explore ways to refine transit service routes and operating plans in a manner that reduces operating costs while maintaining high ridership. In a corridor such as the Sepulveda Pass, which appears to have a large, untapped transit demand, it will be important to equilibrate transit headways to transit demand. As headways decrease, forecast ridership will increase.

Further studies would also establish alignments and station locations for the different transit alternatives and would establish lane configurations, ramp, and direct connector locations for freeway alternatives. Based on the conceptual engineering plans, conceptual operating plans for transit services could be established that would take into account the effects of grades, curves, and station spacing on anticipated operating speeds, as well as grade-crossing delay for any at-grade alternatives.

On the highway side, improvements in forecasting toll demand will be important. The 2012 RTP model has improved tolling analysis capabilities. Perhaps more important, though, will be establishing the "willingness to pay" of travelers in the Sepulveda Pass Corridor, rather than relying on studies done for other corridors. Typically, detailed, corridor-specific stated preference surveys would not be done until a phase after the Alternatives Analysis. However, given the potential cost of the tunnel alternatives and the large uncertainties associated with willingness to pay in this corridor, there may be merit to considering advancing empirical research on this topic in the corridor earlier than would typically be done.

APPENDIX: SYSTEMS PLANNING CONCEPT MAPS

Figure A-1: Concept 1 Map

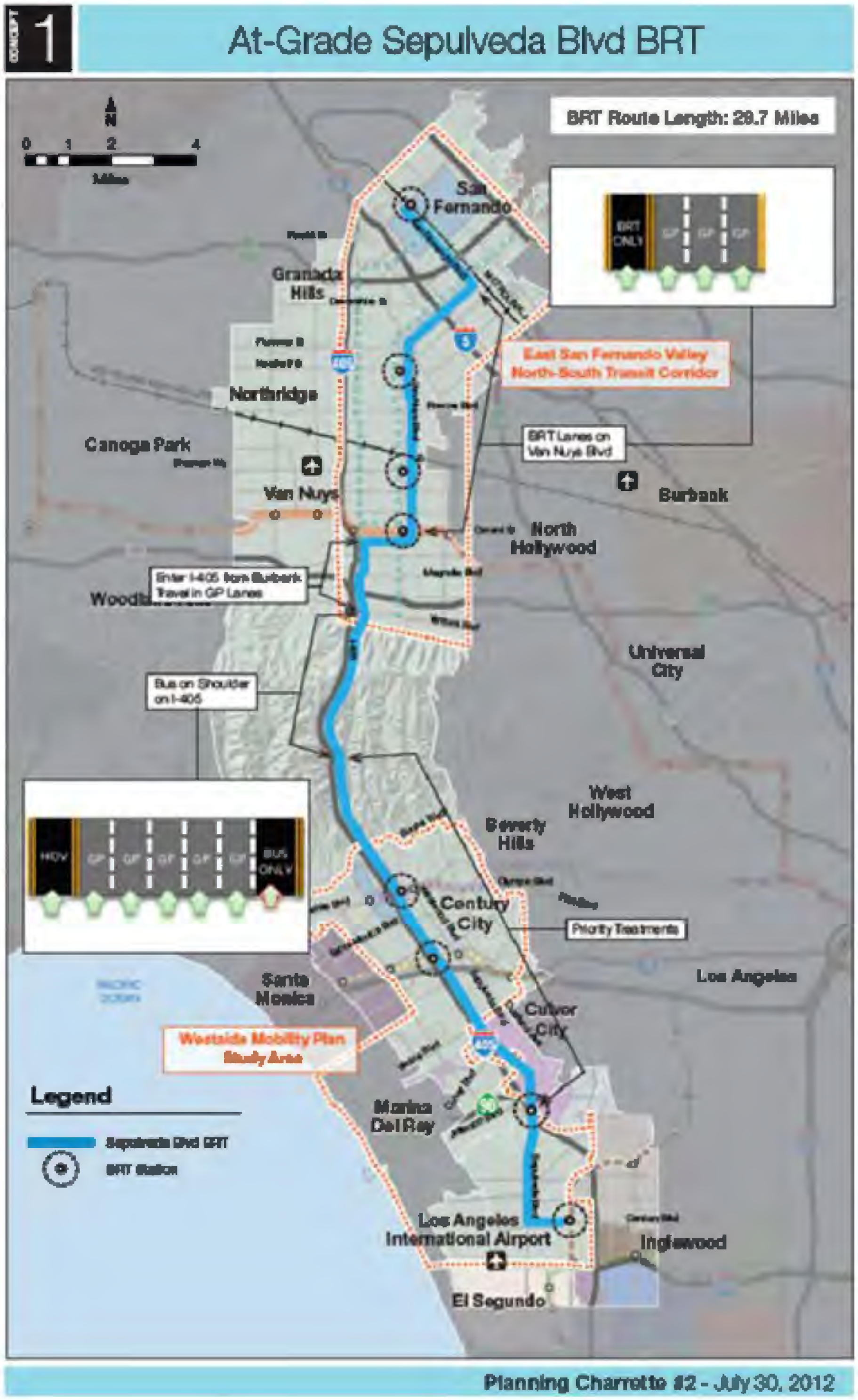


Figure A-2: Concept 2 Map

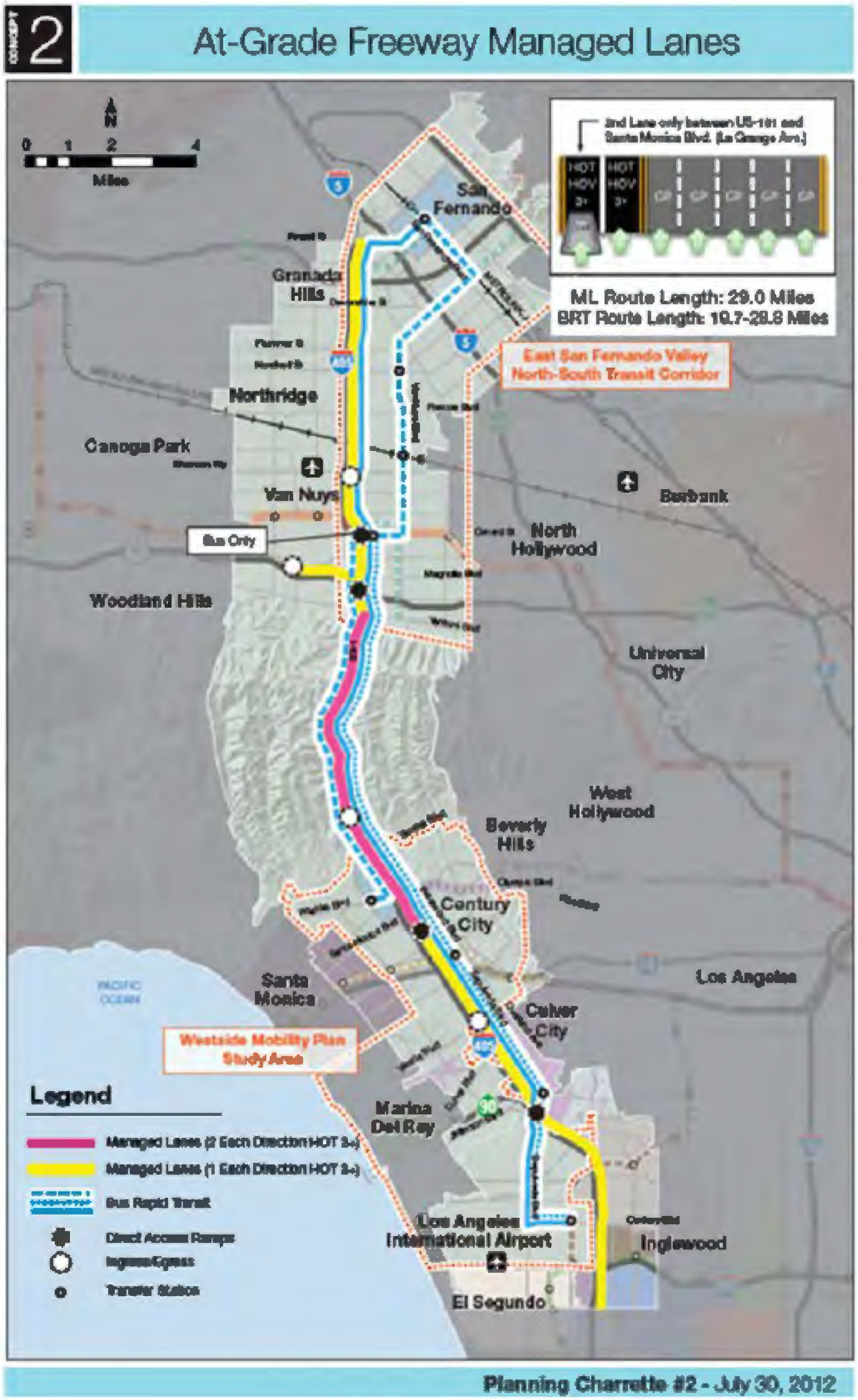


Figure A-3: Concept 3 Map

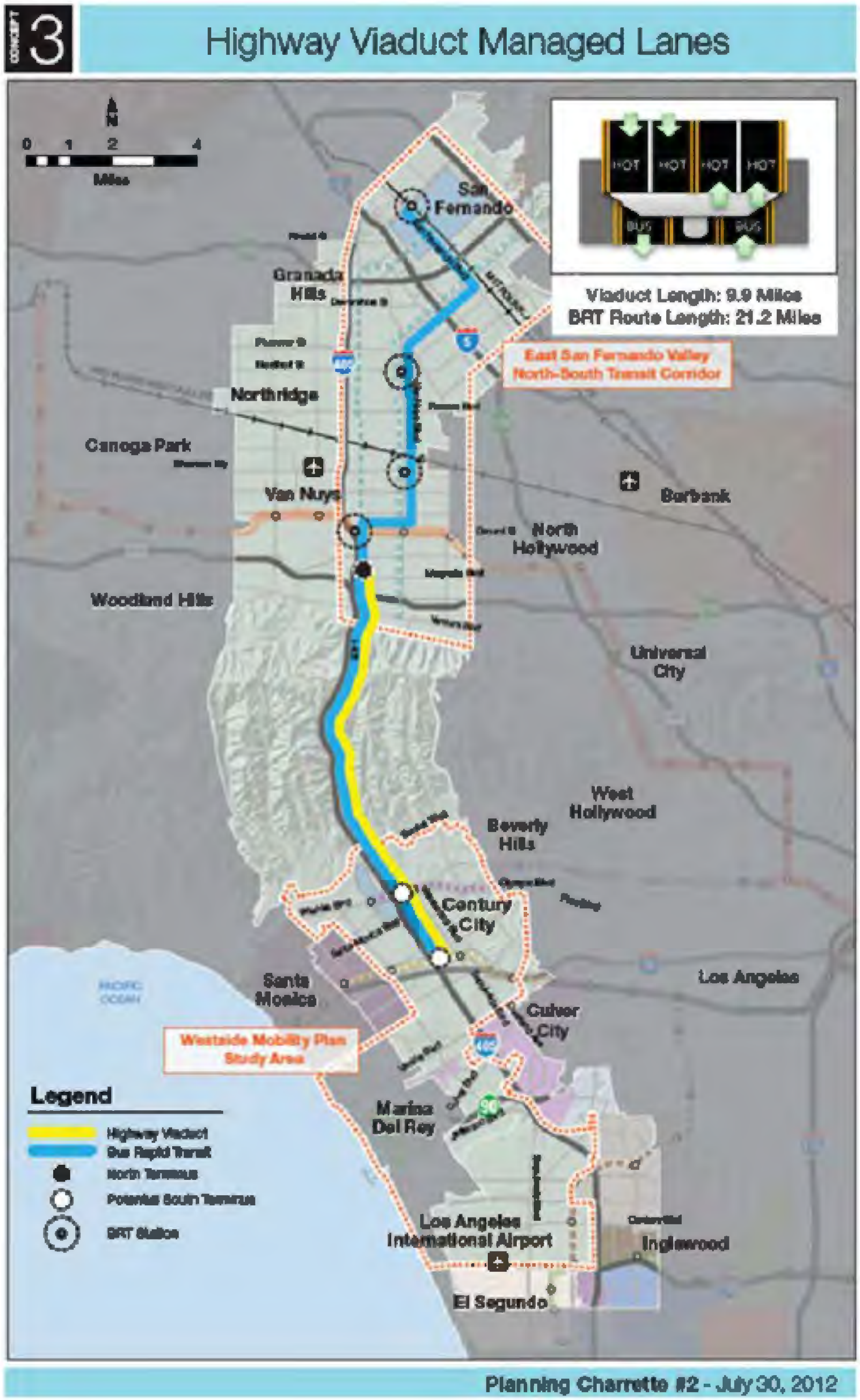


Figure A-4: Concept 4 Map

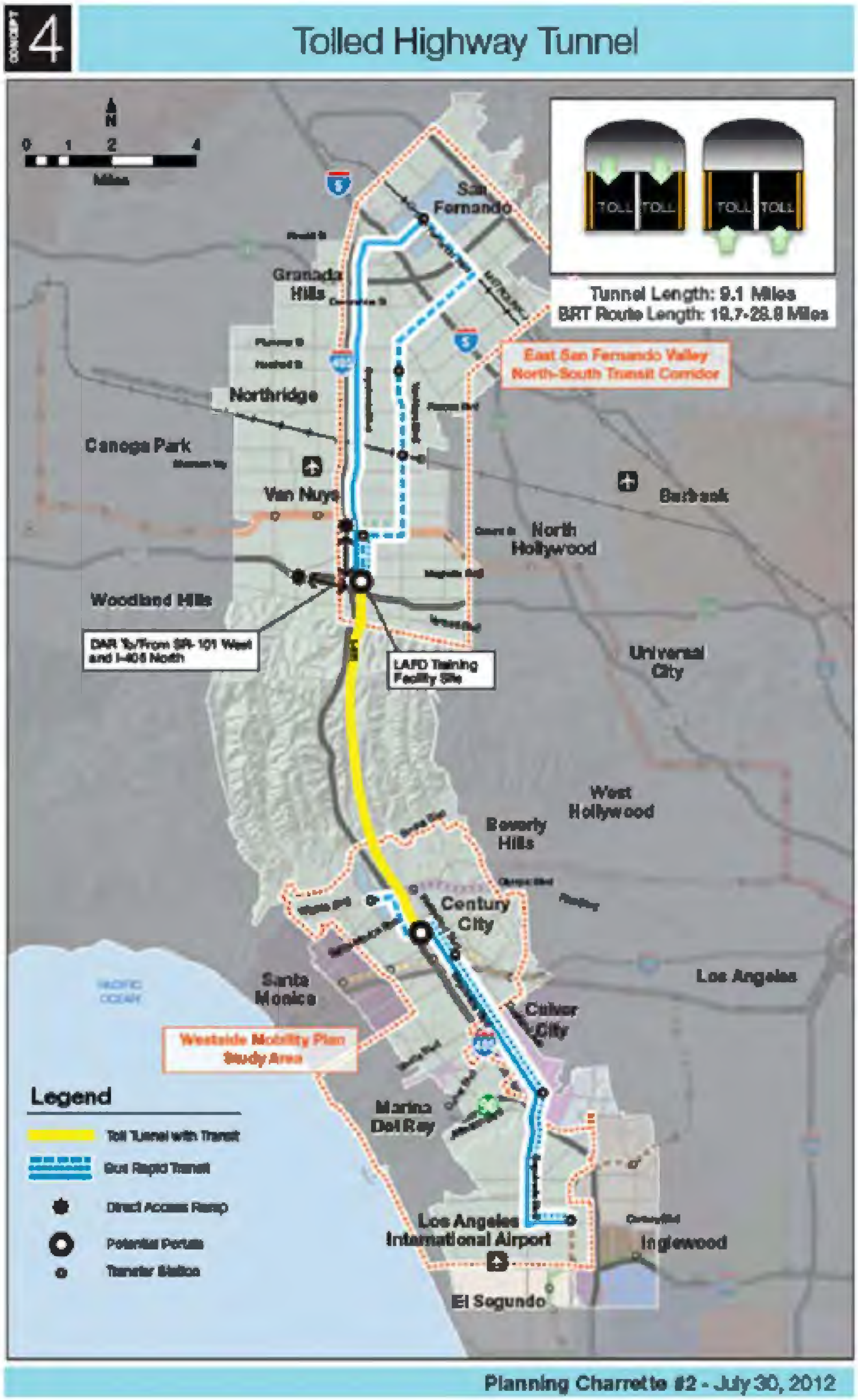


Figure A-5: Concept 5 Map

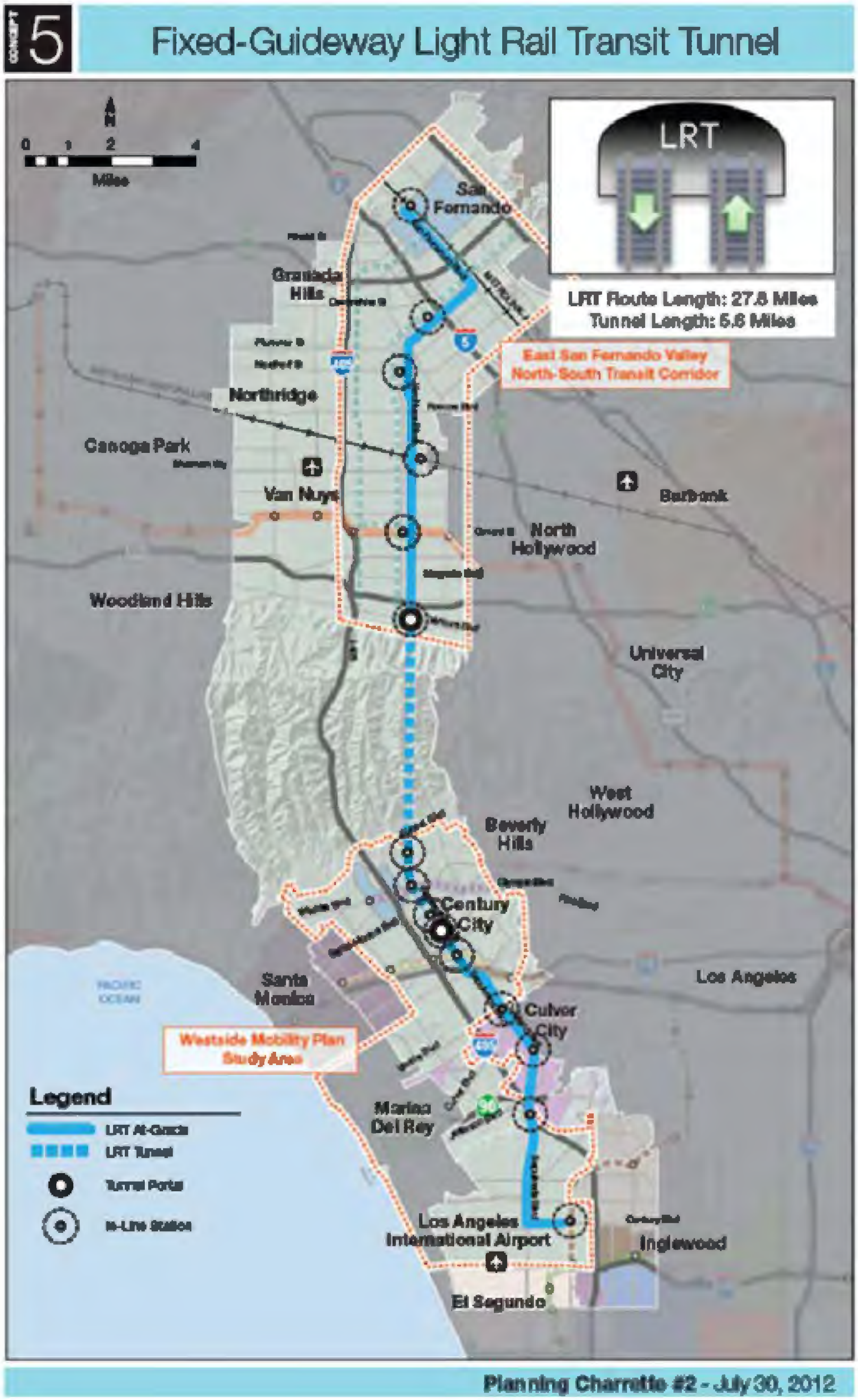
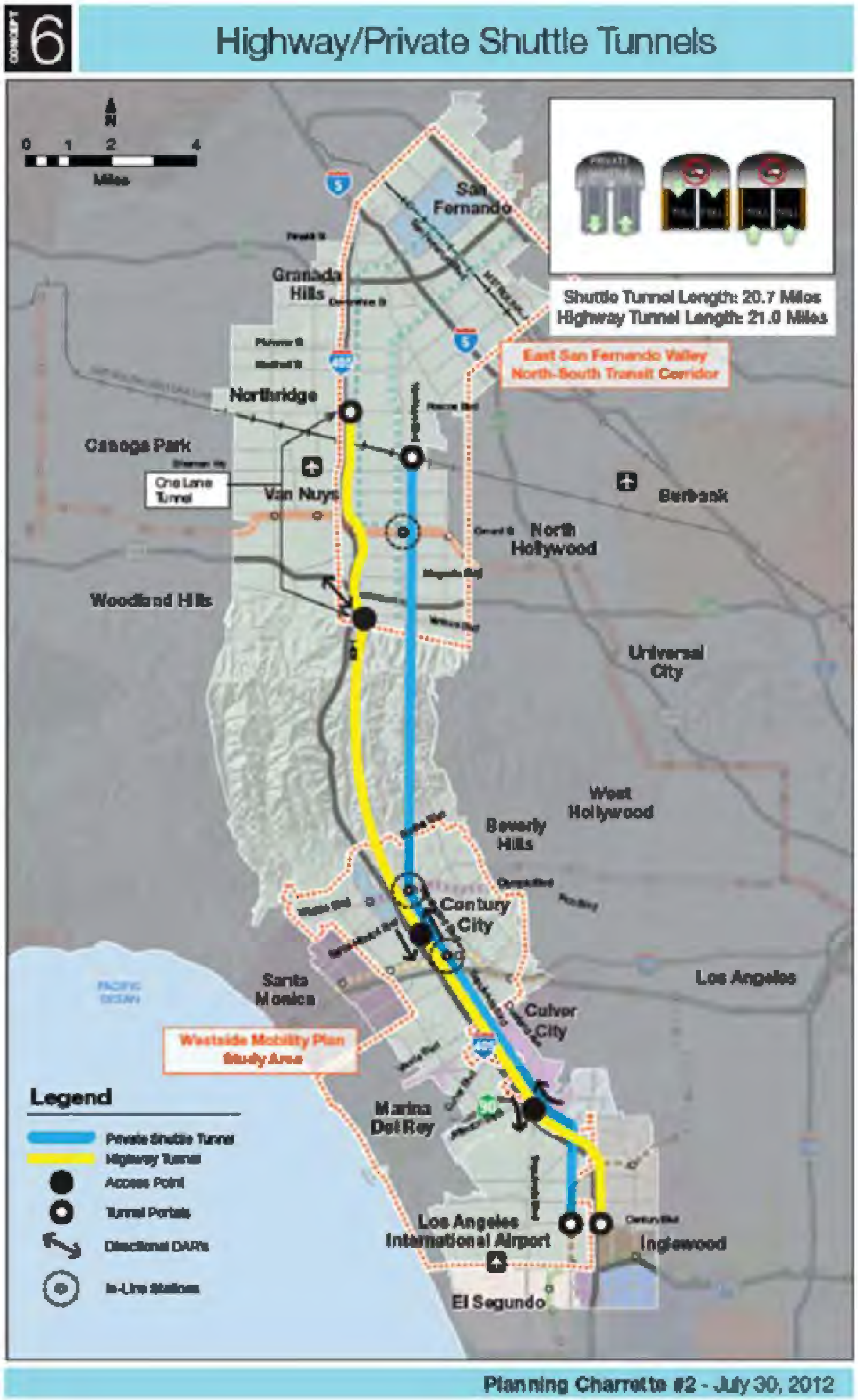


Figure A-6: Concept 6 Map



4.0 - ENGINEERING ISSUES REPORT

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Sepulveda Pass Corridor Systems Planning Study

Engineering Issues Report

Prepared for:

Metro

Prepared by:

HNTB Corporation

in collaboration with Parsons Brinckerhoff, EMI, IBI Group, and V&A

November 2012

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Appendix 2: Higher Speed Buses

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1 INTRODUCTION

This report presents refined corridor system concepts, rough-order-of-magnitude cost estimates, key engineering elements for each concept and issues needing further study. The concepts have been developed through working sessions with Metro planning staff, input from the other consultant teams working on the Transportation Planning, Demand Modeling, and Environmental task orders for the Sepulveda Pass Corridor Systems Planning Study, and from input received at Planning Charrette 1 and 2.

This report provides a summary description of the concepts and any changes resulting from Charrette 2, high-level, conceptual cost estimates, information on key design elements, geotechnical assessments, constructability issues, and issues uncovered during the course of this study that need further investigation and analysis. In addition, conceptual drawings for the concepts are included in the Appendix.

2 CORRIDOR SYSTEM CONCEPTS

The six concepts are presented in further detail in the following sections. In general, Concepts 1 and 2 are mainly at-grade or surface alternatives, Concept 3 is an aerial viaduct alternative, and Concepts 4 through 6 incorporate major subsurface (tunnel) components.

2.1 At-Grade Van Nuys/Sepulveda Boulevard Bus Rapid Transit (BRT)

The proposed at-grade BRT provides a connection between Century Boulevard station with the Green Line and Crenshaw/LAX Light Rail Transit (LRT) line on the south to the San Fernando MetroLink Station to the north. Intermediate stops are proposed at Nordhoff Street, Van Nuys MetroLink/Amtrak, Orange Line Sepulveda Station, Wilshire Boulevard (Westside Subway), Exposition LRT, and Jefferson Boulevard.

The at-grade BRT service traveling along existing roadways will be enhanced by the provision of Bus on Shoulder operations across Sepulveda Pass on I-405 (in both directions), and the provision of traffic signal priority, and queue jump lanes at selected intersections along Sepulveda Boulevard, Van Nuys Boulevard, and San Fernando Road. These enhancements are described below.

Figure 1. Concept 1 At-Grade Van Nuys/Sepulveda BRT Map

2.1.1 Key Engineering Elements

2.1.1.1 Concept Design Elements

The primary engineering design elements associated with Concept 1 are traffic signal and intersection striping modifications associated with queue jump improvements for the proposed BRT service and signing and striping associated with the bus on should operations on I-405 (the north side of the Sepulveda Pass). This concept also assumes the reconfiguration of the Orange Line Sepulveda station

2.1.1.2 Geotechnical Assessment

No uncommon geotechnical issues are anticipated for the roadway facilities required for Concept 1.

2.1.1.3 Constructability Issues

No negative constructability issues are anticipated for Concept 1, on the contrary, Concept 1 may present improved constructability due to its limited construction needs, lower cost and ability to phase intersection and vehicle improvements associated with queue jumps and transit signal priority.

2.1.2 Rough-Order-of-Magnitude Costs

The majority of the unit cost factors used to develop the rough-order-of-magnitude cost estimates were provided by the Metro Cost Estimating Departments. There were certain cases where unit costs were not provided by Metro and the design team relied up available data from similar projects and industry resources, which were reviewed and approved for use by Metro personnel.

The unit costs used for this study represent the concepts at a very high level; alternatives are quantified by a cost per mile unit and major features such as transit stations are assigned a typical unit factor. Where appropriate, the unit costs have been adjusted to reflect economies of scale. The cost estimates have also been adjusted to reflect the physical characteristics of the concept. For example, the typical Metro rail project has a station every mile, whereas some concepts were envisioned to have fewer stations per mile and the unit costs were adjusted accordingly. Lastly, unit costs were developed to reflect program costs and a 30 percent contingency was applied to each concept's total applied unit cost in order to account for the preliminary nature of this feasibility level assessment.

See the Sepulveda Pass Corridor Systems Planning Study Preliminary Cost Report for a full discussion on the costing methodology, unit cost values, general assumptions, and concept specific assumptions and adjustments applied to develop the rough-order-of-magnitude cost estimates.

2.1.2.1 Capital Cost Estimate

The major components of the concept used to develop the rough-order-of-magnitude cost estimate are:

- Shoulder improvements on the northbound and southbound I-405 to accommodate shoulder running buses from Ventura Boulevard to Sepulveda Boulevard
- At-grade BRT Station
- Modifications at the Orange Line station
- Priority treatments, intersections modifications, and queue jump lanes along Sepulveda Boulevard and Van Nuys Boulevard

The rough-order-of-magnitude capital cost estimate for Concept 1 is anticipated to be $162M.

2.1.2.2 Vehicle Cost Estimate

Vehicle costs associated with Concept 1 include vehicles for the proposed Bus Rapid Transit service. A planning-level calculation for both a low and high range fleet size was performed as part of the Demand Modeling task order. The low and high range fleet sizes reflect the provision of BRT service across the Sepulveda Pass. The second component associated with the vehicle cost estimates, is fleet type. Two different fleet options reflect the need for BRT service to maintain a 45 mph speed in the managed lane facility across Sepulveda Pass. The first fleet option replaces the engine and transmission of existing vehicles in Metro’s fleet with a more powerful engine and transmission that can maintain 45 mph and the other is for the purchase of new vehicles (differing from current fleet) that can maintain 45mph across the Sepulveda Pass.

Based on the above consideration, vehicle costs for Concept 1 range from $2M to $37M (refurbished compared to new vehicle purchase) for the estimated low range of BRT service, and from $4M to $78M for the high range of BRT service, for refurbished and new vehicles respectively.

2.1.2.3 Operations and Maintenance Cost Estimate

Operating and maintenance cost estimates were developed using the operating and maintenance cost figures as reported in the Metro Proposed Budget for Fiscal Year 2013, and average weekday passenger mile results from the demand modeling efforts. Based on these inputs, average annual operating costs for BRT operations included as part of Concept 1, the at-grade Sepulveda Boulevard BRT, were estimated at $96M per year.

2.1.3 Issues for Further Investigation and Analysis

Further inquiries and investigation with Caltrans and other municipal agencies that maintain and operate the roadway facilities proposed for the new BRT service will need to be undertaken to understand each agency's particular requirements for implementing bus on shoulder operations and intersection signal, signing and striping changes for queue jump and transit signal priority measures.

2.2 At-Grade Freeway Managed Lanes

Concept 2 would implement managed lane operations in the center lanes of I-405 from the I-5 interchange in the north to the I-105 interchange in the south. Between US-101 and La Grange Avenue, I-405 is proposed to consist of five general purpose (GP) lanes and two managed, high occupancy toll (HOT) lanes in each direction. A possible exception to the provision of five general purpose lanes would be to maintain the four lane section in the southbound direction to limit freeway widening. North of US-101 and south of Santa Monica Boulevard, there would only be one managed HOT lane in each direction.

At the point where the managed lanes transition from two lanes to one lane (at US-101 and at La Grange Avenue), one of the managed lanes will be dropped or added (depending on the direction of travel) to a connecting roadway using direct access ramps. At the north end, a direct access ramp connection to US-101 would provide a connection from the I-405 managed lanes to US-101 serving traffic with origins or destinations west of I-405 (no connections provided for areas east of I-405). As such, traffic going northbound on I-405 would be able to go westbound on US-101 or continue northbound on I-405 depending on lane selection and traffic eastbound on US-101 would have the option of directly entering the I-405 southbound managed lanes via a direct access ramp connection.

The southern Direct Access Ramp connection is proposed to be constructed at La Grange Avenue, just south of Santa Monica Boulevard. In this scenario, ramps would connect the managed lanes in the median of I-405 with a structure to La Grange Avenue (connection could either be under or over I-405). Ramps on the outside of each side of the freeway would provide a connection for managed lanes traffic to the adjacent local streets. As designed, the adjacent local streets (Beloit Avenue on the west side of I-405 and Cotner Avenue on the east side of I-405) would be converted to one way streets, but kept at their existing elevation to maintain access to adjacent properties (other design options may allow for two-way traffic on the frontage roads).

BRT vehicles utilizing the I-405 managed lanes are proposed access to the Orange Line Busway via direct access ramps. The proposed design would allow buses to travel under the northbound lanes of I-405 using a new undercrossing and then access the managed lanes on I-405 via center lane on and off ramps. Standard in-lane ingress and egress from the general purpose lanes to the managed lanes could also be provided at standard Caltrans intervals. Similarly, additional access to the managed lanes (north and south of the two-lane Sepulveda Pass section) could also be provided via additional direct access ramps.

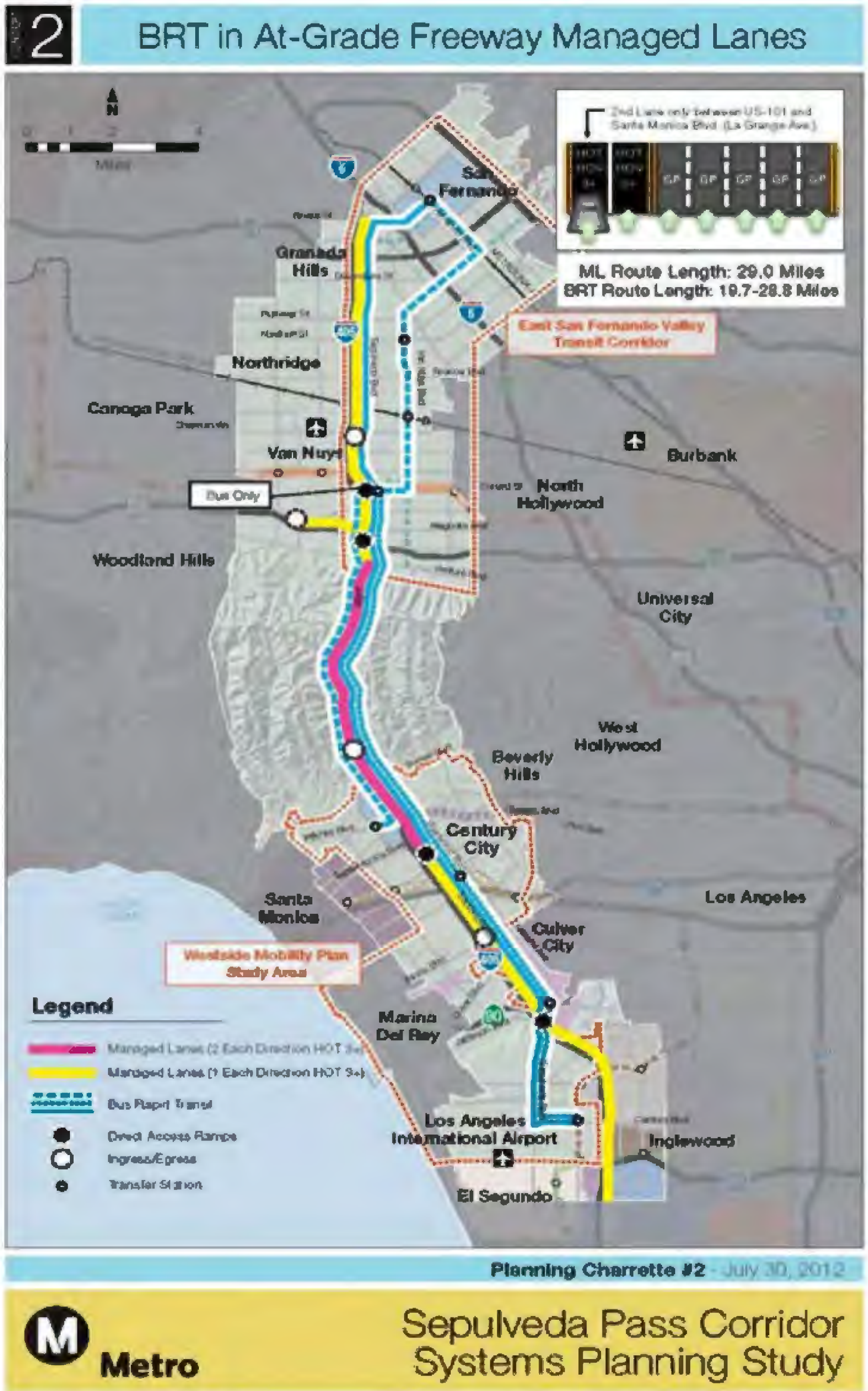


Figure 2. Concept 2 At-Grade Freeway Managed Lanes

Metro

2.2.1 Key Engineering Elements

2.2.1.1 Concept Design Elements

The primary design elements for this concept include the implementation of managed lane operations from approximately the I-5 in the north to the I-105 in the south. The majority of the distance between I-5 and I-105 would be a single lane conversion of the existing HOV lane, with a core segment of two-lane operation (in each direction) across the Sepulveda Pass from the US-101 to La Grange Avenue.

The single lane sections require signing and striping changes, as well as the installation of tolling equipment for managed lane operations. Design elements required for the construction of the two-lane segment of the managed lanes concept would require construction of direct access ramps to connect to the Orange Line, US-101 to and from the west, and at La Grange Avenue, as well as the signing, striping and tolling elements associated with the single lane operations. Construction of the direct access ramp will require additional right-of-way for two of the three proposed locations. At the Orange Line, additional right of way will be required to shift the northbound mainline I-405 lanes to the west, and additional right-of-way will be required to widen I-405 where the direct access ramps from the US-101 will join the two-lane section of managed lanes crossing Sepulveda Pass. The proposed direct access ramps at La Grange Avenue are anticipated to remain within the existing I-405 right-of-way envelope.

2.2.1.2 Geotechnical Assessment

No uncommon geotechnical issues are anticipated for the roadway facilities required for Concept 2.

2.2.1.3 Constructability Issues

Construction of the direct access ramp structures and any associated I-405 freeway mainline construction required to accommodate the direct access facilities is expected to impact traffic operations on I-405 and all adjacent and intersecting roadway facilities. Considerable traffic control and mitigation measures are expected to be required during construction activities.

2.2.2 Rough-Order-of-Magnitude Costs

See Section 2.1.3 of this report for a brief discussion of the methodology and assumptions used when developing the rough-order-of-magnitude costs or the Sepulveda Pass Corridor Systems Planning Study Preliminary Cost Report for a more in-depth discussion.

2.2.2.1 Capital Cost Estimate

The major components of the concept used to develop the rough-order-of-magnitude cost estimate are:

- Direct Access Ramps at the Orange Line Busway, US-101, and La Grange Avenue
- Construction of express lanes which would include restriping, physical barriers, and tolling equipment;
- The incorporation of the BRT improvements from Concept 1 for areas outside of the Sepulveda Pass (Van Nuys and Sepulveda Boulevard).

The rough-order-of-magnitude capital cost estimate for Concept 2 is anticipated to be $1.6B with $0.5B being attributed to the transit-only components of the concept and $1.1B attributed to the highway based components.

2.2.2.2 Vehicle Cost Estimate

Vehicle costs associated with Concept 2 are the same as for Concept 1, as the proposed BRT service is the same for both concepts. As noted for Concept 1, vehicle costs for the lower range of BRT service across Sepulveda Pass is estimated from $2M to $37M (refurbished and new vehicles respectively) and from $4M to $78M for the high range of BRT service, again for refurbished and new vehicles respectively.

2.2.2.3 Operation and Maintenance Cost Estimate

Operating and maintenance cost estimates were developed using the operating and maintenance cost from the Metro Proposed Budget for Fiscal Year 2013 and average weekday passenger miles results from the demand modeling efforts for the Sepulveda Pass Corridor Systems Planning Study. Based on these inputs, average annual operating costs for BRT operations included as part of Concept 2, the at-grade freeway managed lanes, were estimated $138M per year.

2.2.3 Issues for Further Investigation and Analysis

Further traffic analysis is needed to better understand expected managed lane operations, particularly at the two to one lane transition points at US-101 and La Grange Avenue, as well as for the single lane sections to the north of US-101 and south of La Grange Avenue.

2.3 Aerial Viaduct Managed Lanes

The highway viaduct proposed for Concept 3 is an elevated guideway above the median of the I-405 between the US-101 to the I-10. The conceptual aerial viaduct structure would consist of four managed lanes (two in each direction) and would be constructed in the median/shoulder area of the I-405 freeway. As designed, the structure would be supported by 10 foot wide center running columns, utilizing 5 feet of inside shoulder from the exiting north and south bound directions.

Access to the highway viaduct is proposed in three locations, north of US-101 at Burbank Boulevard, at US-101 and a southern access point at La Grange Avenue. The elevated structure would begin at Burbank Boulevard where it would connect to the existing overcrossing, pass over US-101 with direct access ramp connections to US-101 for travelers with origins or destinations west of I-405, travel across the pass and south to the proposed terminus at La Grange Avenue where an aerial T-ramp would provide connections to local streets via La Grange Avenue.

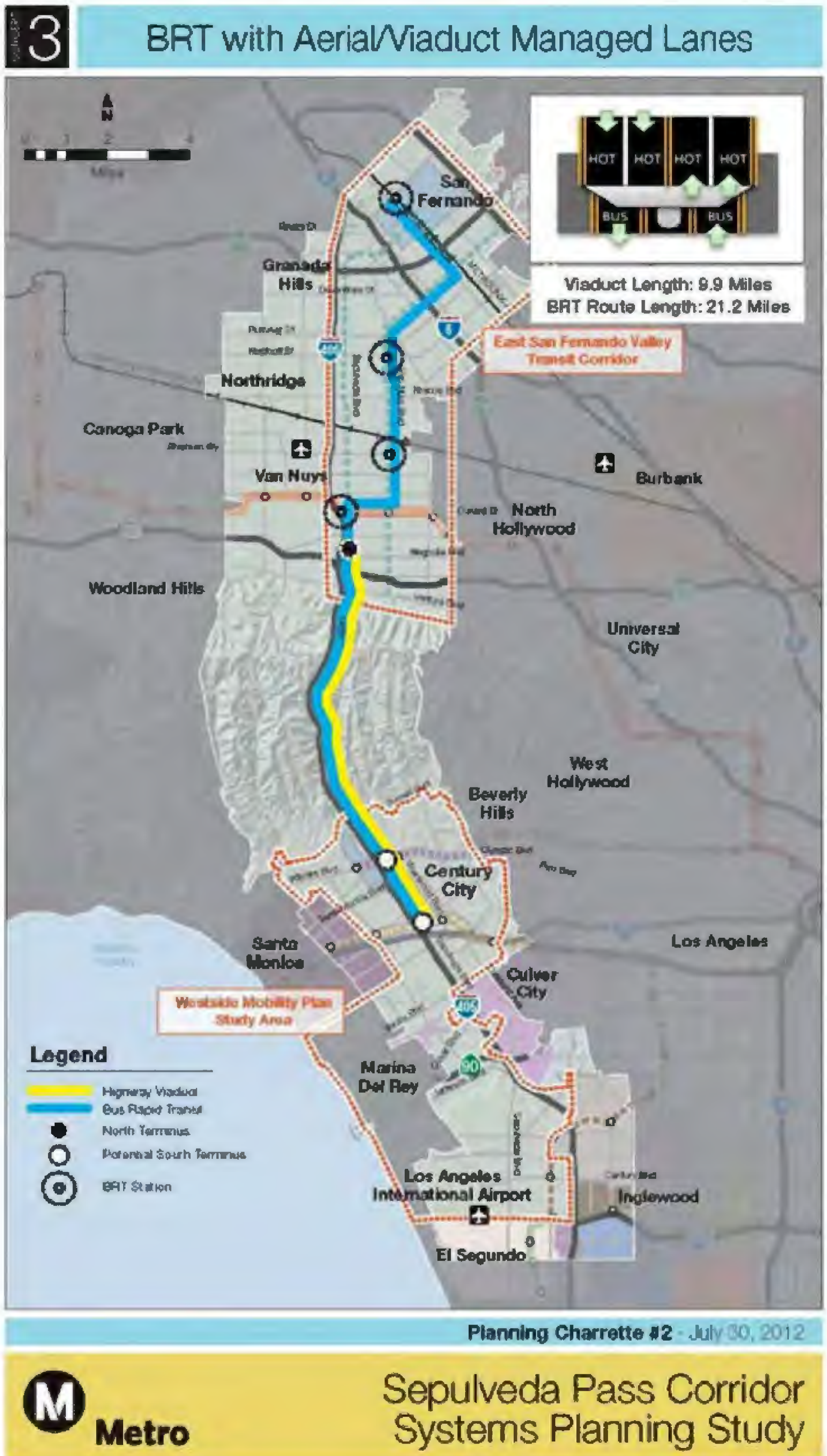


Figure 3. Concept 3 Aerial Viaduct Managed Lanes

2.3.1 Key Engineering Elements

2.3.1.1 Concept Design Elements

The primary design elements for this concept is the aerial viaduct structure and associated direct access structures and ramps at Burbank Boulevard, US-101 and La Grange Avenue. Construction of the proposed direct access locations, as currently designed, are anticipated to require additional right-of-way.

2.3.1.2 Geotechnical Assessment

While no uncommon geotechnical issues are anticipated for the roadway facilities required for Concept 3, geologic and seismic issues should be analyzed in depth to accurately portray any geotechnical or seismic issues associated with an elevated structure of this size.

2.3.1.3 Constructability Issues

Construction of the aerial viaduct and associated direct access ramp structures is expected to impact traffic operations on I-405 and all connecting roadway facilities. Considerable traffic control and mitigation measures are expected to be required during construction activities.

2.3.2 Rough-Order-of-Magnitude Costs

See Section 2.1.3 of this report for a brief discussion of the methodology and assumptions used when developing the rough-order-of-magnitude costs or the Sepulveda Pass Corridor Systems Planning Study Preliminary Cost Report for a more in-depth discussion.

2.3.2.1 Capital Cost Estimate

The major components of the concept used to develop the rough-order-of-magnitude cost estimate were:

- Construction of a four-lane elevated guideway between Burbank Avenue and La Grange Avenue;
- Direct Access Ramps at Burbank Avenue, US-101 and La Grange Avenue; and
- The incorporation of the BRT improvements from Concept 1 for areas outside of the elevated viaduct structure (Van Nuys and Sepulveda Boulevard).

The rough-order-of-magnitude capital cost estimate for Concept 3 is anticipated to be $2.3B with $0.13B being attributed to the transit-only components of the concept and $2.2B attributed to the highway based components.

2.3.2.2 Vehicle Cost Estimate

Vehicle costs associated with Concept 3 are the same as for Concept 1, 2, and 4 as the proposed BRT service is the same for all concepts. As noted for Concept 1 and 2, vehicle costs for the lower range of BRT service across Sepulveda Pass is estimated from $2M to $37M (refurbished and new vehicles respectively) and from $4M to $78M for the high range of BRT service, again for refurbished and new vehicles respectively.

2.3.2.3 Operation and Maintenance Cost Estimate

Operating and maintenance cost estimates were not calculated for Concept 3, as transportation demand modeling efforts were not undertaken for this Concept.

2.3.3 Issues for Further Investigation and Analysis

If Concept 3 is progressed, community based impacts would need to be analyzed and assess. An aerial viaduct is anticipated to create visual quality impacts to residents and businesses adjacent to the I-405 freeway and community impacts during construction may prove to be particularly challenging coming on the heels of the current construction of the I-405 Sepulveda Pass Widening Project.

Additional engineering issues for further analysis and investigation include analyzing the feasibility of using a single column structural approach for the aerial viaduct structure, and ability to provide the needed clearances from existing structures within the US-101 interchange to provide the connector from northbound I-405 to eastbound US-101.

Further traffic analyses needs to be performed to determine the traffic demand and capacity required at the proposed access and egress locations to the elevated viaduct to better understand the operational feasibility of the concept. Traffic management may be somewhat more challenging for Concept 3 than for Concept 2, due to the limited entry and exit points to the viaduct facility, as compared to the potential for intermediate entry and exit points that could be provided from the adjacent general purpose lanes under Concept 2.

Lastly, a highway viaduct concept was considered in the EIR for the I-405 Sepulveda Pass Widening Project, and was ultimately withdrawn due to seismic safety concerns. While a seismic assessment of individual concepts was not completed as part of this study, it would be expected that any further study on this concept would result in similar conclusions regarding seismic issues.

2.4 Tolled Highway Tunnel

Concept 4 would construct a bored tunnel under the Santa Monica Mountains that would carry two lanes of highway traffic in each direction. The tolled tunnel concept is anticipated to have a cross section consisting of either a single bore with two lanes on an upper level and two lanes on a lower level, or two separate bores with two lanes in each bore. Traffic in the tunnel would include both autos and buses. A graphic depicting Concept 4 is shown on the following page.

The tunnel alignment would begin near the I-405/US-101 interchange and would extend south through the Santa Monica Mountains, then south-southeast through Century City east of and loosely following the I-405 roadway (approximately 9 miles). Similar to Concept 2, the southern terminus of the tunnel would be located near La Grange Avenue.

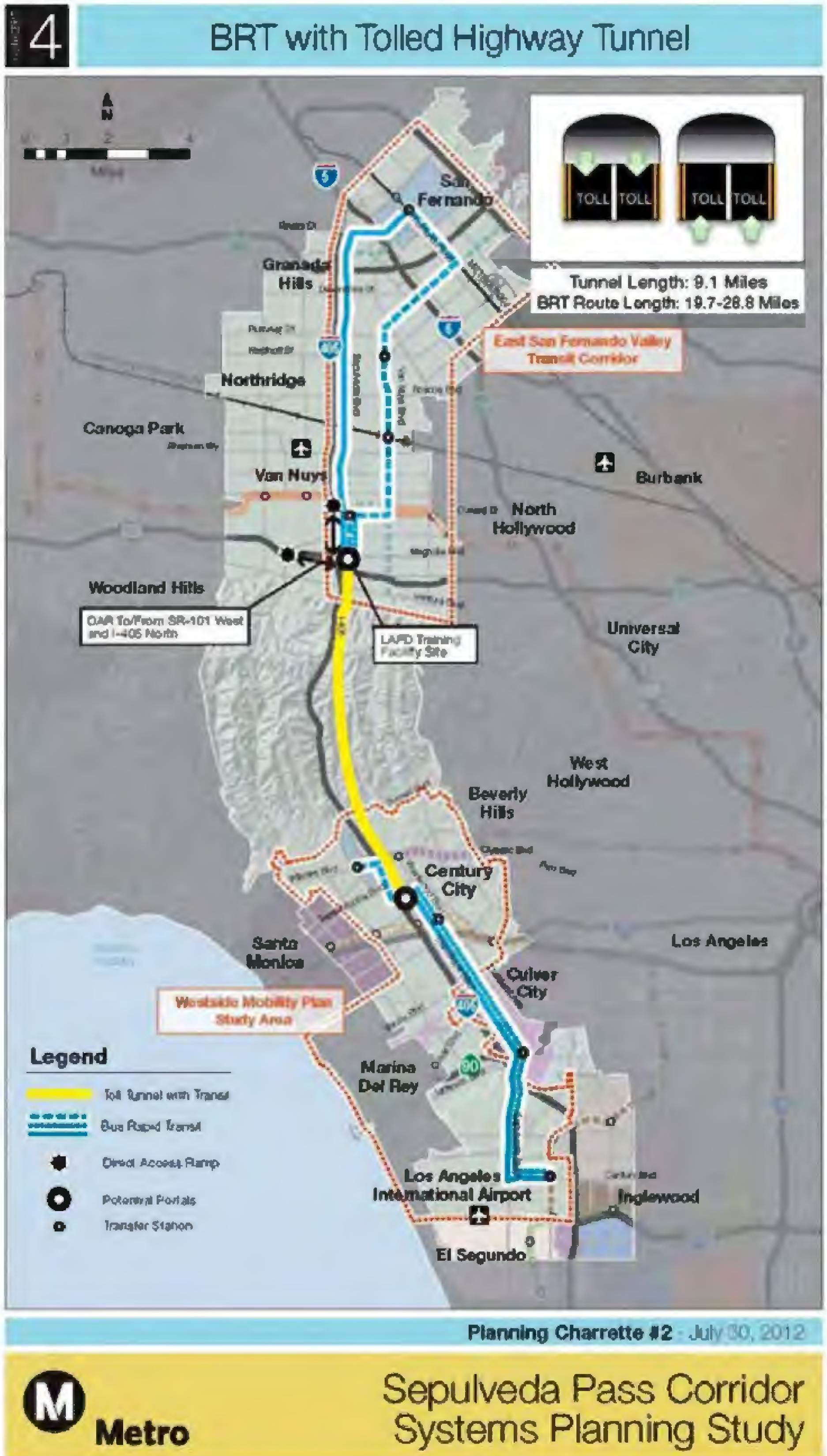


Figure 4. Concept 4 Tolled Highway Tunnel

2.4.1 Key Engineering Elements

2.4.1.1 Concept Design Elements

The primary design elements for Concept 4 are the tunnel structure and the tunnel portal structures near US-101 and La Grange Avenue. Two tunnel portals are needed at the US-101 interchange, one for traffic coming to and from I-405 to the north and one for traffic coming from US-101 to the west. Two concepts were developed for the US-101 tunnel portal connections, the first connects I-405 and US-101 with the tunnel portals with flyover ramps (direct access ramps) to a single, large bore tunnel, and the second would be independent tunnels to I-405 and US-101 that would later join into a single tunnel.

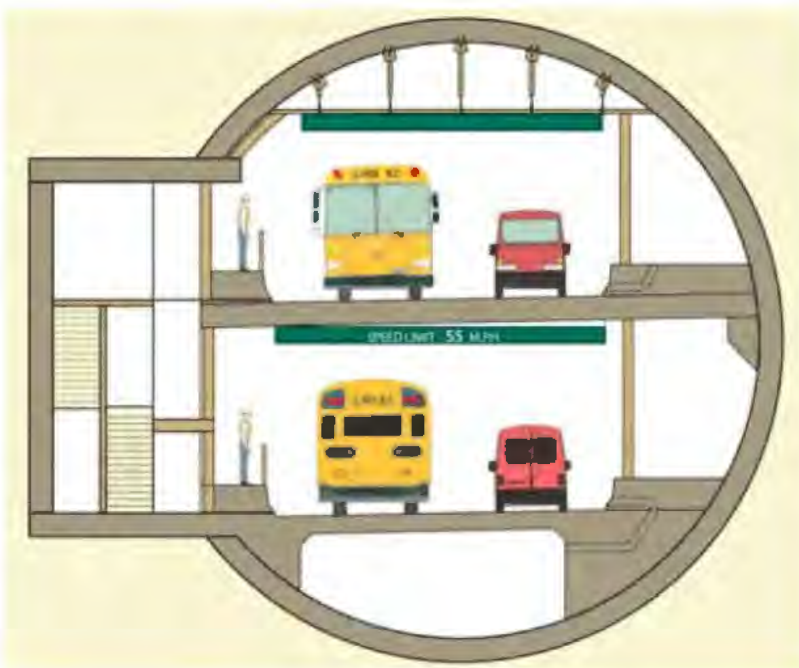


Figure 5. Typical cross-section: Single bore tunnel (stacked roadway) alternative with vertical egress points.

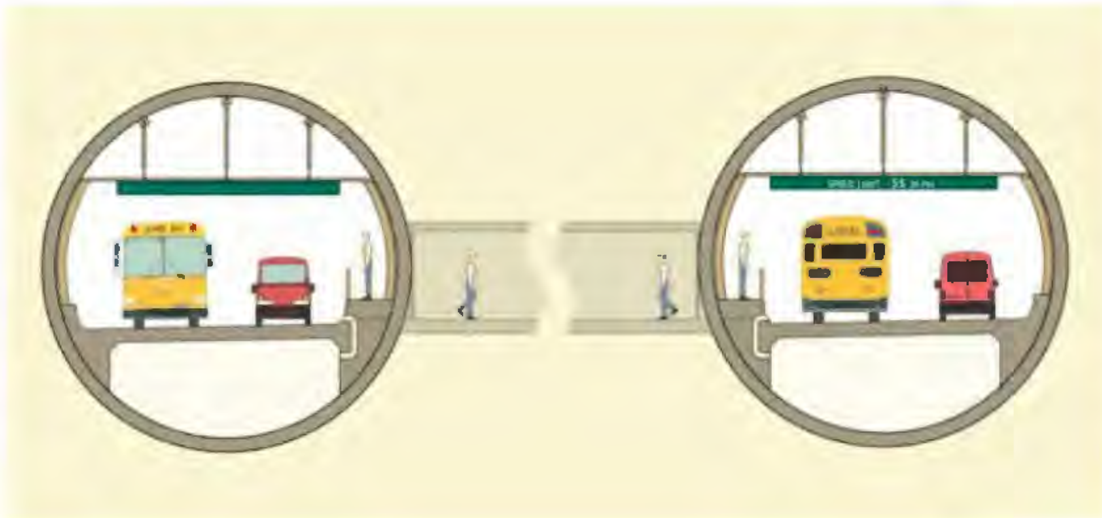


Figure 6. Typical cross-section: twin tunnel alternative with cross passage connections for emergency egress.

2.4.1.2 Geotechnical Assessment

Site specific geological and environmental considerations such as locations and orientation of major seismic faults, historical oil fields, favorable geological formations, widely varying ground water in the study corridor levels regime are of great importance while establishing a desired alignment profile for the selected route.

The alignment is located in a seismically active region and there are numerous potentially active faults in the area. Two of these faults had major earthquakes – North Northridge Hill in 1994 and San Fernando in 1971. Therefore seismic hazards such as fault rupture, seismic shaking, liquefaction and landslides need to be evaluated. Seismic slope stability at portals as well as liquefaction potential of portal structures will require further evaluation. Potential displacements along the existing faults need to be evaluated during design.

In addition to seismic hazards, other geologic hazards that exist in the project area include oil field related hazards, expansive and collapsible soils, and landslides/rock topple (which could impact portals and to a lesser extent, ventilation shafts). The tunnel design must consider the geohazards described above. For example, tunnel joints must be designed to accommodate the anticipated seismic movements, especially where the tunnel connects to portals, shafts and cross passages. In extreme cases (e.g., if the tunnel crosses a fault that has potential for an abrupt displacement), an oversized structure may be considered to accommodate the movement.

Additional information regarding geotechnical issues can be found in the Geotechnical Evaluation Memorandum (Metro, June 20, 2012).

2.4.1.3 Constructability Issues

Constructability issues associated with Concept 4 are mainly surrounding the launch and retrieval of the tunnel boring machine, the launch, retrieval and use of a tunnel boring machine for a single, large-bore tunnel. Further detail on these and other constructability issues include, but are not limited to the following items:

- Siting acceptable portal locations at each end of the tunnel to provide sufficient staging areas required to launch and retrieve the tunnel boring machine.
- The need to separate traffic in the northbound tunnel into two directions, northbound I-405 and westbound US-101, which is expected to require construction of diverging cut-and-cover portal boxed sections that will interface the bored tunnel.
- The southern tunnel portal connections at La Grange may require shifting of the I-405 freeway mainline lanes to create sufficient space in the median for a tunnel portal.
- The removal, transport and identification of locations in which to deposit the excavated soil resulting from the bored tunnel construction, which is estimated at approximately 7.6 million cubic yards.
- Siting of ventilation plants and associated appurtenant tunnel structures within a densely developed urban environment.

2.4.2 Rough-Order-of-Magnitude Costs

See Section 2.1.3 of this report for a brief discussion of the methodology and assumptions used when developing the rough-order-of-magnitude costs or the Sepulveda Pass Corridor Systems Planning Study Preliminary Cost Report for a more in-depth discussion.

2.4.2.1 Capital Cost Estimate

The major components of the concept used to develop the rough-order-of-magnitude cost estimate are:

- A large diameter bore tunnel; and
- Tunnel portals and approaches on either end of the tunnel.

A low range and high range estimate were developed for the tunnel portions of the alignment, with the low range cost representing a 20 percent reduction to reflect an assumed economy of scale associated a tunnel of this length (as compared to a 1 to 2 mile tunnel from which the costs were based). The rough-order-of-magnitude capital cost estimate for Concept 4 ranged from a low range of $10.4B to a high estimate of $12.9B.

2.4.2.2 Vehicle Cost Estimate

Vehicle costs associated with Concept 4 are the same as for Concept 1 and 2, as the proposed BRT service is the same for all concepts. As noted for Concept 1 and 2, vehicle costs for the lower range of BRT service across Sepulveda Pass is estimated from $2M to $37M (refurbished and new vehicles respectively) and from $4M to $78M for the high range of BRT service, again for refurbished and new vehicles respectively.

2.4.2.3 Operation and Maintenance Cost Estimate

Operating and maintenance cost estimates were developed using the operating and maintenance costs reported in the Metro Proposed Budget for Fiscal Year 2013 and average weekday passenger miles results from the demand modeling efforts for the Sepulveda Pass Corridor Systems Planning Study. Based on these inputs, average annual operating costs for BRT operations included as part of Concept 4, the tolled highway tunnel, were estimated $127M per year.

2.4.3 Issues for Further Investigation and Analysis

Further analysis is needed regarding possible portal configurations in order to examine favorable construction staging schemes that would minimize right-of-way requirements and reduce traffic impacts and lane closures.

Tunnel and tunnel portal construction near existing structures will require additional analyses to determine to minimize the impacts to foundations of the existing structures that are adjacent to the tunnel and tunnel portals.

In addition, as noted for Concept 3, traffic management is somewhat more challenging for Concept 4 than for Concept 2, due to the limited entry and exist points to the tunnel facilities. As noted for Concepts 2 and 3, further traffic analyses needs to be performed to determine the traffic demand and capacity required at the proposed portal locations to better assess (tunnel and local street) operational feasibility of the concept and the access and egress locations.

2.5 Fixed-Guideway Light Rail or Heavy Rail Tunnel

Concept 5 proposes a rail line connecting the San Fernando Valley with the West Los Angeles and the Los Angeles Airport. The line would extend approximately 28 miles and connect the Sylmar/San Fernando Metrolink station in the north to the Century Aviation Station to the south. Fifteen stations are proposed with station spacing that is generally 2 miles apart.

Starting at the Sylmar Metrolink station, the rail alignment would run parallel to the existing Antelope Valley tracks before turning south onto Van Nuys Boulevard and traveling south to Ventura Boulevard where it would enter a tunnel portal and travel underneath the Santa Monica Mountains to a portal location south of Santa Monica Boulevard. The rail line would travel south on Westwood Boulevard to Overland Avenue. From Overland Avenue, the line would continue south to Sepulveda Boulevard where it would connect to the Metro Crenshaw or Green Line at the Century Aviation Station.

There are two options associated with this concept, Concept 5A is a light rail alignment that would run at grade in the San Fernando Valley, travel in a tunnel configuration under the Santa Monica Mountains, and then run in an at-grade configuration through West Los Angeles to the Century Aviation Station near LAX. Concept 5B is a heavy rail alignment that has been assumed to run entirely in a tunnel configuration, following the same alignment.

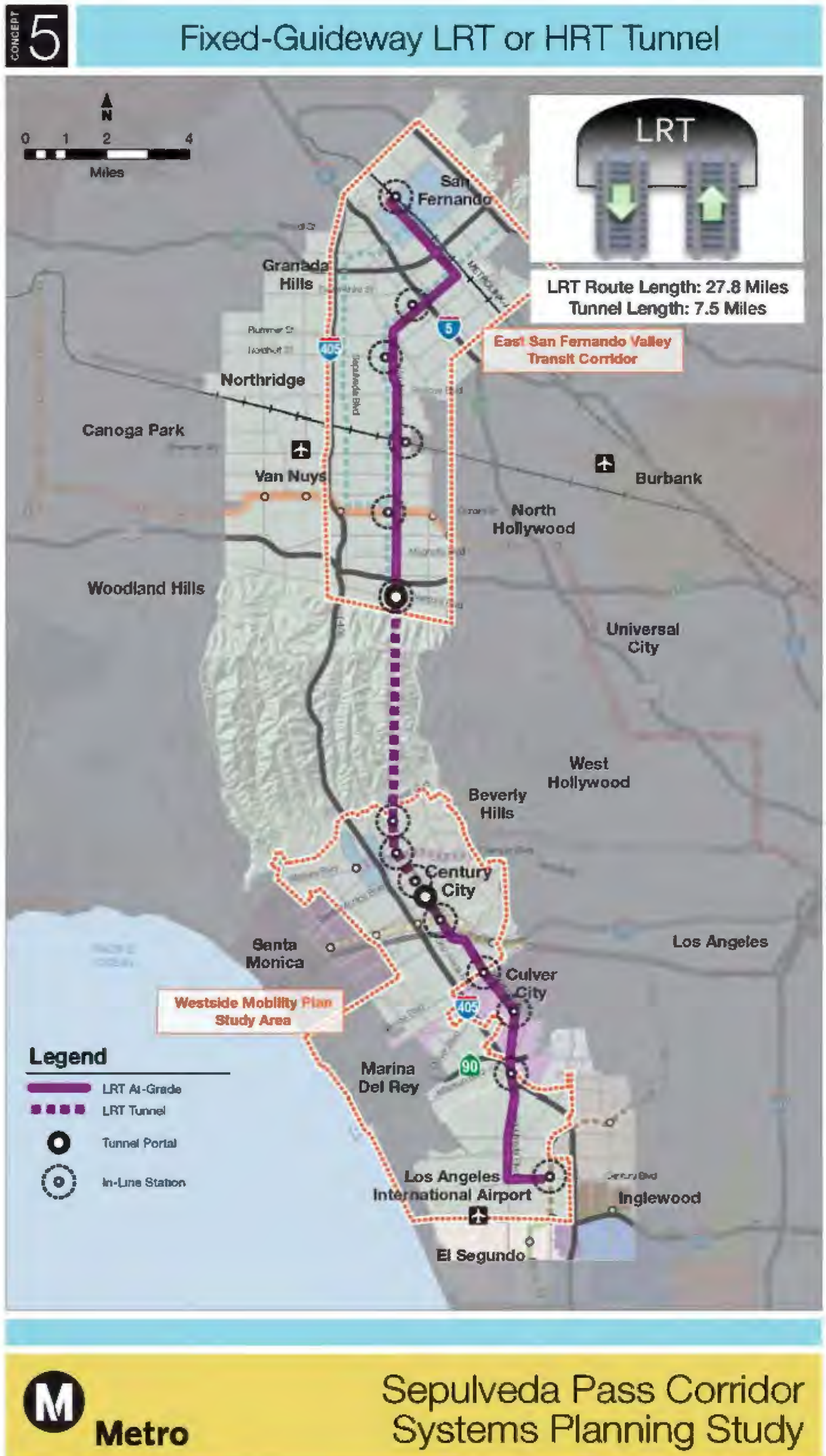


Figure 7. Concept 5 Fixed Guideway Light Rail or Heavy Rail Tunnel

2.5.1 Key Engineering Elements

2.5.1.1 Concept Design Elements

The major design components associated with Concept 5A include at-grade light rail track and necessary associated facilities systems and at-grade stations. Concept 5B includes dual bore tunnels and necessary associated facilities and systems and underground station. Both Concept 5A and Concept 5B have also assumed the need for a maintenance facility.

2.5.1.2 Geotechnical Assessment

As discussed for Concept 4, site specific geological and environmental considerations such as locations and orientation of major seismic faults, historical oil fields, favorable geological formations, widely varying ground water in the study corridor levels regime are necessary to consider when establishing a desired alignment profile for the selected route.

The alignment is located in a seismically active region and there are numerous potentially active faults in the area. Two of these faults had major earthquakes – North Northridge Hill in 1994 and San Fernando in 1971. Therefore seismic hazards such as fault rupture, seismic shaking, liquefaction and landslides need to be evaluated. Seismic slope stability at portals as well as liquefaction potential of portal structures will require further evaluation. Potential displacements along the existing faults need to be evaluated during the design of the tunnel.

In addition to seismic hazards, other geologic hazards that exist in the project area include oil field related hazards, expansive and collapsible soils, and landslides/rock topple (which could impact portals and to a lesser extent, ventilation shafts). The tunnel design must consider the geohazards described above; for example tunnel joints must be designed to accommodate the anticipated seismic movements, especially where the tunnel connects to portals, shafts and cross passages. In extreme cases (e.g., if the tunnel crosses a fault that has potential for an abrupt displacement), an oversized structure may be considered to accommodate the movement.

Additional information regarding geotechnical issues can be found in the Geotechnical Evaluation Memorandum (Metro, June 20, 2012).

2.5.1.3 Constructability Issues

The constructability issues associated with Concept 5 are very similar to those discussed for Concept 4, with the exception of the freeway connections. However, this concept would require the siting of a new maintenance and yard shop facility.

It should also be noted that Metro has extensive experience with the design and construction of LRT facilities, including 20 foot diameter transit rail tunnels, which mitigates some of the identified risks associated with Concept 4.

2.5.2 Rough-Order-of-Magnitude Costs

See Section 2.1.3 of this report for a brief discussion of the methodology and assumptions used when developing the rough-order-of-magnitude costs or the Sepulveda Pass Corridor Systems Planning Study Preliminary Cost Report for a more in-depth discussion.

2.5.2.1 Capital Cost Estimate

Based on direction from Charrette 2, cost estimates were developed for a light rail concept option and a heavy rail concept option. The light rail option would operate in an at-grade configuration on either side of the tunnel from Ventura Boulevard to approximately Santa Monica Boulevard. The "heavy rail" concept option (5B) is assumed to operate in a tunnel configuration for the entire length. Both the light rail and the heavy rail concept options include 14 stations. The major components of the concept used to develop the rough-order-of-magnitude cost estimate are:

- At-grade light rail
- At-grade transit stations
- Dual bore tunnels
- Underground transit stations
- A maintenance facility

A low range and high range estimate were developed for the tunnel portions of the alignment, with the low range cost representing a 20 percent reduction to reflect an assumed economy of scale associated a tunnel of this length. The rough-order-of-magnitude capital cost estimate for Concept 5 ranged from a low range of $7.4B to $8.3B for the light rail concept option to a high estimate of $13.6B to $17.5B for the "heavy rail" concept option.

2.5.2.2 Vehicle Cost Estimate

Vehicle cost associated with the proposed rail service for Concept 5, are included in the overall per mile capital costs discussed above.

2.5.2.3 Operation and Maintenance Cost Estimate

Operating and maintenance cost estimates were developed using the operating and maintenance costs as reported in the Metro Proposed Budget for Fiscal Year 2013 and average weekday passenger miles results from the demand modeling efforts for the Sepulveda Pass Corridor Systems Planning Study. Based on these inputs, average annual operating costs for the two rail options (LRT and heavy rail) included as part of Concept

5, ranged from an estimated $142M per year for light rail operations to $188M per year for heavy rail operations.

2.5.3 Issues for Further Investigation and Analysis

Construction of the portal location will require laydown areas that may impact property and require right of way acquisitions. The portal would be a flared box construction until it reaches the minimum cover required for tunnels which is generally one tunnel diameter, or somewhat less, depending on ground conditions. The box would flare to reach the full width of the track center to center of 39'. Further geologic studies would determine the actual portal dimensions and shape. Further analysis is needed regarding possible portal configurations in order to examine favorable construction staging schemes that would minimize right-of-way requirements and reduce traffic impacts and lane closures.

Siting of a new maintenance and yard shop facility may be challenging within the corridor's highly developed urban area.

2.6 Toll Tunnel and Rail Tunnel

Concept 6 would be very similar to Concepts 4 and 5, as it consists of a bored highway tunnel through the Santa Monica Mountains and also includes a second tunnel for a private shuttle/rail service.

The proposed highway tunnel would be longer than that proposed for Concept 4, with the northern portal at approximately Roscoe Boulevard and the southern portal in the LAX area, near Century Boulevard. From Roscoe Boulevard to US-101 the highway tunnel would consist of one lane in each direction. A second lane would be added in the southbound direction coming from eastbound US-101, while a northbound lane would exit to westbound US-101 from northbound I-405. The highway tunnel would consist of two lanes in each direction from US-101, south across Sepulveda Pass and to the southern portal near LAX.

The private shuttle/rail tunnel would be shorter than that proposed for Concept 5, with a northern terminus at the Van Nuys MetroLink Station and a slightly more direct route to the Century Aviation Station that roughly parallels I-405.

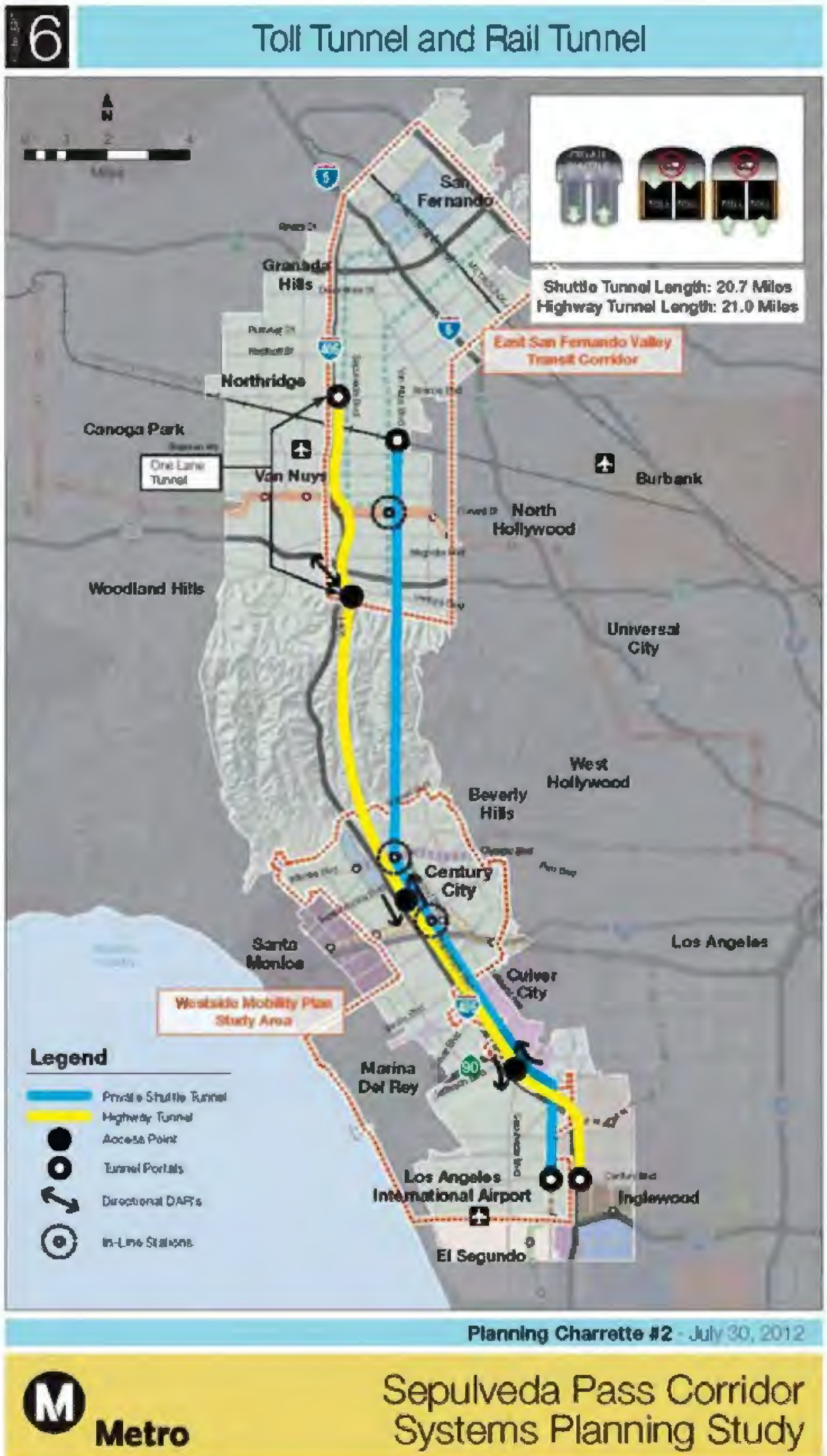


Figure 8. Concept 6 Toll Tunnel and Private Shuttle/Rail Tunnel

2.6.1 Key Engineering Elements

2.6.1.1 Concept Design Elements

The primary design elements for Concept 6 for the highway tunnel structure and the tunnel portal structures near Roscoe Boulevard, US-101 and Century Boulevard, near LAX. A single tunnel portal can accommodate both entering and exiting traffic at the Roscoe Boulevard and Century Boulevard portals, but two portals are needed at the US-101 interchange, one for traffic coming to and from I-405 to the north and one for traffic coming from US-101 to the west.

The major design components associated with the private shuttle tunnel is the tunnel structure, tunnel portals, tunnel stations, light rail track, necessary associated facilities systems and a maintenance and yard shop facility.

2.6.1.2 Geotechnical Assessment

As discussed for Concepts 4 and 5, site specific geological and environmental considerations such as locations and orientation of major seismic faults, historical oil fields, favorable geological formations, widely varying ground water in the study corridor levels regime are necessary to consider when establishing a desired alignment profile for the selected routes.

As noted, the alignments are located in a seismically active region and there are numerous potentially active faults in the area and seismic hazards such as fault rupture, seismic shaking, liquefaction and landslides need to be evaluated. Seismic slope stability at portals as well as liquefaction potential of portal structures will require further evaluation. Potential displacements along the existing faults need to be evaluated during the design of the tunnels.

Other geologic hazards previously noted also apply to Concept 6, such as oil field related hazards, expansive and collapsible soils, and landslides/rock topple. Both the highway and the private shuttle tunnel designs must consider the geohazards described above. In extreme cases, special design and structures may be necessary to account for the geologic and seismic conditions that exist in the corridor. Additional information regarding geotechnical issues can be found in the Geotechnical Evaluation Memorandum (Metro, June 20, 2012).

2.6.1.3 Constructability Issues

In addition to the constructability issues noted for Concepts 4 and 5, which are also applicable to Concept 6. However, under Concept 6, at the US 101 highway tunnel portal, traffic in the northbound tunnel needs to separate into the two destinations (northbound 405 or westbound US 101) while still in the tunnel. This is expected to require the construction of cut and cover transition box structures of varying widths and would create challenges from a constructability, right of way, and maintenance of traffic standpoint. At the US 101, at the La Grange Avenue and Sepulveda Boulevard portals, the tunnel would need to be configured to allow ingress and egress while also allowing for through traffic continuing in the tunnel. This will also create a need for a transition box structure and similar issues as stated above would need to be addressed. Further analysis is needed to determine the specific requirements for each portal and the expected temporary and permanent right of way impacts due to tunnel construction.

2.6.1.4 Rough-Order-of-Magnitude Costs

See Section 2.1.3 of this report for a brief discussion of the methodology and assumptions used when developing the rough-order-of-magnitude costs or the Sepulveda Pass Corridor Systems Planning Study Preliminary Cost Report for a more in-depth discussion.

2.6.1.5 Capital Cost Estimate

Concept 6 consists of a bored highway tunnel through the Santa Monica Mountains from approximately Roscoe Boulevard to the southern end of the Study corridor at LAX, near Century Boulevard. Concept 6 also includes a private shuttle service that would be located in either a large, single-bore tunnel, or a twin bore tunnel from Sylmar to the LAX area, with destinations and operating characteristics as for the “heavy rail” option for Concept 5.

A low range and high range estimate were developed for the tunnel portions of the alignment, with the low range cost representing a 20 percent reduction to reflect an assumed economy of scale associated a tunnel of this length. The rough-order-of-magnitude capital cost estimate for Concept 6 was estimated to have a low range of $30.8B to $38.7B.

2.6.1.6 Vehicle Cost Estimate

Vehicle cost associated with the proposed rail service for Concept 6, are included in the overall per mile capital costs discussed above.

2.6.1.7 Operation and Maintenance Cost Estimate

Operating and maintenance cost estimates were developed using the operating and maintenance costs for bus service and light rail operations as reported in the Metro Proposed Budget for Fiscal Year 2013 and average weekday passenger miles results from the demand modeling efforts for the Sepulveda Pass Corridor Systems Planning Study. Based on these inputs, average annual operating costs for the rail component of Concept 6 were estimated $104M per year.

2.6.2 Issues for Further Investigation and Analysis

As noted for Concepts 4 and 5, construction of the portal location will require laydown areas that may impact property and require right of way acquisitions. The portal would be a flared box construction until it reaches the minimum cover required for tunnels which is generally one tunnel diameter, or somewhat less, depending on ground conditions. In the case of the private shuttle tunnel, the box would flare to reach the full width of the track. Further analysis is needed regarding possible portal configurations in order to examine favorable construction staging schemes that would minimize right-of-way requirements and reduce traffic impacts and lane closures.

Another constructability issue with concept 6, similar to Concept 4 is the construction of tunnel portals and tunnel facilities near existing structures, and the need to minimize impacts to the foundations of the existing neighboring structures.

As noted for Concept 3 and 4, traffic management is somewhat more challenging for the concepts that have limited entry and exit points to the roadway facility. Further traffic analyses need to be performed to determine the traffic demand and capacity required at the proposed portal locations to better assess (tunnel and local street) operational feasibility of the concept and the access and egress locations.

Lastly, similar to Concept 5, the private shuttle tunnel would require the siting of a new maintenance and yard shop facility, which may be challenging within the corridor's highly developed urban area.

3 NEXT STEPS

This study has identified six representative concepts. A potential outcome of subsequent studies could be the identification of other feasible alternatives, which should also be thoroughly analyzed for merit. Further studies would also establish alignments and station locations for the different transit alternatives and would establish lane configurations, ramp, and direct connector locations for freeway alternatives. Based on the conceptual engineering plans, conceptual operating plans for transit services could be established that would take into account the effects of grades, curves, and station spacing on anticipated operating speeds, as well as grade-crossing delay for any at-grade alternatives. The next steps expected to be required as part subsequent planning or environmental studies include, but are not limited to, those listed below.

At-Grade and Aerial Viaduct Options (Concepts 1, 2 and 3)

- Create basemap including titles search for proper right of way requirements assessment;
- Additional geotechnical desk study;
- Search of existing utilities records and buildings records;
- Develop preliminary ramp configurations;
- Refine cost estimate;
- Refine environmental analysis of potential impacts and mitigation;
- Refinement of demand modeling and financial analysis;
- Identify sources of funding and propose likely project delivery method;
- Perform cost/benefit analysis based on above;
- Community outreach.

Tunnel Options (Concepts 4, 5 and 6)

In addition to the items listed above for Concepts 1 through 3, concepts with tunnel sections will, at a minimum, require the following analyses and evaluations:

- Refine portal locations;
- First phase of geotechnical site investigation, including deep borings in the Santa Monica Mountains and laboratory testing;
- Reconfirm initial assessment of large diameter TBM feasibility with TBM manufacturers, based on site investigation results;
- Refine tunnel alignment, profile, and configuration;
- Develop concepts for tunnel ventilation, fire life/safety and other tunnel systems and facilities;
- Identify possible locations for fan plant buildings;
- Perform conceptual design and produce conceptual drawings for underground structures and fan plant buildings.
- Identify standard design components that can be utilized as “typicals” to reduce design, construction, and operating cost.

Appendix 1: Conceptual Drawings

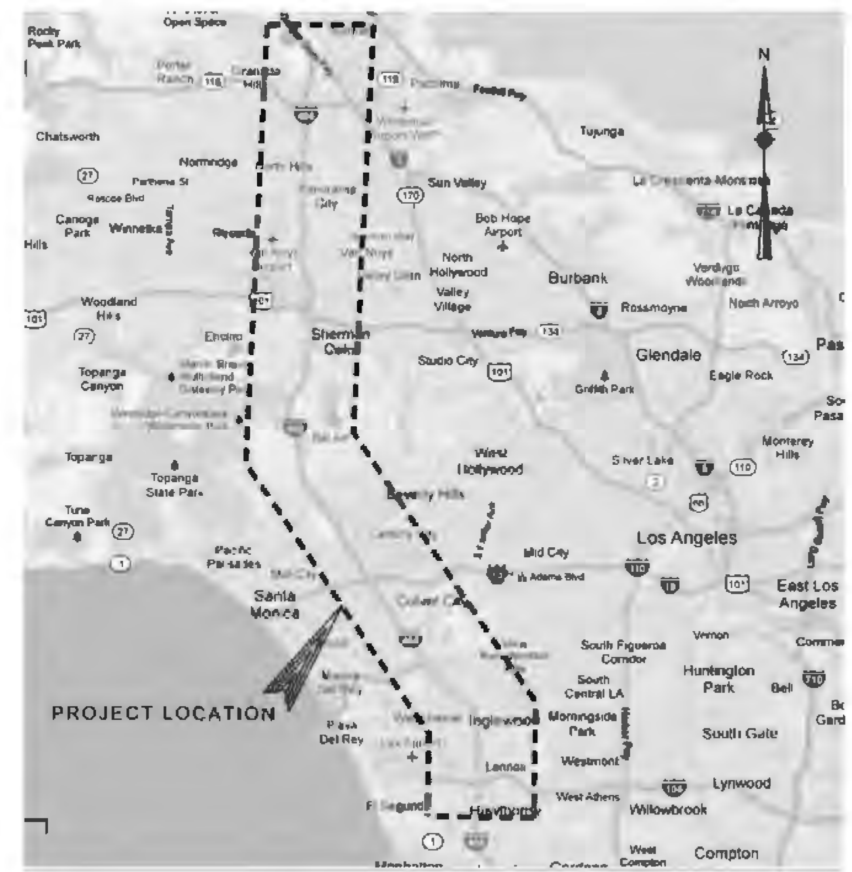
SEPULVEDA PASS CORRIDOR SYSTEMS PLANNING STUDY

SYSTEMS PLANNING CONCEPTS AND ENGINEERING ISSUES REPORT

APPENDIX: CONCEPTUAL DRAWINGS

LIST OF FIGURES

SHEET NO.	DRAWING NO.	SHEET DESCRIPTION
1	GN-00	COVER SHEET & LIST OF FIGURES
CONCEPT 1		
2	C1-01	CONCEPT 1 KEY MAP, AT-GRADE SEPULVEDA BLVD BRT
3	C1-02	CONCEPT 1 TYPICAL SECTIONS
4	C1-03	TYPICAL QUEUE JUMP LANE
CONCEPT 2		
5	C2-01	CONCEPT 2 KEY MAP, AT-GRADE FREEWAY MANAGED LANES
6	C2-02	CONCEPT 2 TYPICAL SECTIONS
7	C2-03	ORANGE LINE DIRECT ACCESS RAMP LAYOUT
8	C2-04	ORANGE LINE DIRECT ACCESS RAMP CROSS SECTION
9	C2-05	US 101 DIRECT ACCESS RAMP (1 OF 2)
10	C2-06	US 101 DIRECT ACCESS RAMP (2 OF 2)
11	C2-07	LA GRANGE DIRECT ACCESS RAMPS
12	C2-08	LA GRANGE DIRECT ACCESS RAMP CROSS SECTION
13	C2-09	LA GRANGE / EXPO PURPLE LINE OVERVIEW
14	C2-10	OPTIONAL DIRECT ACCESS RAMPS AT SEPULVEDA BLVD
15	C2-11	OPTIONAL DIRECT ACCESS RAMPS AT HOWARD HUGHES
CONCEPT 3		
16	C3-01	CONCEPT 3 KEY MAP, HIGHWAY VIADUCT MANAGED LANES
17	C3-02	HIGHWAY VIADUCT MANAGED LANES CROSS SECTION
18	C3-03	HIGHWAY VIADUCT MANAGED LANES BURBANK BLVD "T-RAMP"
19	C3-04	HIGHWAY VIADUCT MANAGED LANES SECTION B-B
20	C3-05	HIGHWAY VIADUCT MANAGED LANES LA GRANGE DIRECT ACCESS RAMPS
21	C3-06	HIGHWAY VIADUCT MANAGED LANES SECTION A-A
CONCEPT 4		
22	C4-01	CONCEPT 4 KEY MAP, TOLLED HIGHWAY TUNNEL
23	C4-02	58 FOOT SINGLE BORE TUNNEL SECTION (STACKED ROADWAY)
24	C4-03	US 101 DIRECT ACCESS RAMPS AND TUNNEL PORTAL
25	C4-04	LA GRANGE DIRECT ACCESS RAMPS
CONCEPT 5		
26	C5-01	CONCEPT 5 KEY MAP, FIXED-GUIDWAY LRT OR HRT TUNNEL
27	C5-02	VAN NUYS CROSS SECTION, TUNNEL CROSS SECTION, WESTWOOD BLVD CROSS SECTION
28	C5-03	VENTURAL PORTAL
29	C5-04	SOUTH PORTAL
CONCEPT 6		
30	C6-01	CONCEPT 6 KEY MAP, TOLL TUNNEL OR RAIL TUNNEL
31	C6-02	PRIVATE SHUTTLE TUNNEL PORTAL VAN NUYS METROLINK STATION
32	C6-03	PRIVATE SHUTTLE TUNNEL PORTAL CRENSHAW BLVD / LAX
33	C6-04	HIGHWAY TUNNEL PORTAL AT ROSCOE / PARTHENIA
34	C6-05	HIGHWAY TUNNEL PORTAL AT SEPULVEDA BLVD
35	C6-06	HIGHWAY TUNNEL PORTAL AT CENTURY BLVD / LAX



VICINITY MAP

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AeroTech Mapping

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COVER SHEET & LIST OF FIGURES

DRAWING NO. GN-00

SHEET NO. 1

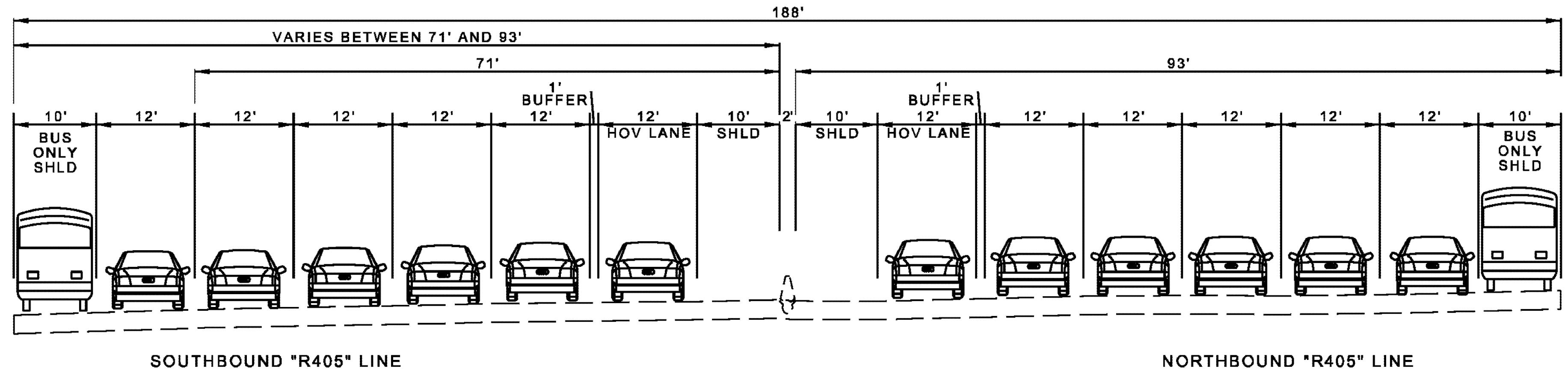
CONCEPT 1

At-Grade Sepulveda Blvd BRT

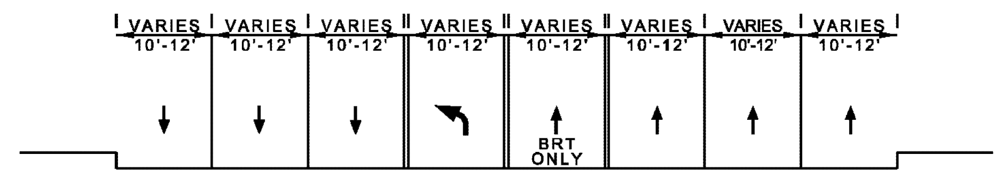
Drawing C1-01

Metro

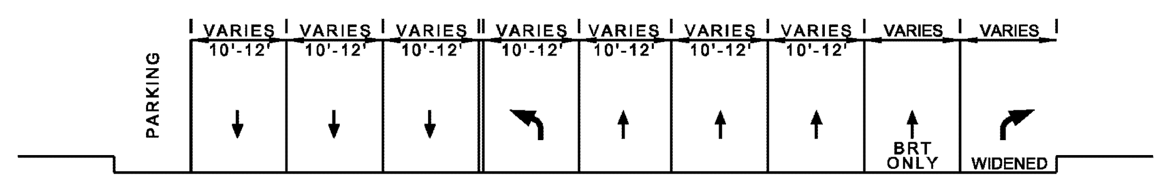
Sepulveda Pass Corridor Systems Planning Study



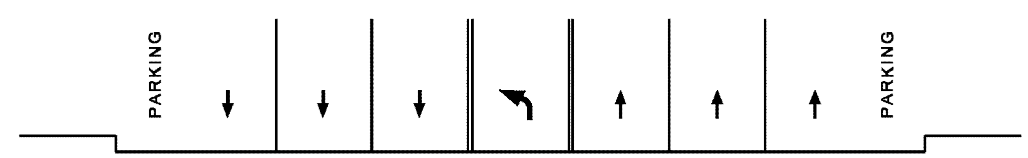
CONCEPT 1 PROPOSAL



PROPOSED QUEUE JUMP SECTION
SEPULVEDA BOULEVARD (CONSTRAINED ROW)



PROPOSED QUEUE JUMP SECTION
SEPULVEDA BOULEVARD (UNCONSTRAINED ROW)



TYPICAL EXISTING LANE CONFIGURATION
AT PROPOSED QUEUE JUMP SECTION

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SYSTEMS PLANNING STUDY

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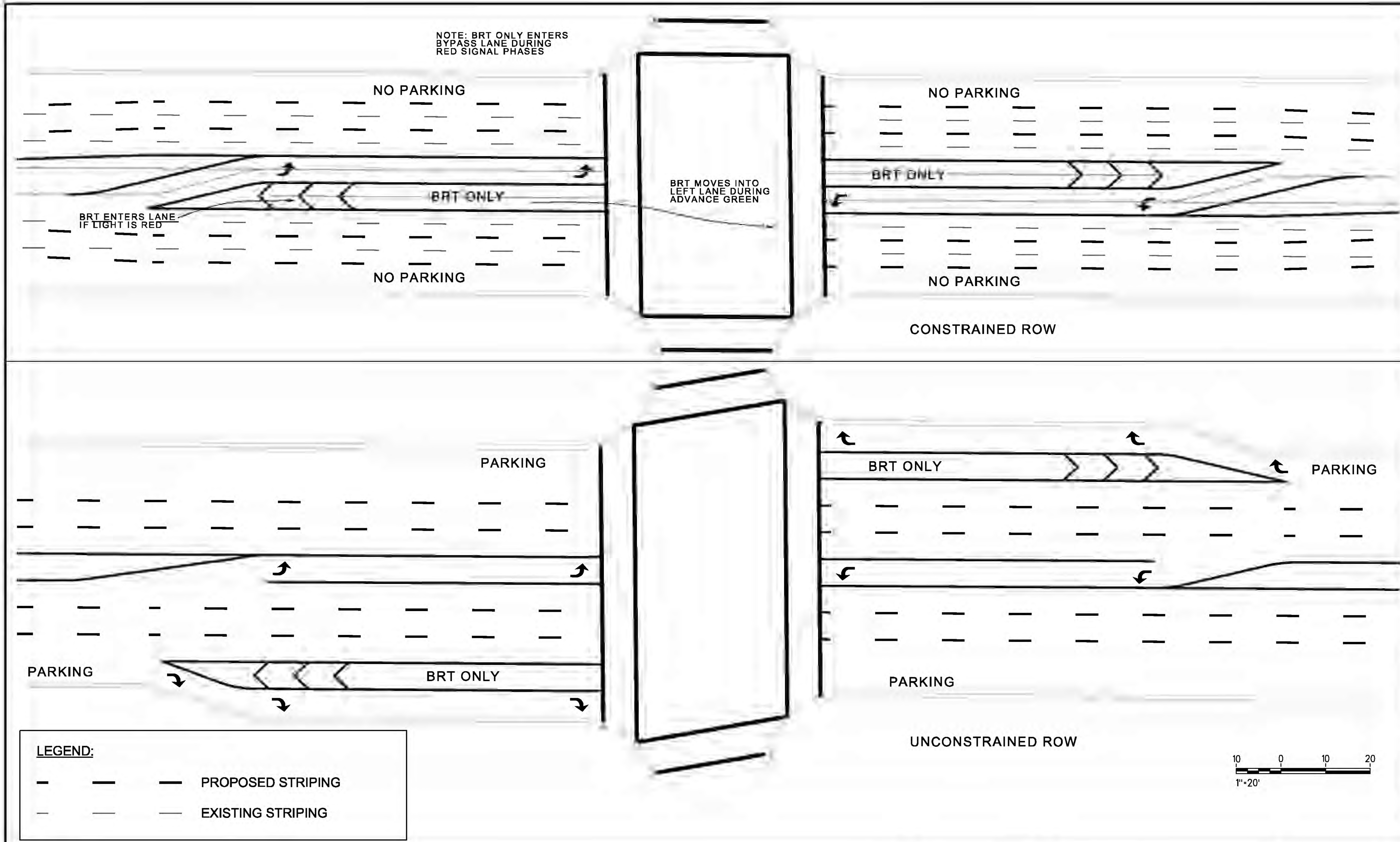
IBI GROUP

CONCEPT 1
TYPICAL SECTIONS

DRAWING NO.
C1-02

SHEET NO.
2



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IBI GROUP

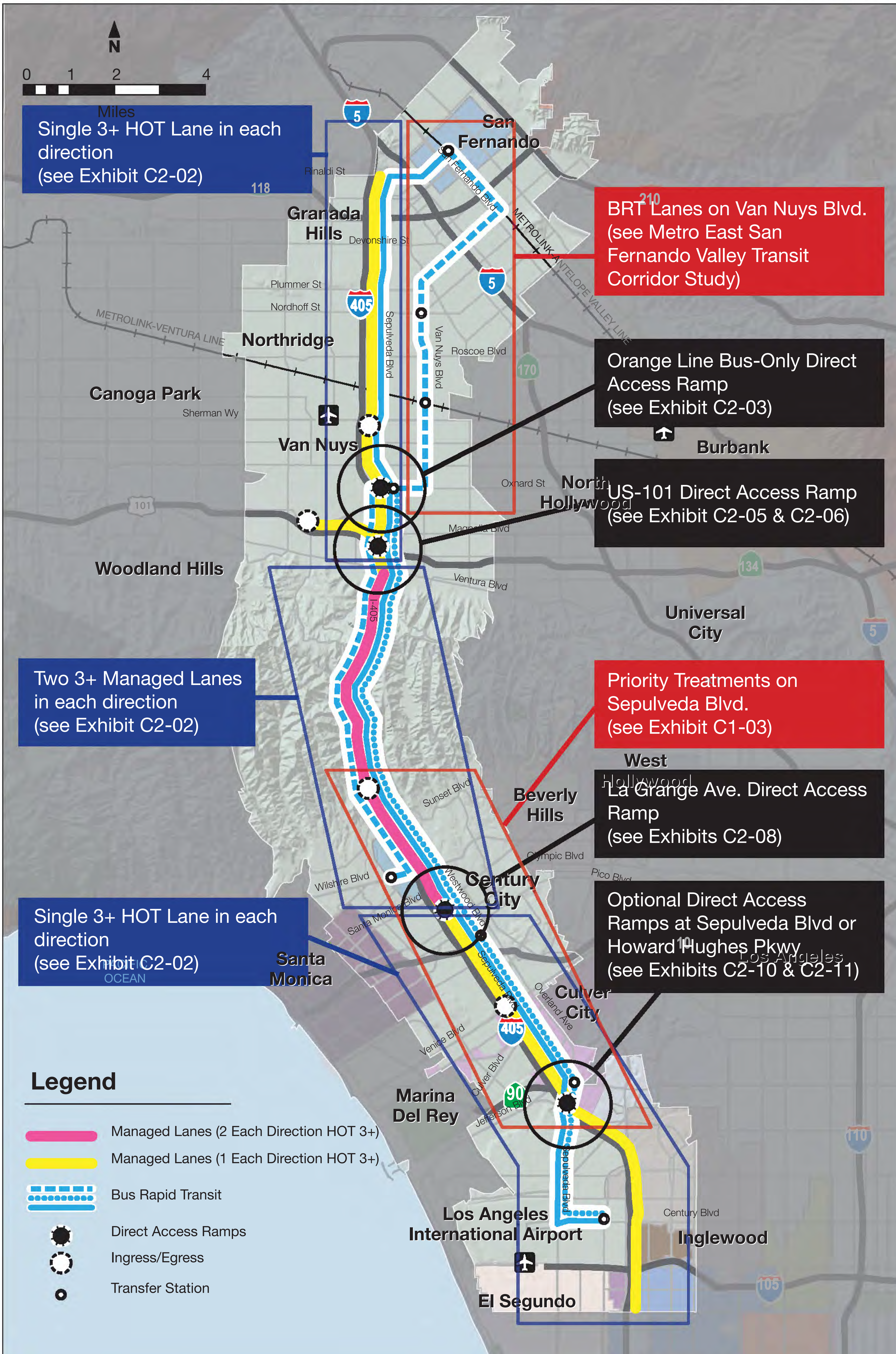
TYPICAL QUEUE JUMP LANE

DRAWING NO. C1-03

SHEET NO. 4

CONCEPT 2

At-Grade Freeway Managed Lanes



Drawing C2-01

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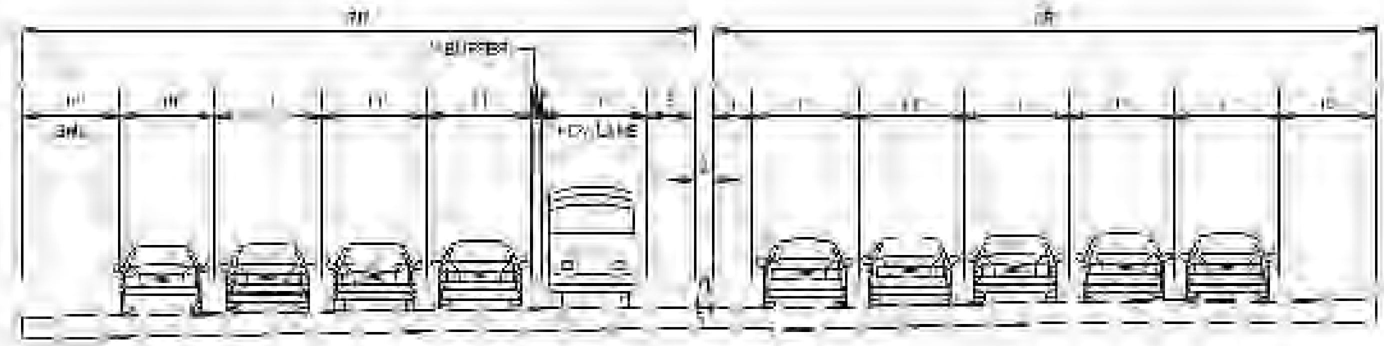
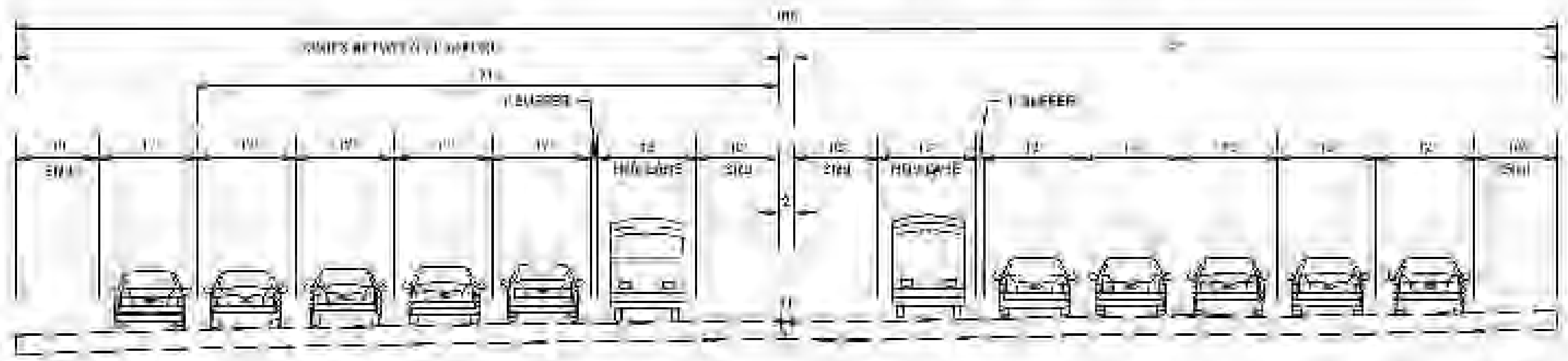
Sepulveda Pass Corridor Systems Planning Study



SOUTHBOUND "R405" LINE | NORTHBOUND "R405" LINE

I-405 BEFORE CURRENT WIDENING PROJECT

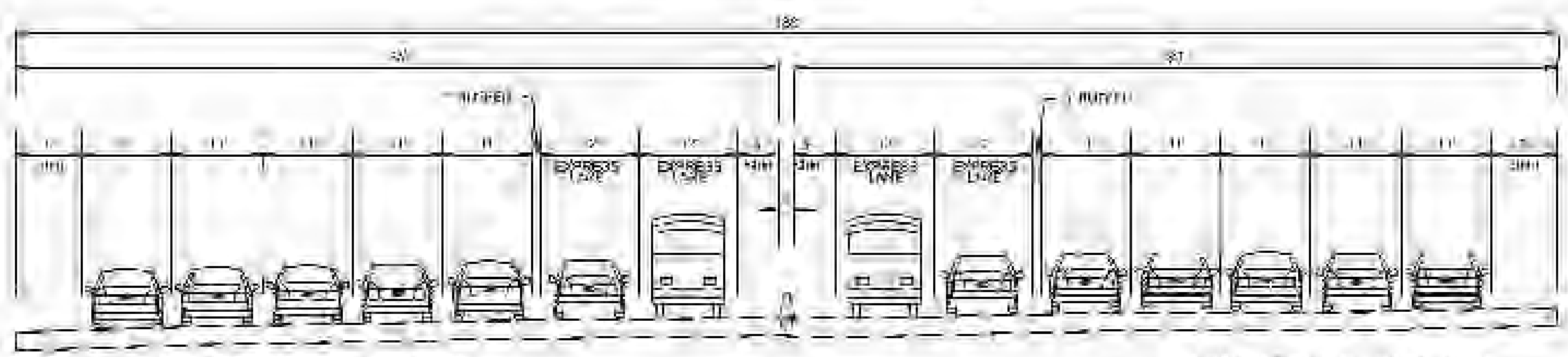
4 GENERAL PURPOSE + 1 HOV



SOUTHBOUND "R405" LINE | NORTHBOUND "R405" LINE

I-405 WITH CURRENT WIDENING PROJECT

5 GENERAL PURPOSE + 1 HOV



SOUTHBOUND "R405" LINE | NORTHBOUND "R405" LINE

POSSIBLE FUTURE I-405 WITH ADDITION OF MANAGED LANES

5 GENERAL PURPOSE + 2 HOV (MODIFIED)

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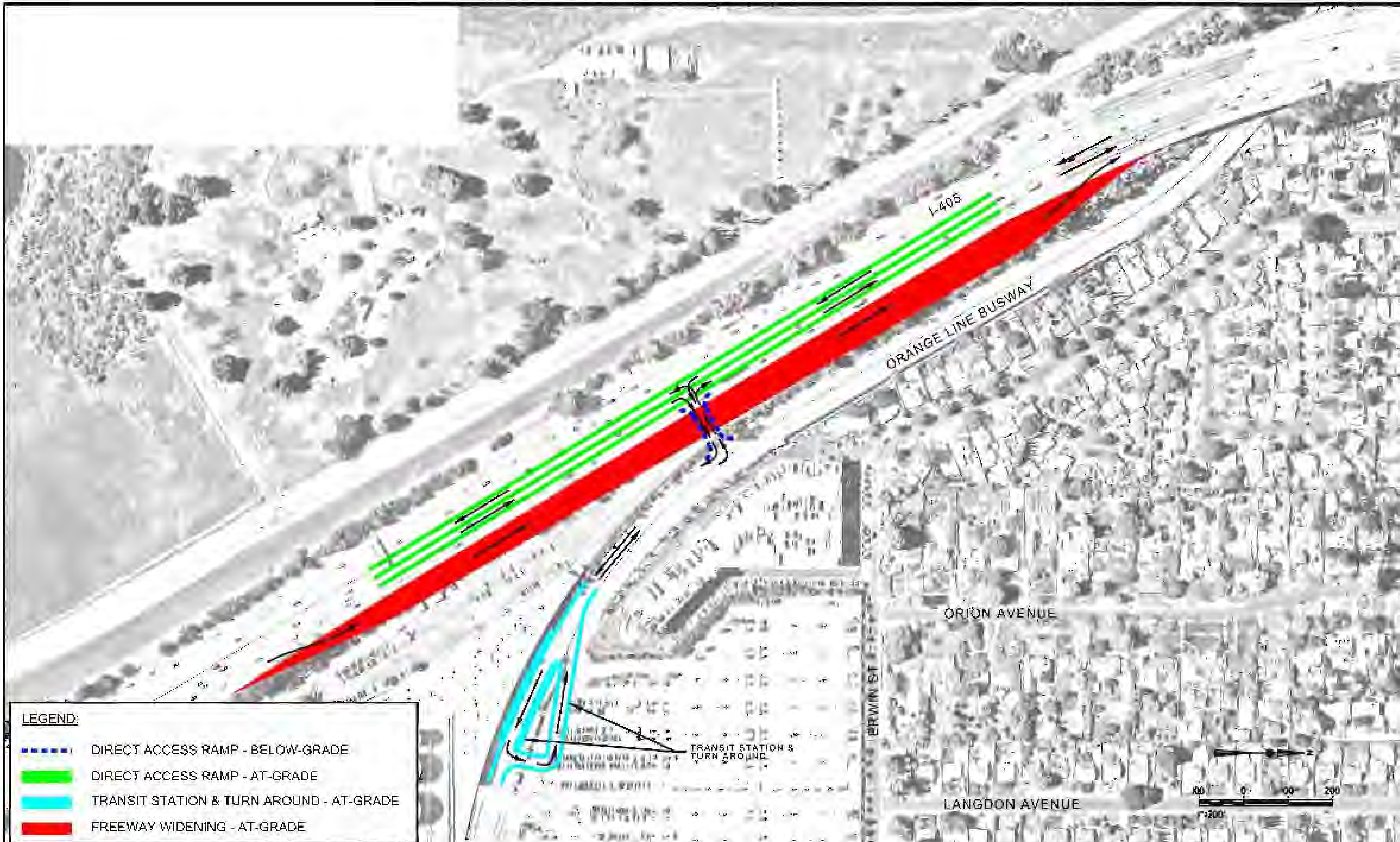
I-405 MANAGED LANES CROSS SECTIONS

DRAWING NO.: C2-03

SHEET NO.: 6



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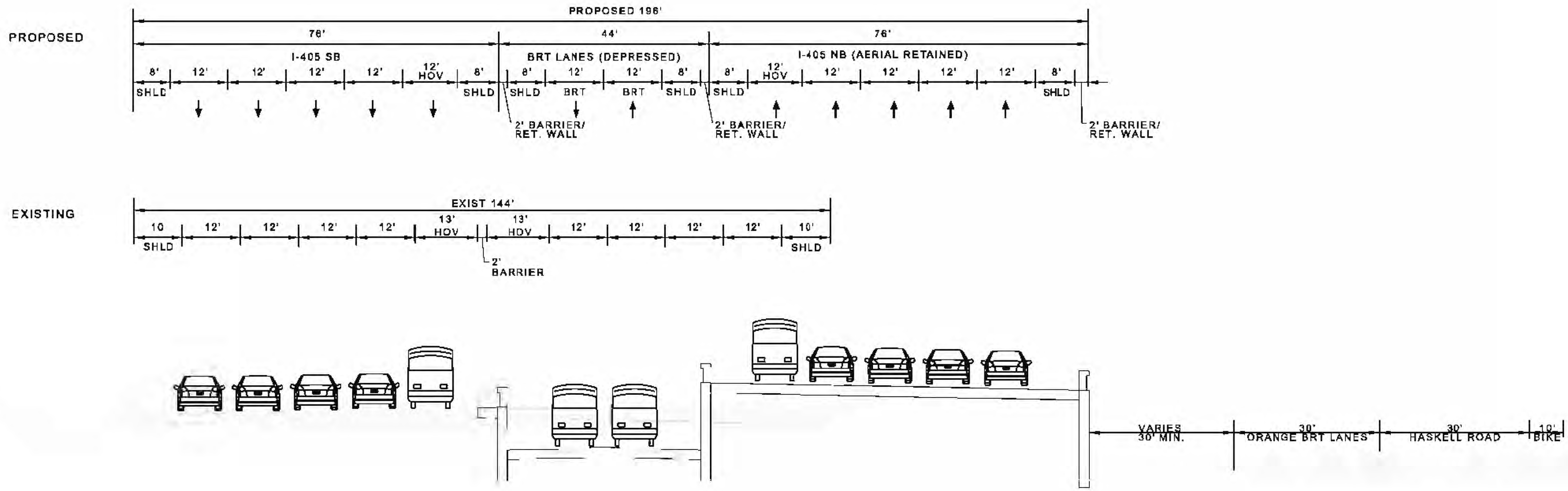
IBI GROUP

ORANGE LINE
DIRECT ACCESS RAMP
LAYOUT

DRAWING NO.
C2-03

SHEET NO.
7



PROPOSED CROSS SECTION
@ I-405 W/ BRT LANES NORTH OF DIRECT ACCESS RAMP ACCESS

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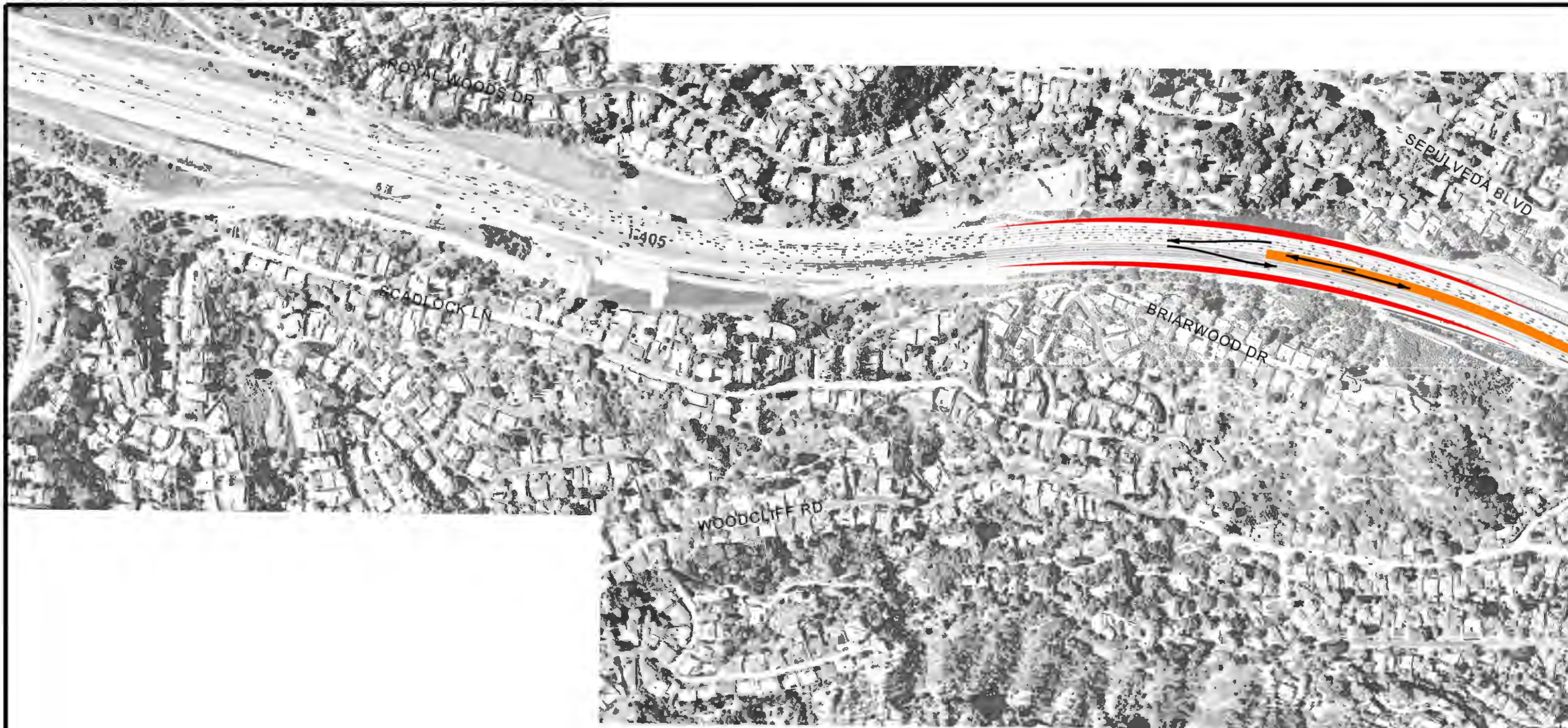
IBI GROUP

ORANGE LINE
DIRECT ACCESS RAMP
CROSS SECTION

DRAWING NO.
C2-04

SHEET NO.
8



LEGEND:

Orange	DIRECT ACCESS RAMP - AERIAL
Red	FREEWAY WIDENING - AT-GRADE

N

200 0 200 400

1"=400'

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US 101 DIRECT ACCESS RAMP

DRAWING NO.
C2-05

SHEET NO.
09

LEGEND:

DIRECT ACCESS RAMP - AERIAL

200 0 200 400
1"=400'

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US 101 DIRECT ACCESS RAMP

DRAWING NO.
C2-06

SHEET NO.
10

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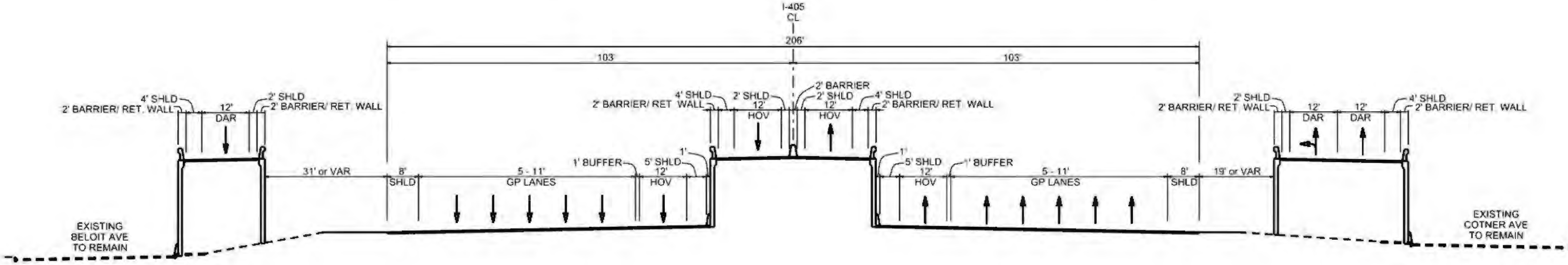
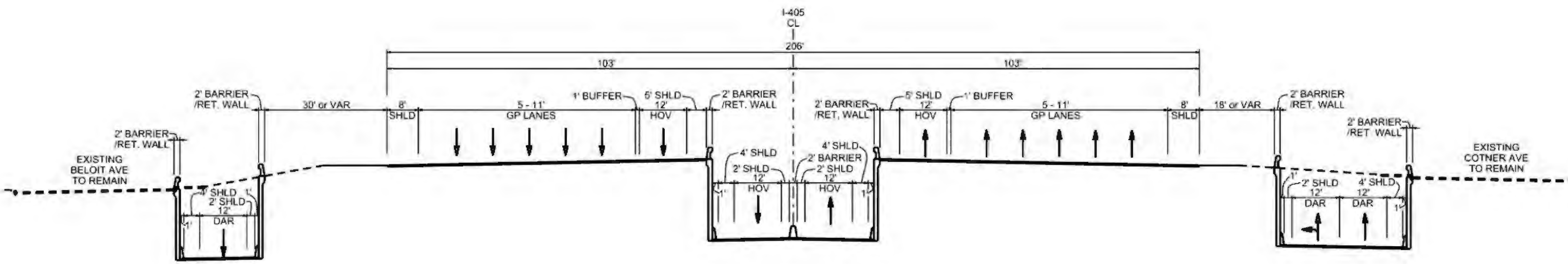
LA GRANGE DIRECT
ACCESS RAMPS

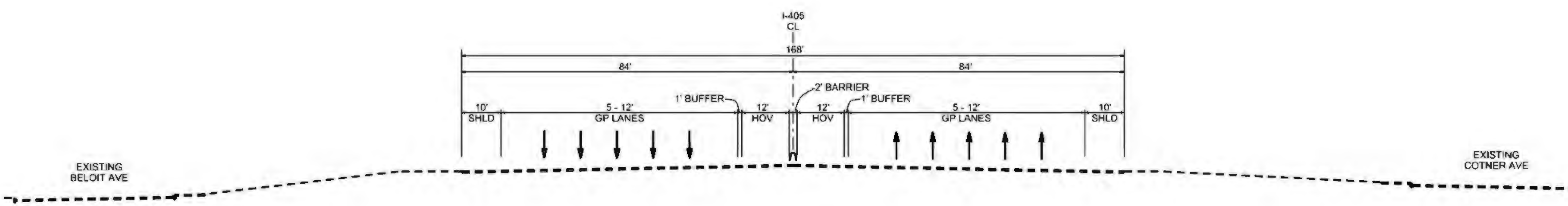
DRAWING NO.	C2-07
SHEET NO.	11



PROPOSED Aerial Option (C4-04)



PROPOSED Below-Grade Option (C2-07)



EXISTING

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SYSTEMS PLANNING STUDY

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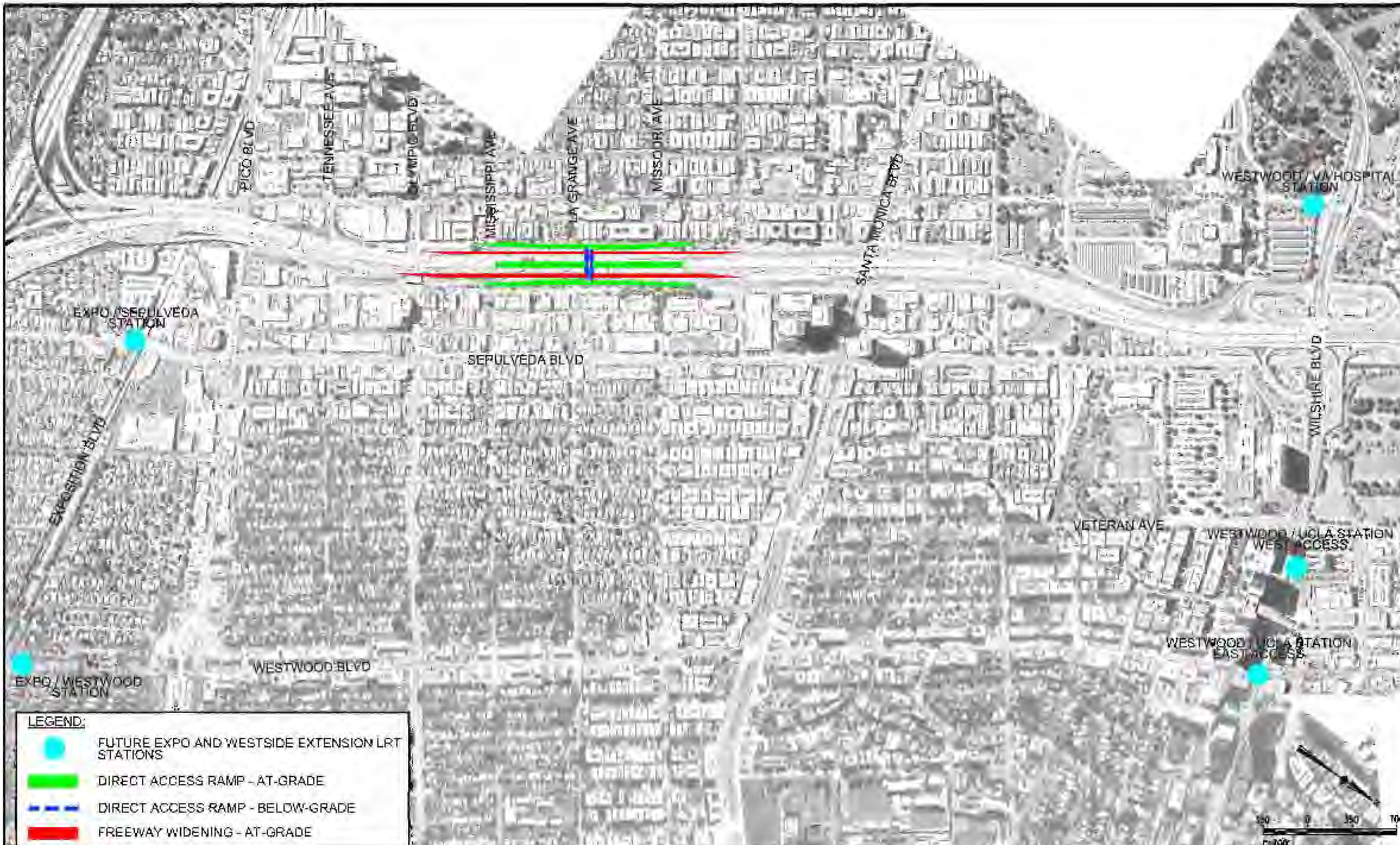
LA GRANGE DIRECT
ACCESS RAMP
CROSS SECTION

DRAWING NO.
C2-08

SHEET NO.
12



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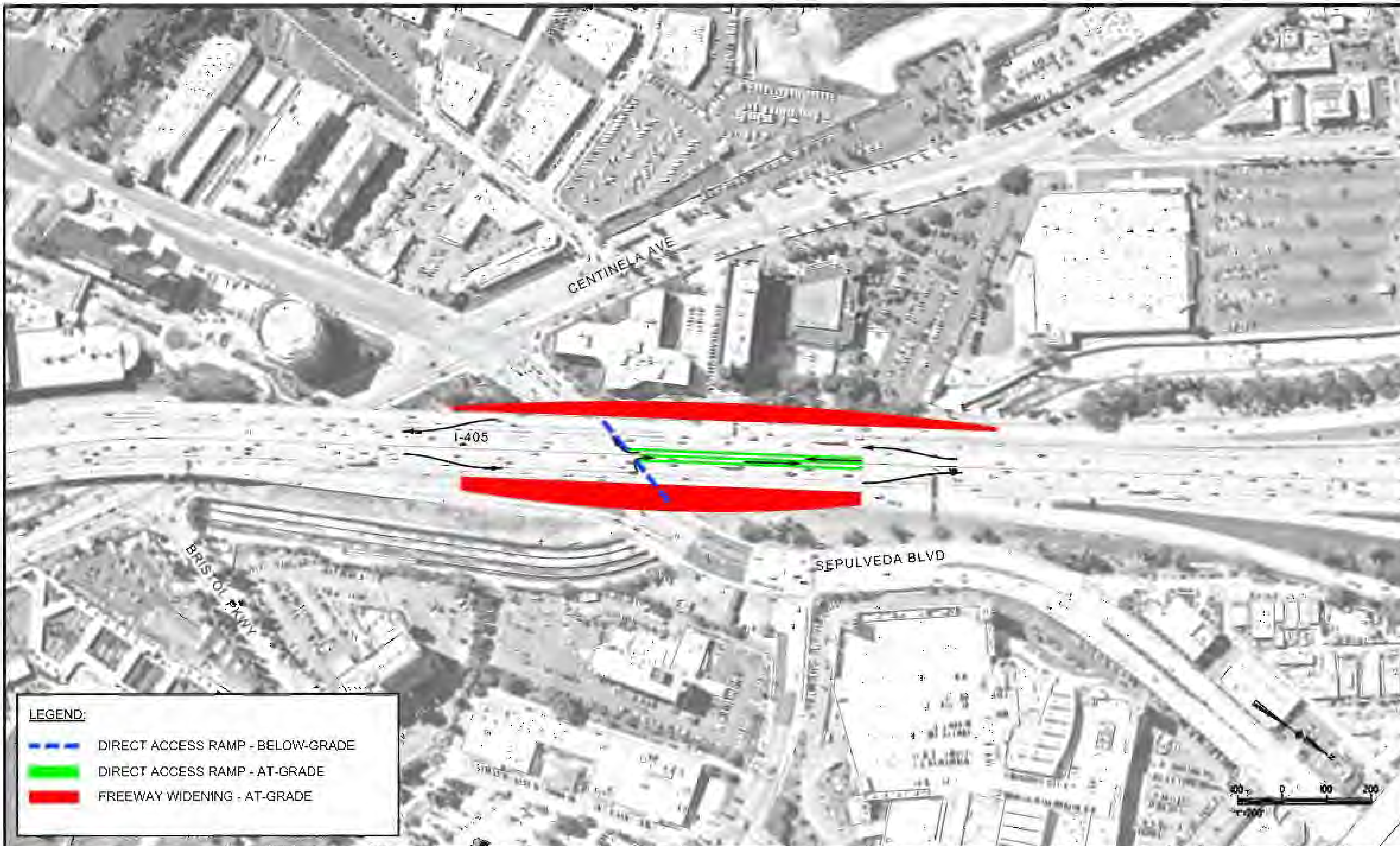
LA GRANGE / EXPO
PURPLE LINE OVERVIEW

DRAWING NO
C2-09

SHEET NO
13



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SYSTEMS PLANNING STUDY

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OPTIONAL DIRECT ACCESS RAMPS AT SEPULVEDA BLVD

DRAWING NO.	C2-10
SHEET NO.	14

LEGEND:

DIRECT ACCESS RAMP - AERIAL

Aerial Mapping Provided by:

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SYSTEMS PLANNING STUDY

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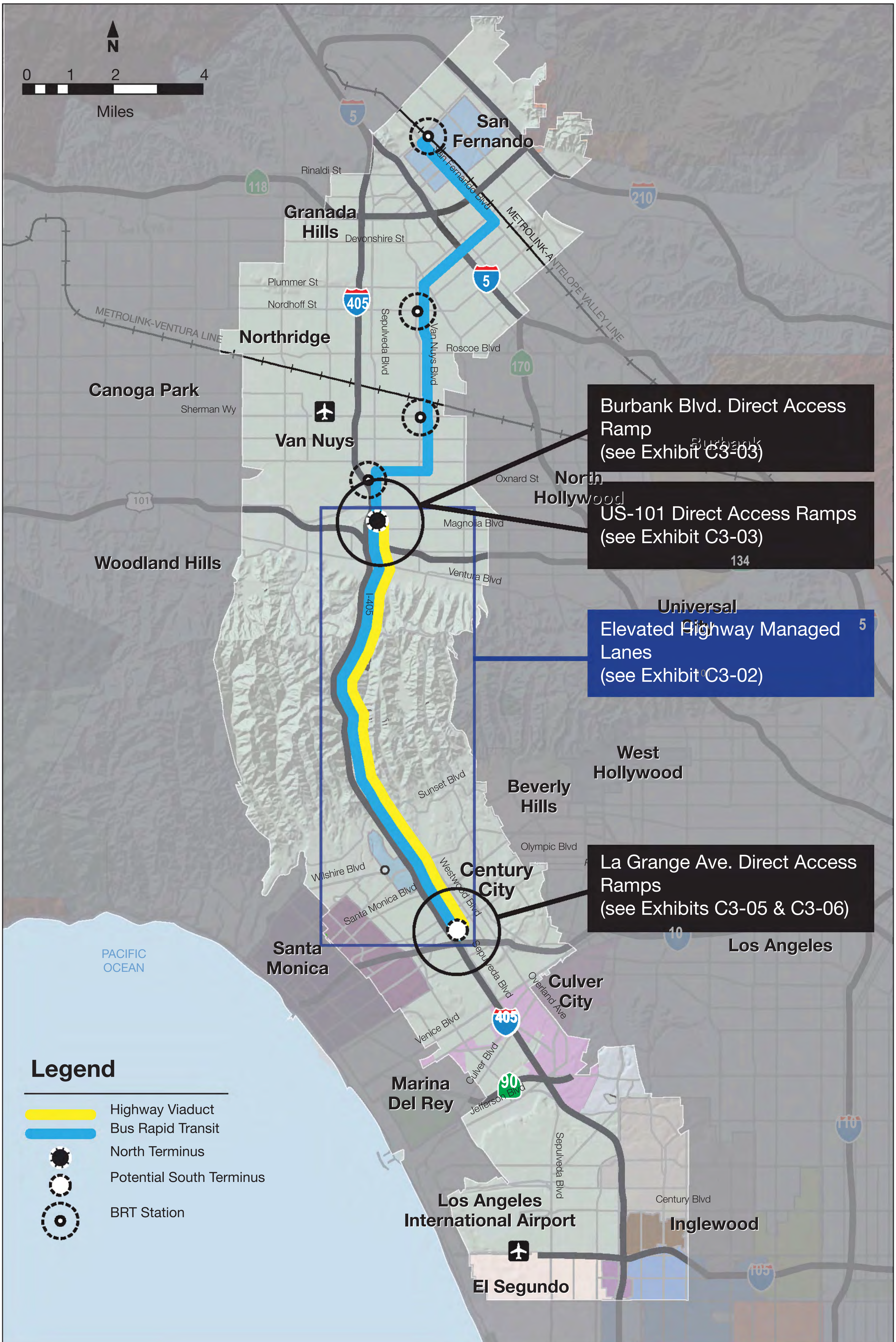
OPTIONAL DIRECT ACCESS
RAMPS AT HOWARD HUGHES

DRAWING NO
C2-11

SHEET NO
15

Highway Viaduct Managed Lanes

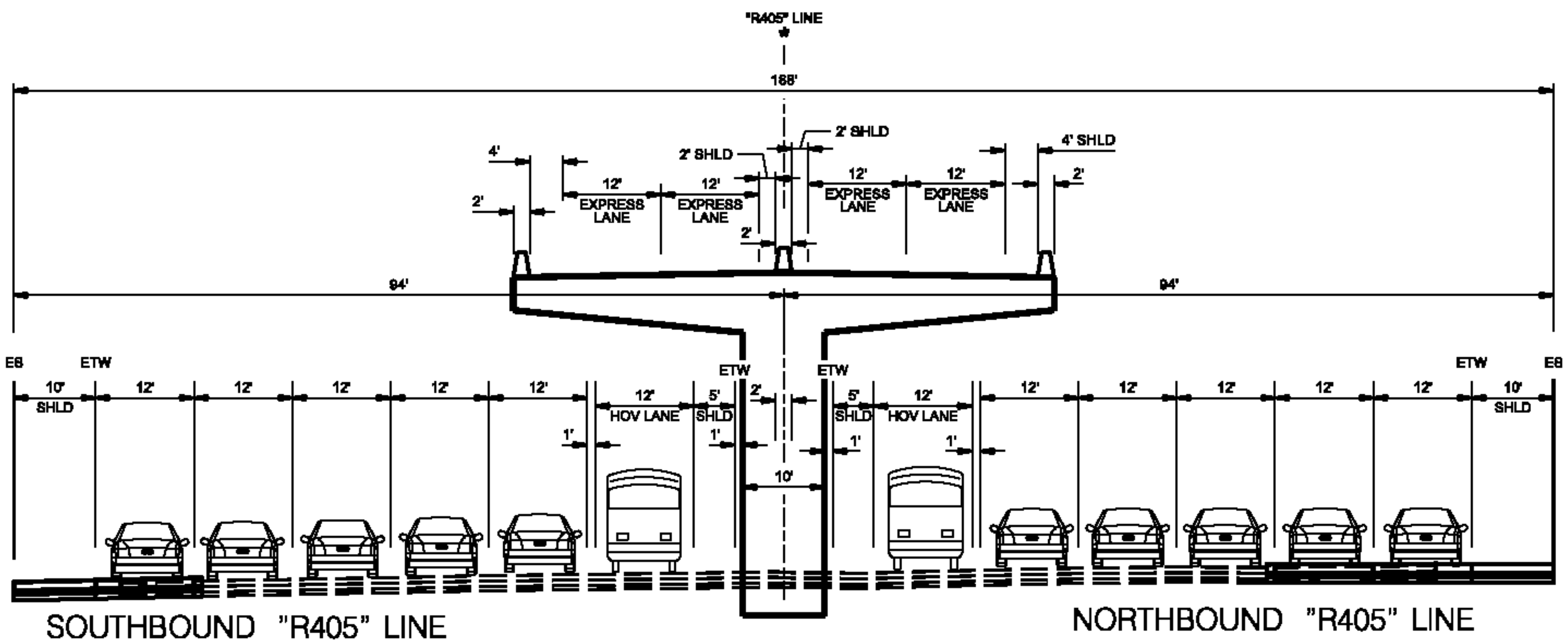
CONCEPT 3



Drawing C3-01

Metro

Sepulveda Pass Corridor Systems Planning Study



CONCEPT 3 – HIGHWAY VIADUCT

5GP + 1HOV (SURFACE) + 2HOV (ELEVATED)

N.T.S.

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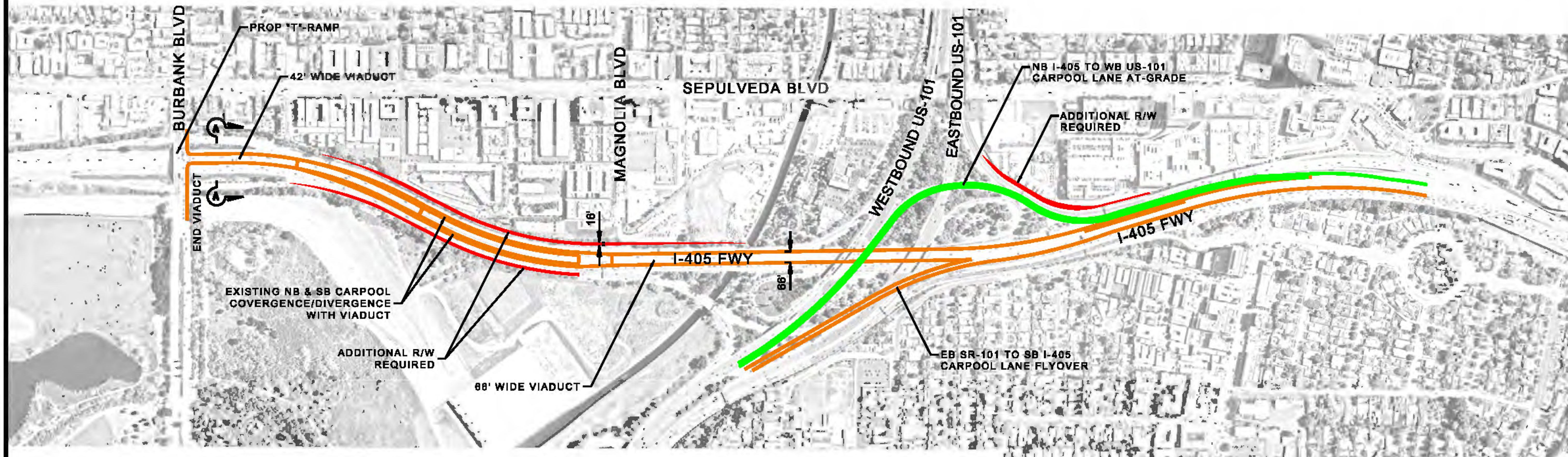
LOS ANGELES, CA 90013
213.972.9700

HIGHWAY VIADUCT MANAGED LANES CROSS SECTION

DRAWING NO. C3-02

SHEET NO. 17



LEGEND:

- DIRECT ACCESS RAMP - AERIAL
- FREEWAY WIDENING - AT-GRADE
- CARPOOL LANE - AT-GRADE

150 0 150 300

1"=300'

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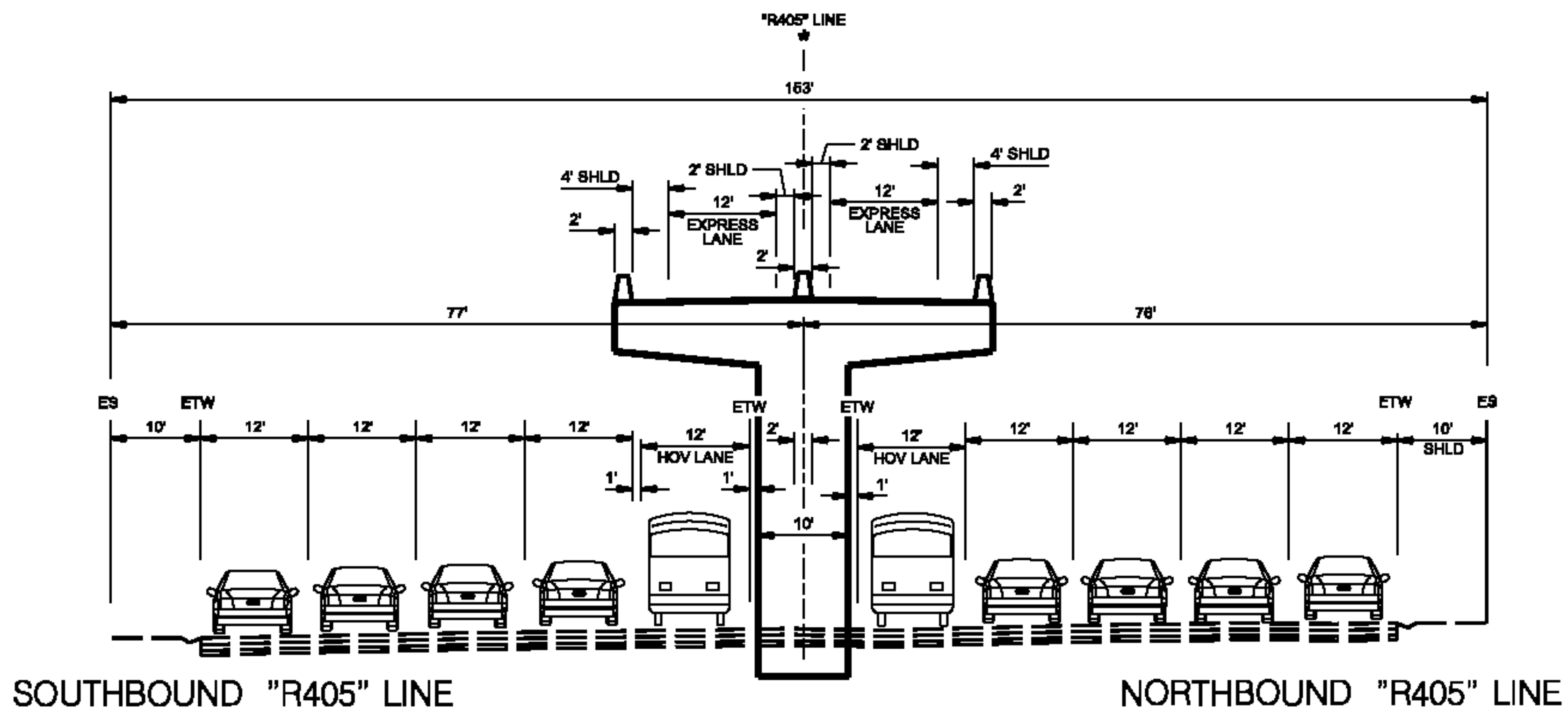
HIGHWAY VIADUCT MANAGED LANES
BURBANK BLVD "T-RAMP"

DRAWING NO.
C3-03

SHEET NO.
18



CONCEPT 3 – HIGHWAY VIADUCT

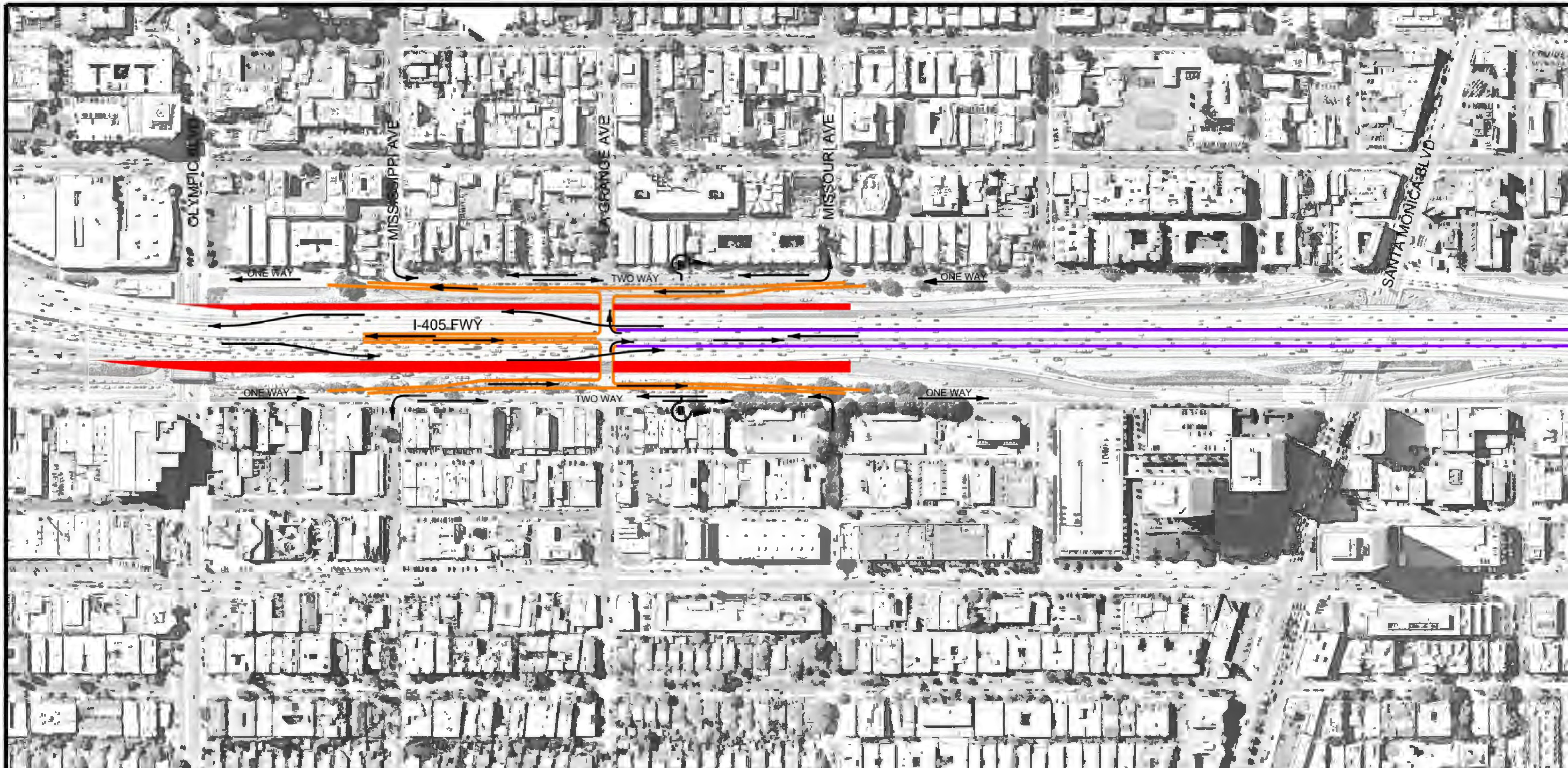
5GP + 1HOV (SURFACE) + 1HOV (ELEVATED)

N.T.S.

Aerial Mapping Provided by: AeroTech Mapping, Inc. 2580 Montessouri, Suite 104 Las Vegas, NV 89117 Phone: 702-228-6277	Metro	SEPULVEDA PASS CORRIDOR SYSTEMS PLANNING STUDY	HNTB 601 W. Fifth Street Suite 1000 Los Angeles, CA 90071	V&A INC. 530 S. HEWITT ST. SUITE 121 LOS ANGELES, CA 90013 213.972.9700	HIGHWAY VIADUCT MANAGED LANES SECTION A-A

DRAWING NO. C3-04

SHEET NO. 19



LEGEND:

- DIRECT ACCESS RAMP - AERIAL
- FREEWAY WIDENING - AT-GRADE
- AERIAL VIADUCT

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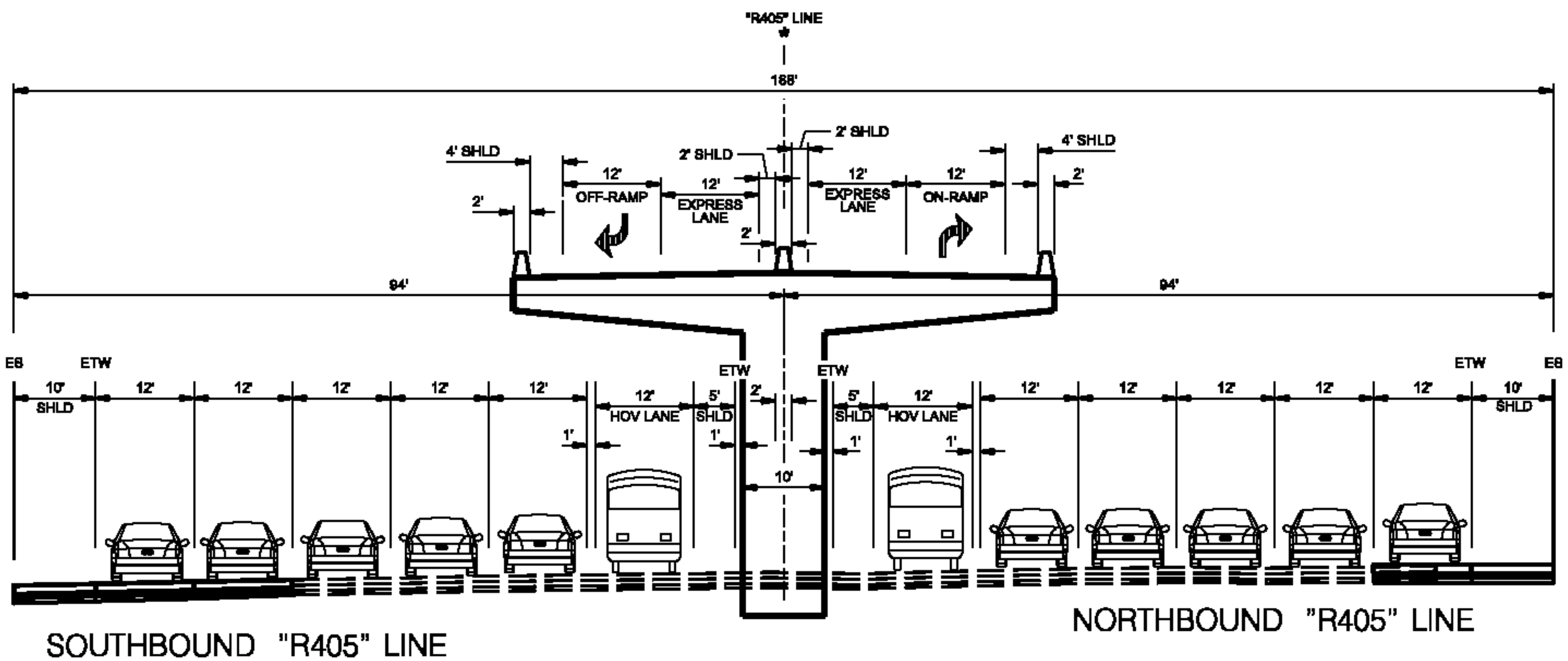
HIGHWAY VIADUCT MANAGED LANES
LA GRANGE DIRECT
ACCESS RAMPS

DRAWING NO. C3-05

SHEET NO. 20



CONCEPT 3 – HIGHWAY VIADUCT

5GP + 1HOV (SURFACE) + 2HOV (ELEVATED)

N.T.S.

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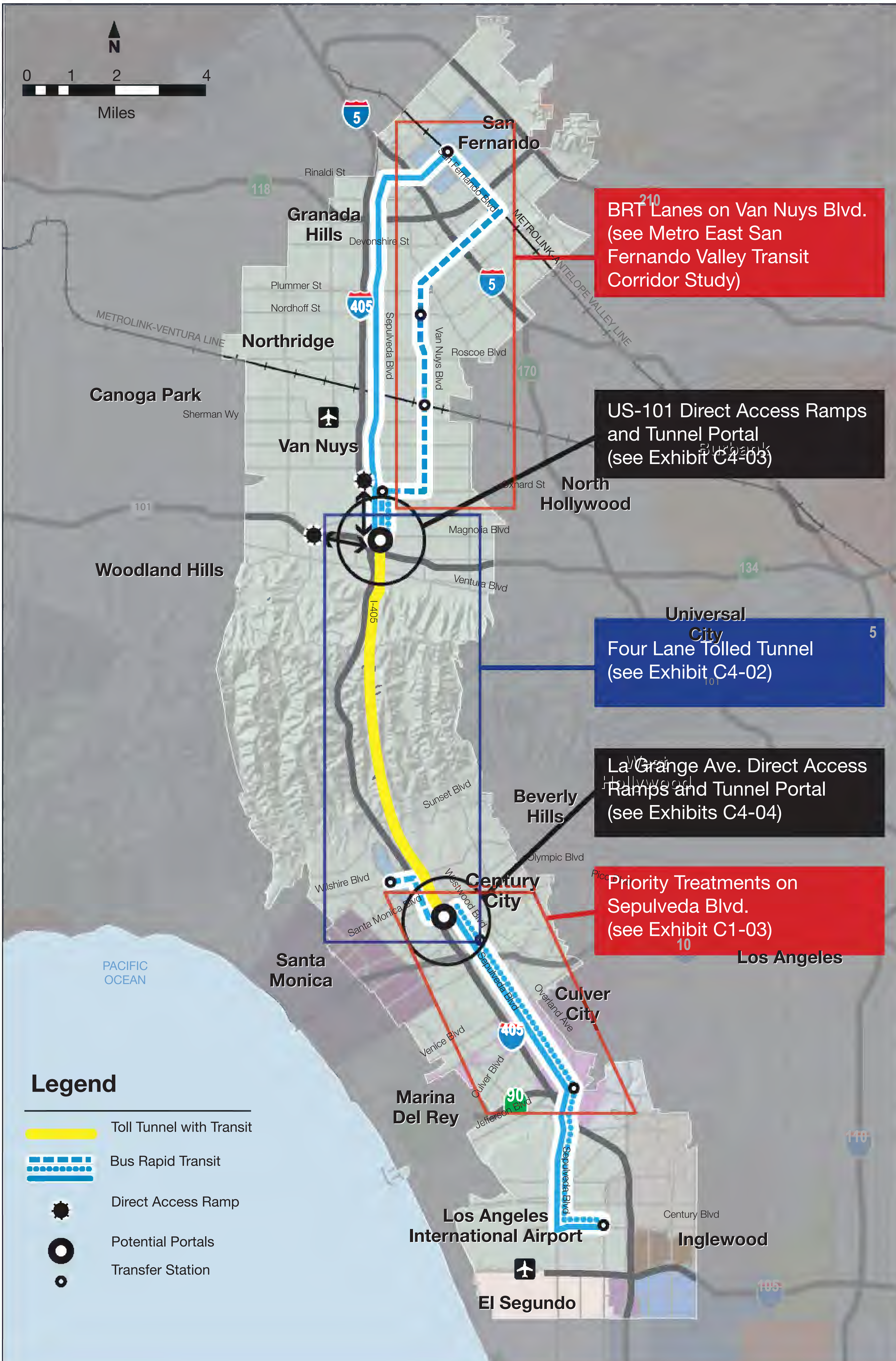
HIGHWAY VIADUCT MANAGED LANES
SECTION B-B

DRAWING NO.	C3-06
SHEET NO.	21

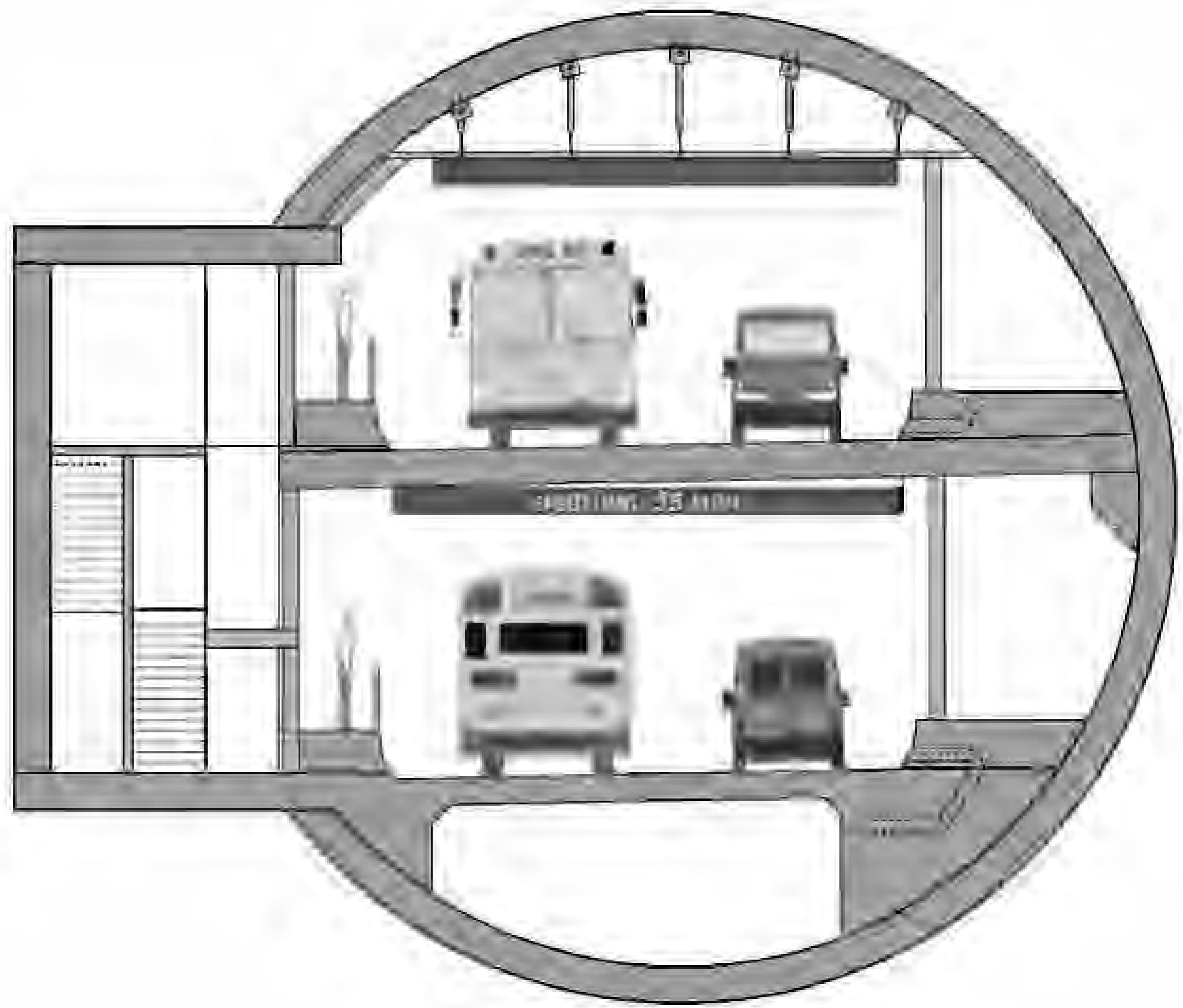
CONCEPT 4 Tolled Highway Tunnel



Drawing C4-01

Metro

Sepulveda Pass Corridor Systems Planning Study



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SEPULVEDA PASS CORRIDOR
SYSTEMS PLANNING STUDY

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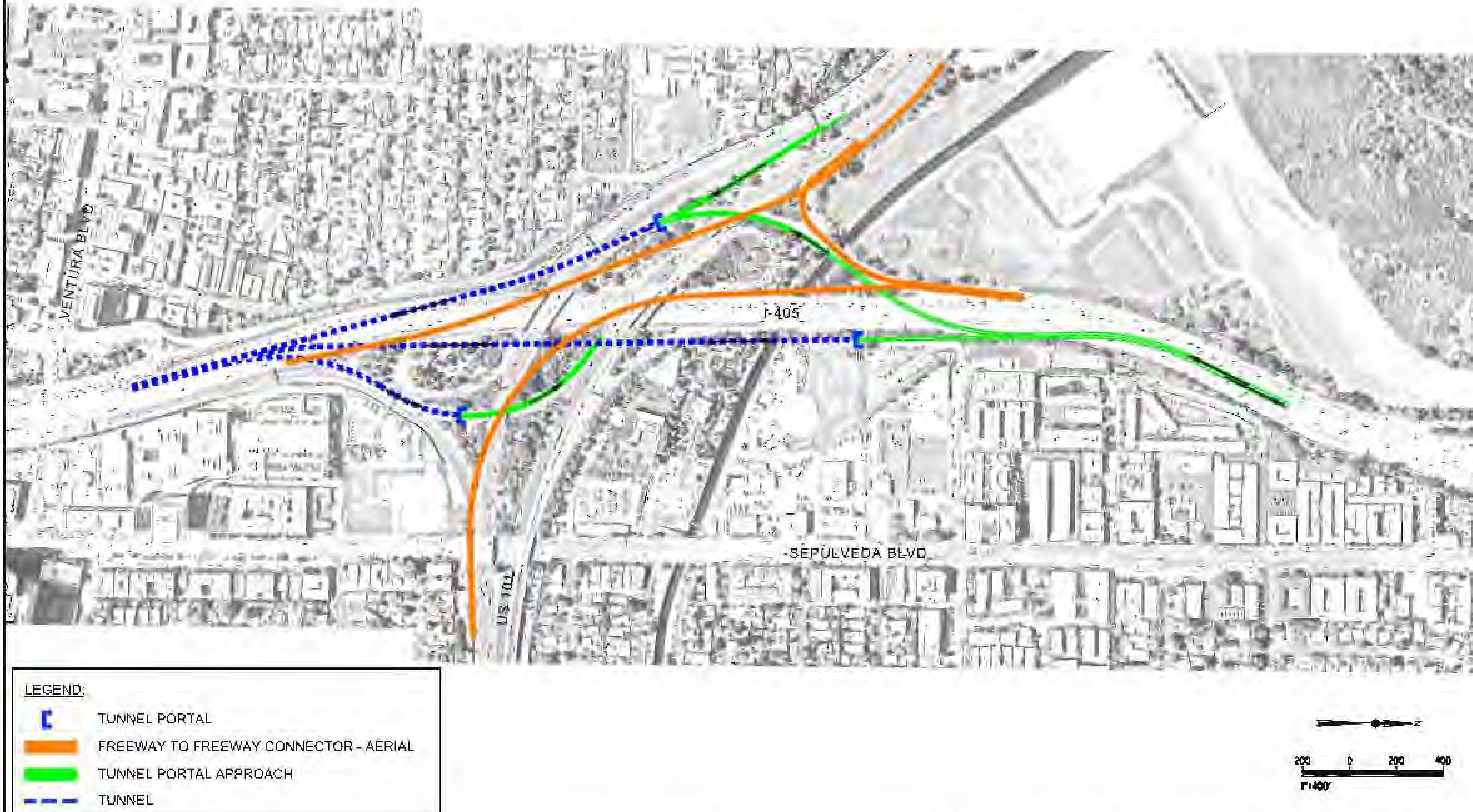
58 FOOT SINGLE BORE
TUNNEL SECTION
(STACKED ROADWAY)

DRAWING NO.
C4-02

SHEET NO.
23



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SEPULVEDA PASS CORRIDOR
SYSTEMS PLANNING STUDY

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US 101 DIRECT ACCESS RAMPS
AND TUNNEL PORTAL

DRAWING NO.
C4-03

SHEET NO.
24

Metro

SEPULVEDA PASS CORRIDOR
SYSTEMS PLANNING STUDY

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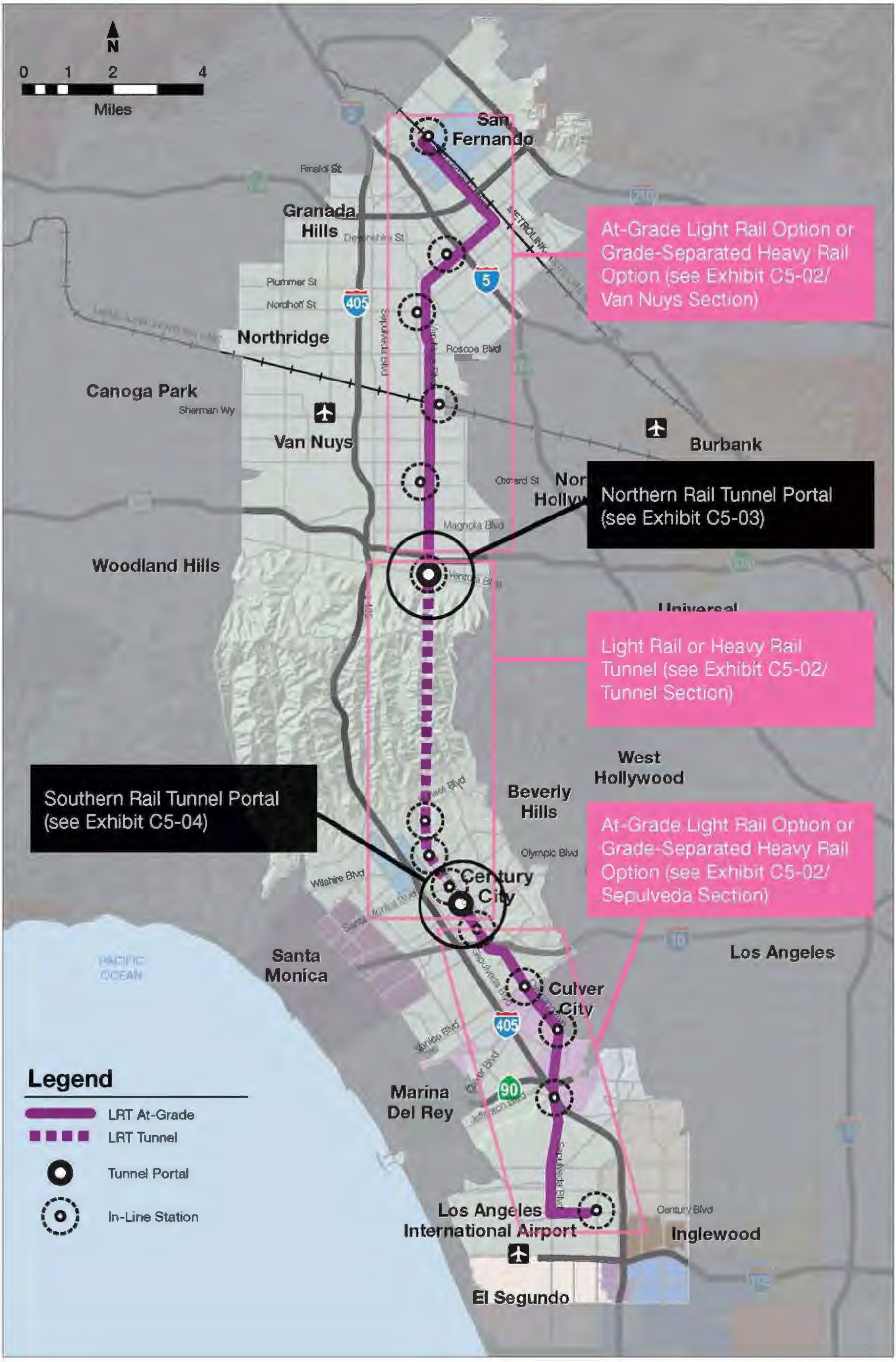
LA GRANGE
DIRECT ACCESS RAMPS

DRAWING NO. C4-04

SHEET NO. 25

CONCEPT 5

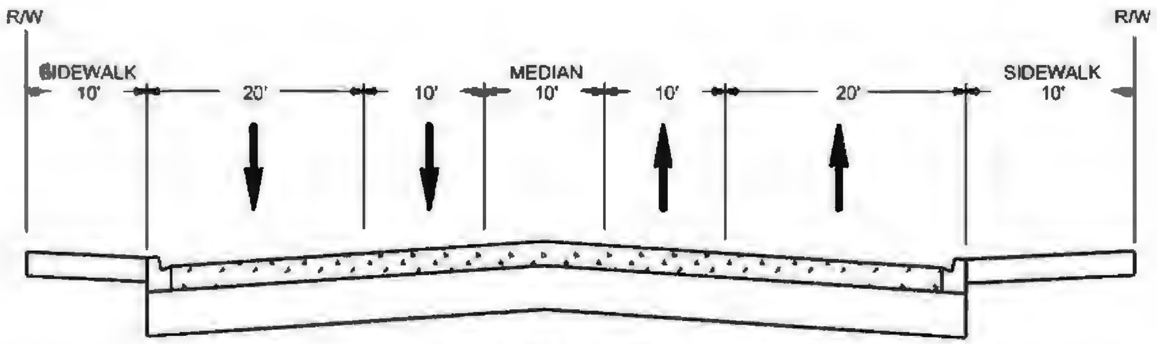
Fixed-Guideway LRT or HRT Tunnel



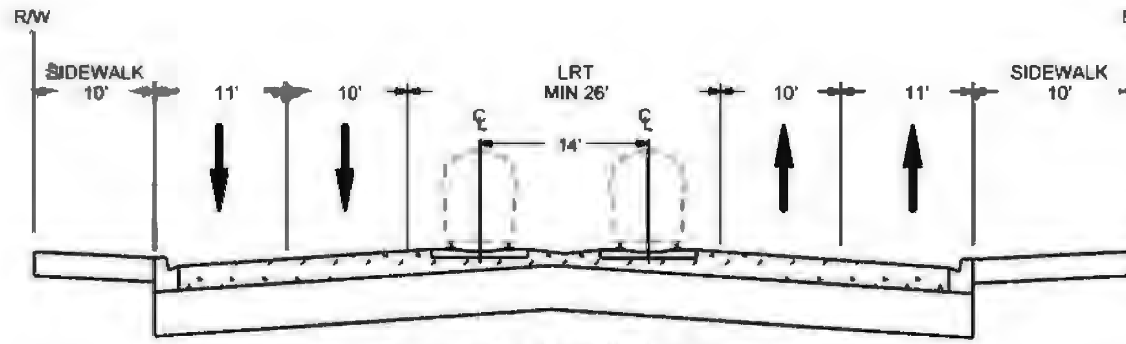
Drawing C5-01

Metro

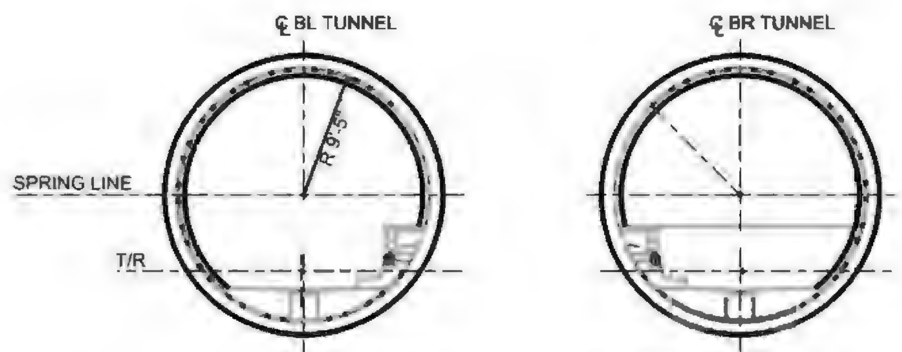
Sepulveda Pass Corridor Systems Planning Study



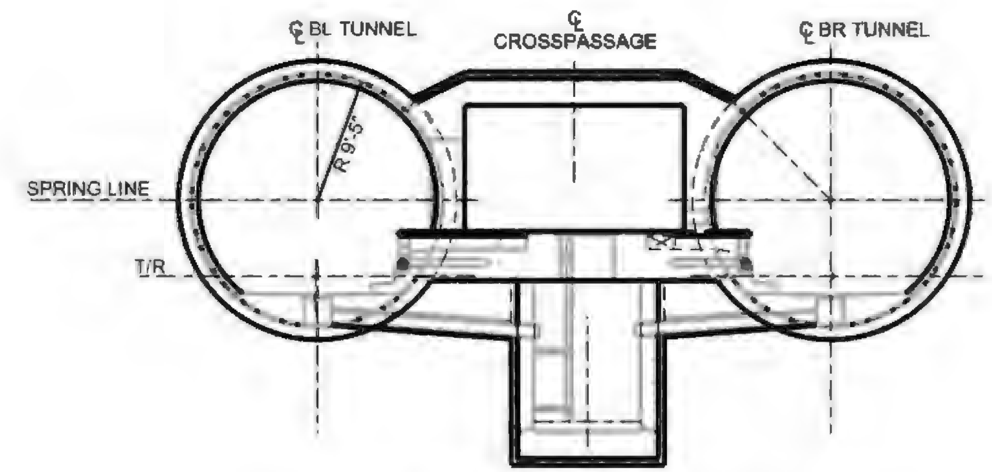
EXISTING VAN NUYS BLVD



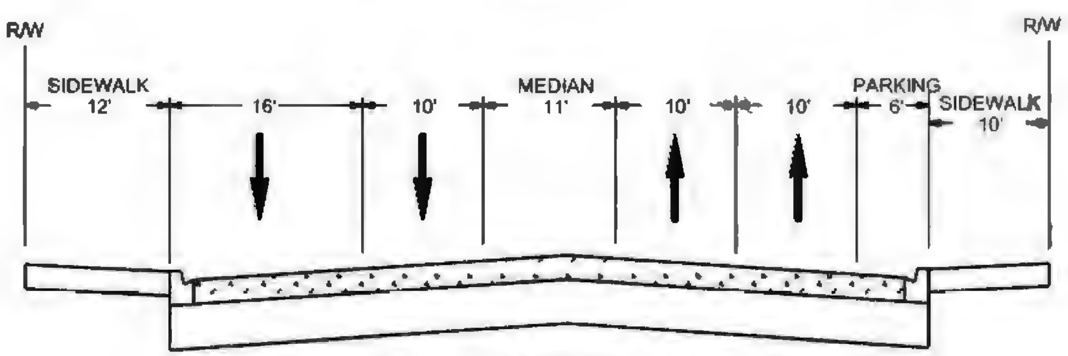
PROPOSED VAN NUYS BLVD



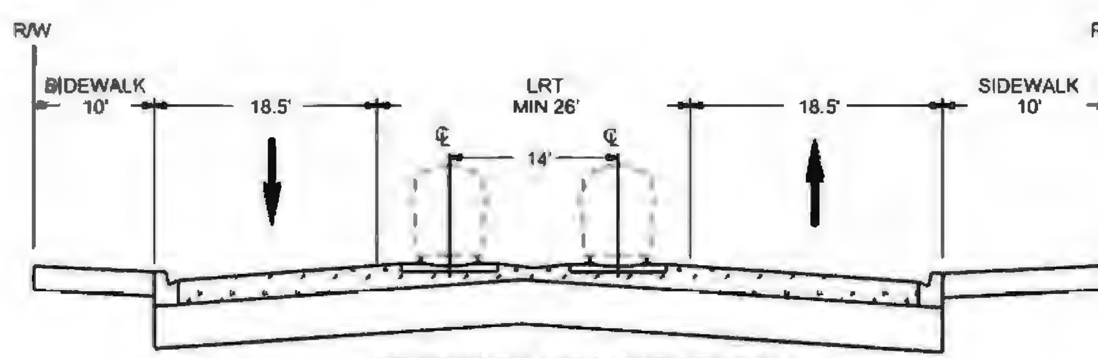
TYPICAL TUNNEL SECTION



TYPICAL CROSS-PASSAGE WITH SUMP SECTION



EXISTING WESTWOOD BLVD



PROPOSED WESTWOOD BLVD

NOTE:
1. TYPICAL SECTIONS NOT TO SCALE.

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AeroTech Mapping, Inc.
2580 Montessouri, Suite 104
Las Vegas, NV 89117
Phone 702-228-6277

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444 S. Flower Street
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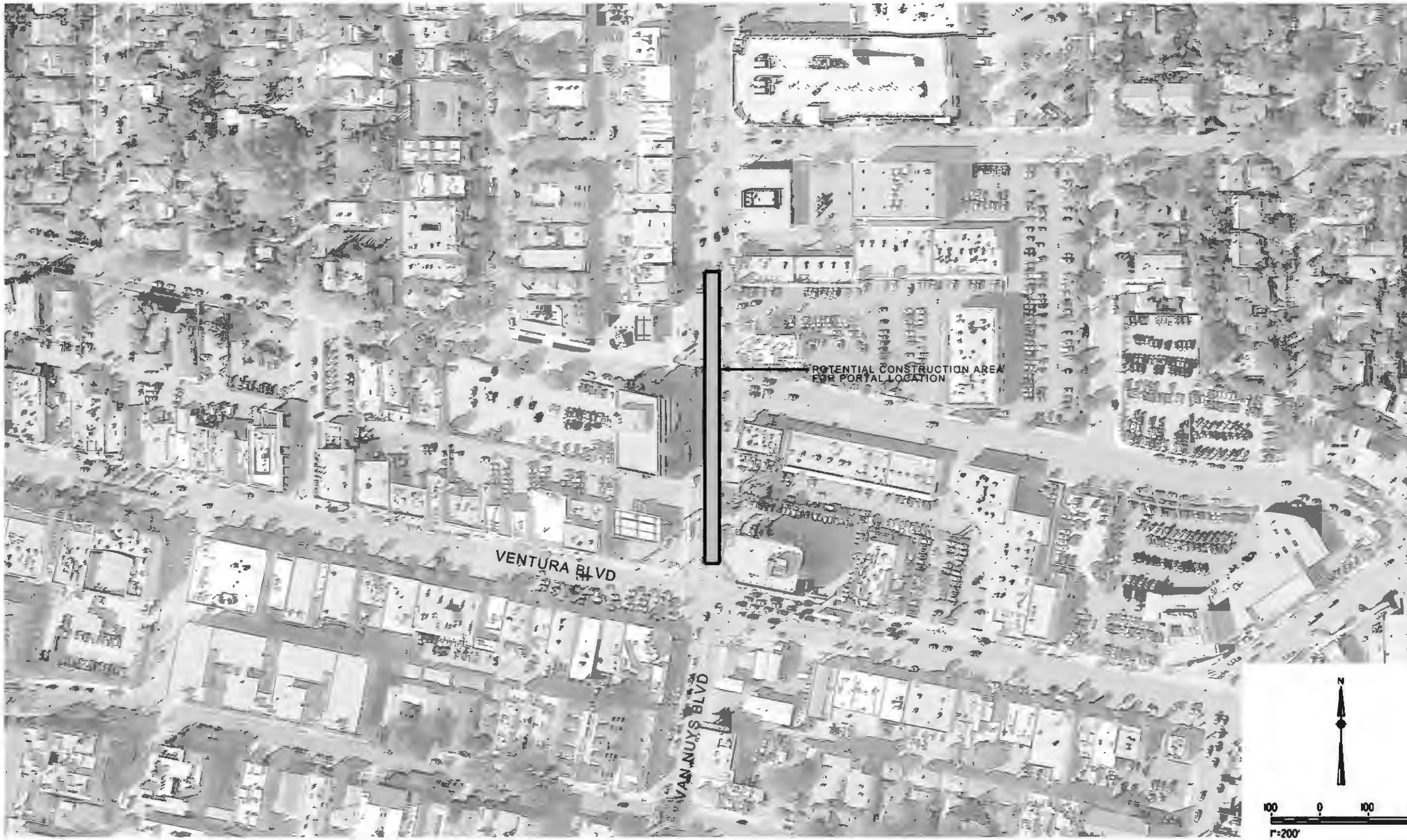
Los Angeles, CA 90071

VAN NUYS CROSS SECTION
TUNNEL CROSS SECTION
WESTWOOD BLVD CROSS SECTION

DRAWING NO. C5-02

SHEET NO. 27



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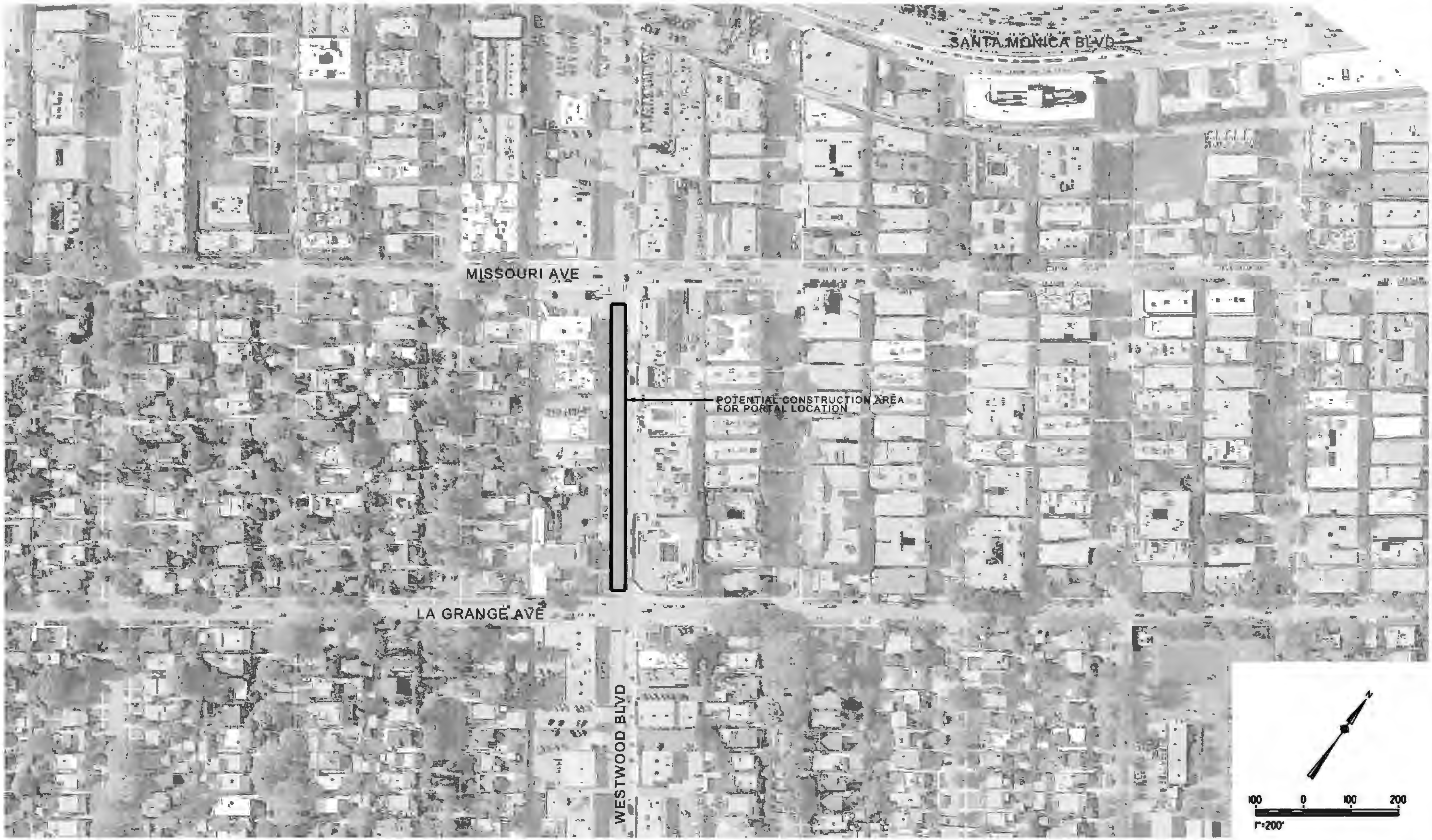
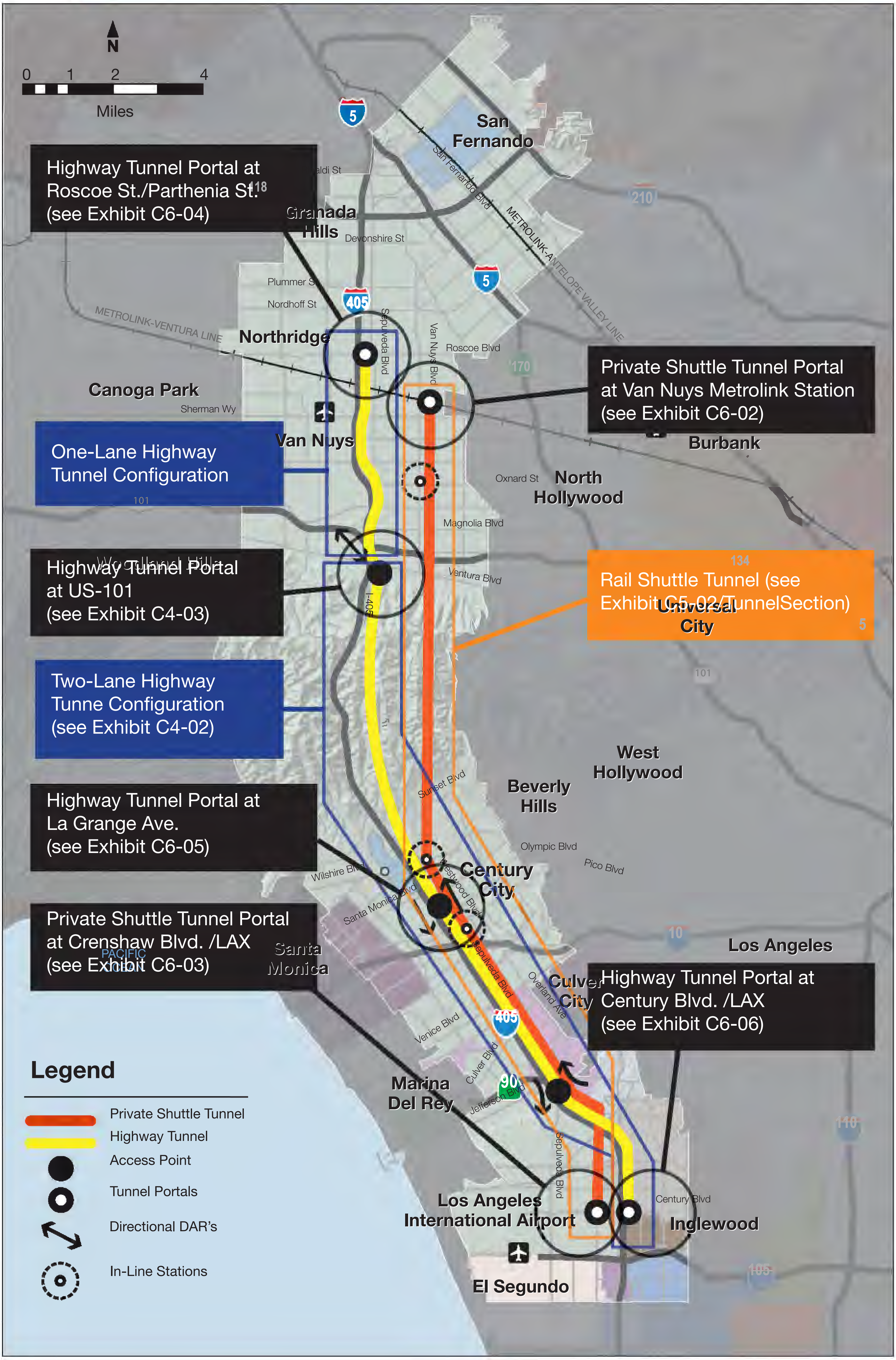
VENTURA PORTAL

DRAWING NO. C5-03



Aerial Mapping Provided by. AeroTech Mapping, Inc. Las Vegas, NV 89117 Phone 702-228-6277	Metro — SEPULVEDA PASS CORRIDOR SYSTEMS PLANNING STUDY	HNTB 601 W. Fifth Street Suite 1000 Los Angeles, CA 90071	PARSONS BRINCKERHOFF 444 S. Flower Street Suite 800 Los Angeles, CA 90071	SOUTH PORTAL	DRAWING NO. C5-04 SHEET NO. 29

CONCEPT 6 Toll Tunnel and Rail Tunnel



Drawing C6-01

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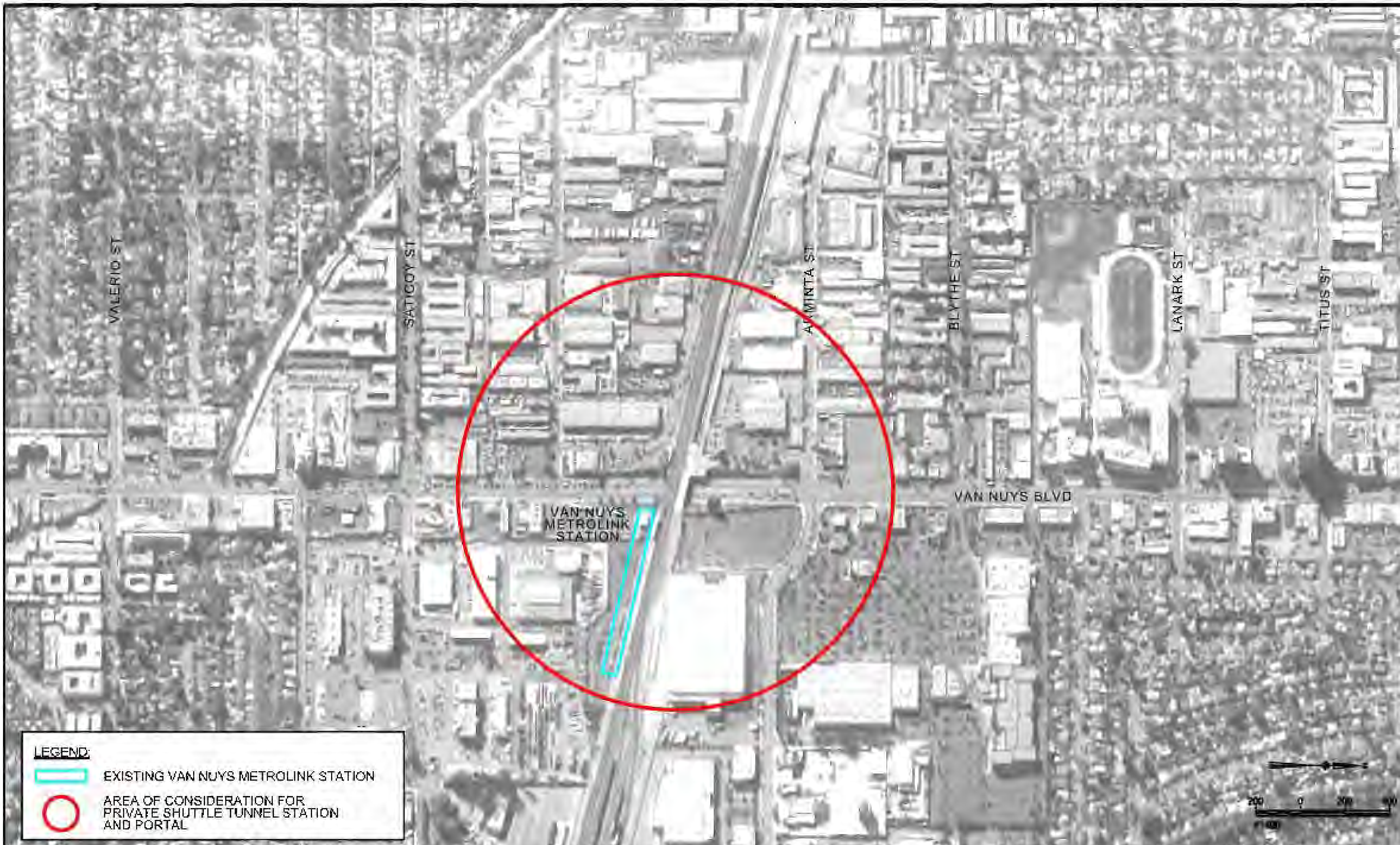
Sepulveda Pass Corridor Systems Planning Study



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PRIVATE SHUTTLE
TUNNEL PORTAL
VAN NUYS METROLINK STATION

DRAWING NO.
C6-02

SHEET NO.
31

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PRIVATE SHUTTLE
TUNNEL PORTAL
CRENSHAW BLVD / LAX

DRAWING NO.
C6-03

SHEET NO.
32

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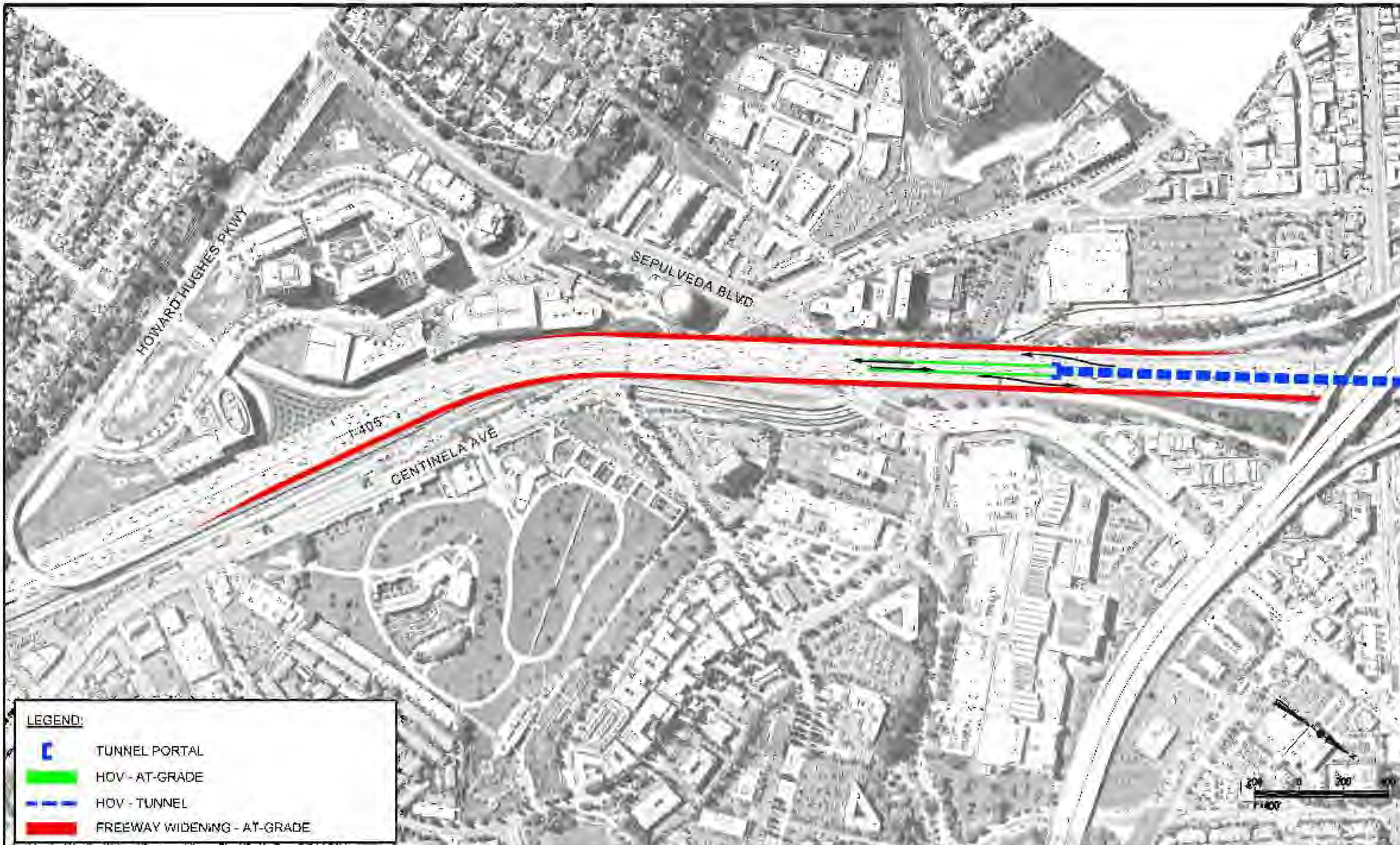
HIGHWAY TUNNEL PORTAL
AT ROSCOE / PARTHENIA

DRAWING NO.
C6-04

SHEET NO.
33



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SYSTEMS PLANNING STUDY

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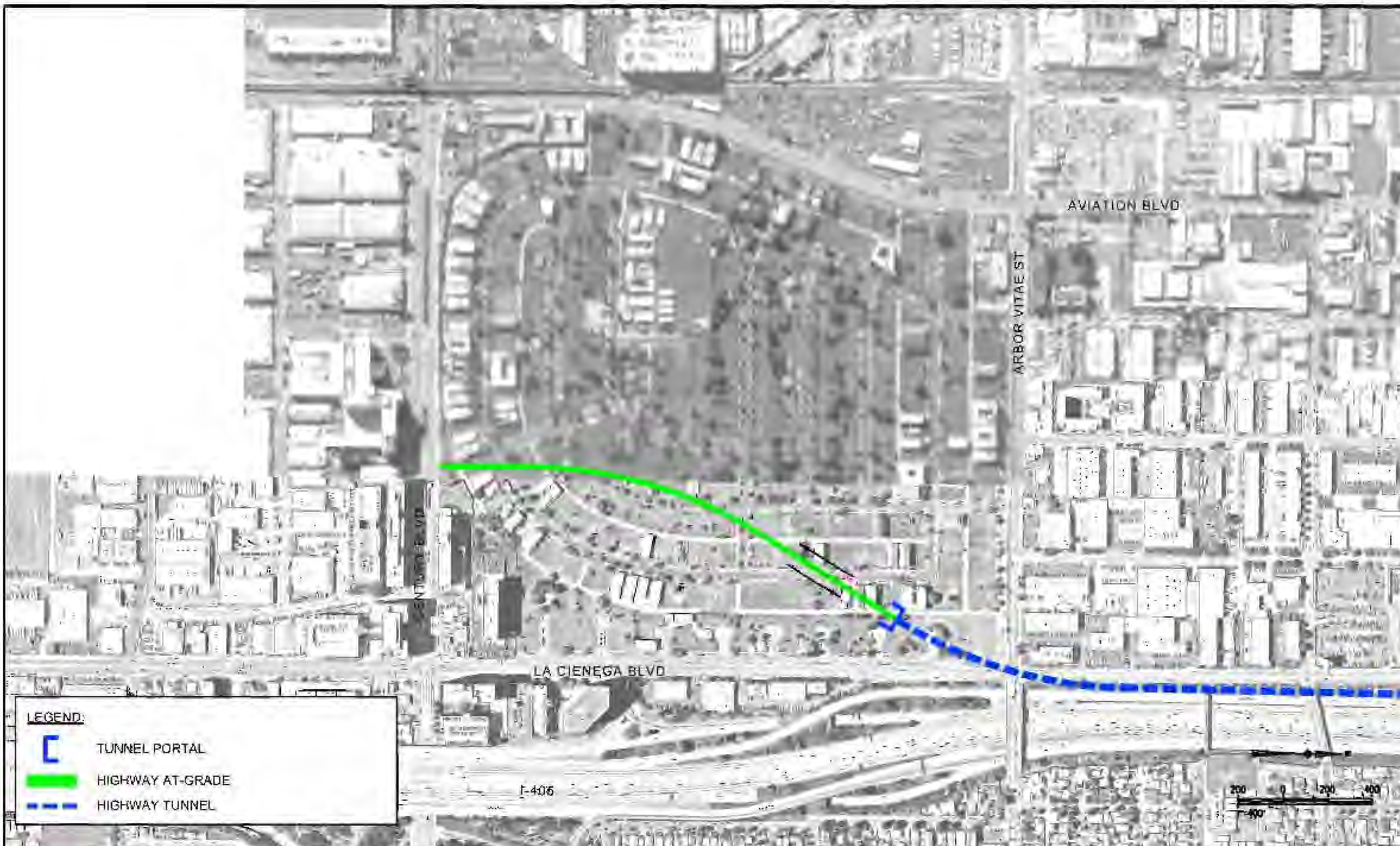
HIGHWAY TUNNEL PORTAL
AT SEPULVEDA BLVD

DRAWING NO
C6-05

SHEET NO
34



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HIGHWAY TUNNEL PORTAL
CENTURY BLVD / LAX

DRAWING NO.
C6-06

SHEET NO.
35

Appendix 2: Higher Speed Buses

Metro Interoffice Memo

Date	November 7, 2012
To	Roger Martin, David Mieger
From	Steve Brye
Subject	Higher Power Bus for the Sepulveda Pass

Many Metro buses currently in revenue service are not able to maintain adequate revenue service speed over the soon to open High Occupancy Vehicle (HOV) lanes over the Sepulveda Pass. These existing buses could also not maintain adequate revenue service speed over the Sepulveda Pass if the HOV lanes were at some point converted to Express Lanes. Therefore any Metro bus service operated in these lanes, now or in the future, requires exploration of higher power buses that would be able to sustain higher speeds through this corridor.

Metro can explore options for higher horsepower configurations for existing transit vehicles that Metro could use over the Sepulveda Pass or in other HOV/Express Lane locations.

Ideally these higher power buses should be able sustain highway speeds (50 mph+) even at 2 to 5 percent grades.

Metro staff is aware of alternate propulsion system configurations that may be better suited to operating on grades than those currently used in Metro's bus fleet. The current predominant Metro bus engine is the Cummins-Westport ISLG 8.9 liter engine. For standard buses, this engine usually operates at 280 horsepower and 900 pounds of torque. This engine has an alternate configuration available in a 320 horsepower configuration with 1,000 pounds of torque, and this higher horsepower is estimated to allow buses to maintain speeds over the Sepulveda Pass in the 45 to 55+ mile per hour range.

Cummins-Westport and Doosan both now offer larger displacement 11- 12 liter CNG engines that could potentially allow even higher speeds (55-65 mph+) over the Sepulveda Pass. Additional engineering work is still needed to determine whether these larger engines could feasibly be retrofitted into current transit bus configurations.

5.0 - PRELIMINARY COST REPORT

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Sepulveda Pass Corridor Systems Planning Study

Preliminary Cost Report

Prepared for:

Metro

Prepared by:

HNTB Corporation

in collaboration with Parsons Brinckerhoff, EMI, IBI Group, and V&A

November 2012

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1 INTRODUCTION

This report presents the preliminary cost estimates for the engineering concepts developed and refined as part of the Sepulveda Pass Corridor Systems Planning Study. The concepts have been developed through working sessions with Metro planning staff, input from the other consultant teams working on the Transportation Planning, Demand Modeling, and Environmental task orders for the Sepulveda Pass Corridor Systems Planning Study, and from input received at Planning Charrette #1 and Planning Charrette #2.

This report will present Rough Order of Magnitude (ROM) cost estimates for capital, operating and maintenance cost for each systems planning concept. The cost estimates presented in this report reflect the conceptual nature of the study and should be used as a high level metric to compare the alternatives against one another by the Transportation Planning Task Order and to develop the Cost Effectiveness Indices and other evaluation measures by the Demand Modeling Task Order.

The cost estimates will continue to be refined as the concepts are further developed in subsequent studies such as an Alternatives Analysis.

It is important to note that general concept drawings were develop as part of this study, not detailed engineering drawings. Therefore, quantities are at a very high level and not a detail bottoms up approach that would be expected in later development of the concepts.

2 SOURCES OF COST DATA

In accordance with the contract and scope of work for this project, the unit cost factors have been provided by the Metro Cost Estimating Departments. In cases where information was not provided by the Metro Cost Estimating Department, the design team relied upon available data from similar projects and industry resources.

The unit costs in this report are meant to represent the concepts at a very high level. For instance, alternatives are quantified by a cost per mile unit and major features such as transit stations are assigned a typical unit factor. The costs are also meant to reflect the program cost, not just the capital construction cost. For example, vehicle costs are included in the per mile costs for the rail concepts because they are part of the Metro provided costs.

Where appropriate, the unit costs have been adjusted to reflect economies of scale. The cost estimates have also been adjusted to reflect the physical characteristics of the concept. For example, the typical Metro rail project has a station every one mile. Some of the concepts in this report have fewer stations per mile and have been adjusted accordingly.

2.1 Metro Historic Projects

A key source of data for the preparation of this cost estimate was data on historical Metro projects. Table 2.1.1 provides a summary of historic Metro Projects

Table 2.1.1: Metro Historic Project Costs

	Length (Miles)	Number of Stations	Technology	Construction Start	Current Budget (Millions)	Adjusted for Inflation (Millions) 2012	Cost Per Mile (Millions) 2012
Red Line Segment 1	4.4	5	HR	1986	$ 1,439	$ 3,013	$ 685
Red Line Segment 2	6.7	8	HR	1991	$ 1,739	$ 2,930	$ 437
Red Line Segment 3	6.3	3	HR	1994	$ 1,313	$ 2,033	$ 323
Blue Line Long Beach	22	22	LR	1985	$ 877	$ 1,870	$ 85
Green Line El Segundo	20	14	LR	1991	$ 712	$ 1,200	$ 60
Gold Line Pasadena	13.7	13	LR	2000	$ 735	$ 979	$ 71
Gold Line Eastside	6	8	LR	2004	$ 899	$ 1,092	$ 182
Mid-City Exposition Phase 1	8.6	10	LR	2006	$ 927	$ 1,055	$ 123
Orange Line San Fernando Valley	14	14	BRT	2003	$ 340	$ 424	$ 30
MOL Extension San Fernando Valley	4	4	BRT	2009	$ 216	$ 231	$ 58

The Metro Estimating Department provided the draft cost data presented in Appendix 1 to aid in the development of alternatives for Planning Charette #1.

2.2 Representative Projects

In addition to the Metro Historic projects, the design team gathered cost data from representative projects that had similar features and scopes to the six Systems Planning Concepts. The representative projects range from local Metro highway projects, to the SR-99 Tunnel Project (Alaskan Way Viaduct Replacement Project), which is constructing a large-diameter bored highway tunnel. Representative projects that were reviewed are presented in Table 2.2.1.

Table 2.2.1: Representative Projects

Highway/Rail Project	Length (Miles)	Number of Transit Stations	Technology	Construction Completion	Budget (Millions)	Adjusted for Inflation (Millions) 2012	Cost Per Mile (Millions) 2012
Metro ExpressLanes I-110 and I-10	25.0	9	At-Grade Managed Lanes	2012/2013	$290	$290	$18 - $30 (1)
Selmon Expressway Florida	14.1	0	Managed Lanes	2007	$420	$475	$33 (2)
Alaska Highway Viaduct Replacement Tunnel	1.8	0	58' Single Bore Highway Tunnel	2013	$2,034	$2,034	$1.044 (3)
Metro Purple Line Extension Twin Bore Tunnels	9.0	7	20' Heavy Rail Twin Bore Tunnels	2022-2036	$4,536	$4,536	$504 (4)
Metro Blue Line	22	22	LRT At-Grade	1990	$877	$1,870	$85 (5)
Miami Tunnel Project	0.75	0	43' Dual Bore Highway Tunnels	2014	$1,000	$1,000	$1.333 (6)

Footnotes:
1. Metro Express Lanes Average Bid Prices for 2 Express Lanes (mid point of construction 2012) = $12M per mile. Construction cost has been increased to cover management and programmatic costs.
2. Derived from Published Reports
3. Derived from Published Reports
4. Metro Westside Subway Extension Project (2012)
5. Metro Estimating Historic Costs Escalated to 2012 dollars

6. Derived from Published Reports

2.3 Vehicle Cost Estimates

As was noted earlier, vehicle costs are included in the per-mile capital costs for the per-mile rail costs. As such, the vehicle costs associated with Concepts #5 and #6 are contained within the base, per-mile capital costs. However, concepts #1, #2, and #4 include a Bus Rapid Transit component, which is not included in the infrastructure capital costs for these concepts. Vehicle costs for these concepts were calculated separately from the infrastructure capital costs. In order to estimate the required fleet size, a planning-level calculation for a low range fleet size and a high range fleet size was performed by the Demand Modeling Task Order for the three BRT routes included in the concepts.

It is important to note that the modeling for the managed lanes concepts assumes that the minimum speed of travel is 45 mph. The vehicles in Metro's existing bus fleet are unable to maintain this minimum speed over the Sepulveda Pass. Therefore, two options are presented in the vehicle cost estimate.

1. The first option is to replace the existing engine and transmission in those vehicles that will be operating over the Sepulveda Pass with a more powerful engine and transmission that can maintain 45 mph over the Sepulveda Pass
2. The second option is to purchase new vehicles that can maintain 45 mph over the Sepulveda Pass

The low range fleet size and the high range fleet size as well as the two options for upgrading the vehicles are shown in Table 2.3.1.

Table 2.3.1: Vehicle Costs							
				Low Range		High Range	
BRT Route	Max Peak Run time	15% Layover	Effective Run Time	Coded Headway	Bus Per Direction	Equil. Headway	Bus Per Direction
Sylmar to LAX	94	14.1	109	10	11	4.2	26
Sylmar to Purple Line/VA	83	12.45	96	5	20	3.9	25
Orange Line/Sepulveda to LAX	65	9.75	75	5	15	1.6	47
Total Buses Per Direction					46		98
Total Buses Both Directions					92		196
Vehicle Cost Refurbished[1]					**$1,840,000**		**$3,920,000**
Vehicle Cost New[2]					**$36,800,000**		**$78,400,000**

Assumptions:
1. Refurbished vehicle cost assumes replacement of engine and transmission in existing fleet ($20,000 for new engine and transmission) in order to navigate the Sepulveda Pass at the minimum managed lane speed of 45 mph.
2. New vehicle cost assumes purchase of new vehicle for the fleet ($400,000 per bus) in order to navigate the Sepulveda Pass at the minimum managed lane speed of 45 mph.

3 ROUGH ORDER OF MAGNITUDE (ROM) COST ESTIMATES

The capital cost estimates for infrastructure and vehicles are presented below for the six Systems Planning Concepts.

3.1 Capital Cost Estimates

The six Systems Planning Concepts are presented in detail in the Initial Route Concept Report and the Systems Planning Concepts Drawings and Engineering Issues Report under separate covers so they will be described in general terms in this report. The capital cost estimates take into account those items which are attributable to transit improvements and those items which are attributable to highway improvements. A 30% contingency has also been applied to all capital cost estimates. A summary of all concepts is presented at the end of this section in Table 3.2.1.

3.1.1 Concept #1 - At-Grade Sepulveda Boulevard Bus Rapid Transit (BRT)

Concept #1 proposes an at-grade Bus Rapid Transit (BRT) that provides a connection between Century Boulevard station with the Green Line and Crenshaw/LAX LRT line on the south to the San Fernando MetroLink Station on the north. The major components of the concept used to develop the rough order of magnitude cost estimate are:

- Shoulder improvements on the northbound and southbound I-1405 to accommodate shoulder running buses from Ventura Blvd to Sepulveda Blvd

- At-grade BRT Stations
- Modifications at the Orange line station
- Priority treatments, intersections modifications, and queue jump lanes along Sepulveda Blvd and Van Nuys Blvd

The Rough Order of Magnitude Capital Cost Estimate for Concept #1 is presented in Table 3.1.1.

Table 3.1.1
Rough Order of Magnitude Cost Estimate – Concept 1

Concept #1						
At-Grade Sepulveda BRT						
Item	**Unit**	**Cost**	**Quantity**	**Transit**	**Highway**	**Total**
Bus on Shoulder - Shoulder Improvements[1]	Miles	$ 2,500,000	8.4	$ 21,000,000		
BRT Stations[2]	Each	$ 1,000,000	8	$ 8,000,000		
Install Turnaround at Orange Line Station[3]	Each	$ 1,250,000	1	$ 1,250,000		
Priority Treatments @ Intersections[4]	Each	$ 40,000	85	$ 3,400,000		
Intersection / Median Reconfiguration[5]	Each	$ 500,000	5	$ 2,500,000		
Queue Jump Lanes[6]	Each	$ 350,000	20	$ 7,000,000		
				$ -		
Sub Total				$ 43,150,000	$ -	$ 43,150,000
Management and Programmatic Adjustments[9]				$ 21,575,000		$ 21,575,000
30% Contengency[7]				$ 19,417,500	$ -	$ 19,417,500
Vehicle Costs[8]				$ 78,400,000	$ -	$ 78,400,000
Total				**$ 162,542,500**	$ -	**$ 162,542,500**

Assumptions:
1. Shoulder Improvements in NB and SB directions from Ventura Blvd to Sepulveda Blvd.
2. At-Grade BRT Stations.
3. See Conceptual Drawing in Final Systems Planning Concepts Drawings and Engineering Issues Report.
4. There are 105 signalized intersections along concept route, assume 85 (80%) receive priority treatment.
5. Five intersections will receive Intersection/Median Reconfiguration.
6. 55 of the 105 intersections could potentially receive Queue Jump Lanes. Assume 20 receive Queue Jump Lanes.
7. A 30% contingency has been applied to the sub-total due to the conceptual nature of the study.
8. High Range Vehicle Cost Estimate from Table 2.3.1.
9. Cost has been increased by 50% to cover management and programmatic costs.

3.1.2 Concept #2 - At-Grade Freeway Managed Lanes

Concept #2 proposes to construct managed lanes in the median of I-405 from the interchange with I-5 in the north to I-105 in the south. Between US 101 and Santa Monica Boulevard, I-405 would consist of five general purpose (GP) lanes and two managed (HOT or HOV) lanes in each direction. North of US 101 and south of Santa Monica Boulevard, there would only be one managed lane in each direction. The managed lanes would be constructed within the existing right-of-way and would be accomplished through the Sepulveda Pass by restriping the existing roadway. The major components of the concept used to develop the rough order of magnitude cost estimate are:

- Construction of Express Lanes which would include restriping, physical barriers, and tolling equipment
- Direct Access Ramps and select locations for transit and highway use
- The incorporation of the BRT improvements from Concept #1

The Rough Order of Magnitude Capital Cost Estimate for Concept #2 is presented in Table 3.1.2.

3.1.3 Concept #3 - Highway Viaduct Managed Lanes

Concept #3 proposed an elevated highway viaduct in the median of the I-405 between Burbank Ave and the Pico Blvd. The major components of the concept used to develop the rough order of magnitude cost estimate are:

- Construction of an elevated guideway between Burbank Ave and Pico Blvd
- Direct Access Ramps and select locations for transit and highway use
- The incorporation of the BRT improvements from Concept #1

The Rough Order of Magnitude Capital Cost Estimate for Concept #3 is presented in Table 3.1.3.

3.1.4 Concept #4 - Tolled Highway Tunnel

Concept 4 would construct a bored tunnel under the Santa Monica Mountains that would carry two lanes of highway traffic in each direction. The tunnel cross section would consist of either a single bore with two lanes on an upper level and two lanes on a lower level, or two separate bores with two lanes in each bore. For the purpose of the costs estimate, a large bore configuration similar to the Alaskan Way Tunnel was assumed. Portals and approaches would be required at either end of the tunnel. The major components of the concept used to develop the rough order of magnitude cost estimate are:

- A large diameter bore tunnel
- Portal and approaches on either end of the tunnel

A low range and high range estimate is presented for the tunnel alternatives. The low range estimate reduces the tunneling cost by 20% represent economies of scale associated with the length of tunnel. The Rough Order of Magnitude Capital Cost Estimate for Concept #4 is presented in Table 3.1.4.

Table 3.1.2
Rough Order of Magnitude Capital Cost Estimate – Concept 2

Concept #2						
At-Grade Freeway Managed Lanes						
Item	**Unit**	**Cost**	**Quantity**	**Transit**	**Highway**	**Total**
Construction of Express Lanes[1,2,3,4]	Miles	$ 14,400,000	29.0		$ 417,600,000	
Orange Line Direct Access Ramps	Each	$150,000,000	1	$ 150,000,000		
US 101 Direct Access Ramps	Each	$300,000,000	1		$ 300,000,000	
Le Grange Direct Access Ramps	Each	$150,000,000	1	$ 150,000,000		
Sepulveda Direct Access Ramps	Each	$150,000,000	1		$ 150,000,000	
At-Grade BRT Improvements[6]	Each	$ 64,725,000	1	$ 64,725,000		
				$ -		
			Sub Total	$ 364,725,000	$ 867,600,000	$ 1,232,325,000
			30% Contengency[7]	$ 109,417,500	$ 260,280,000	$ 369,697,500
			Vehicle Costs[8]	$ 78,400,000		$ 78,400,000
			Total	**$ 552,542,500**	**$ 1,127,880,000**	**$ 1,680,422,500**

Assumptions:
1. Assumes the construction of one Express Lane in each direction within the existing ROW for the entire length of the project.
2. Existing HOV lane is converted to Express Lane throughout the project.
3. Two Express Lanes through the Sepulveda Pass from Ventura Blvd to I-10 within the existing ROW (restriping of exiting GP lanes).
4. Metro standard cost of $12M per mile for HOT lanes construction has been reduced by 20% for economies of scale and increased by 50% to cover management and programmatic costs.
5. Direct Access Ramps include construction and potential ROW costs.
6. Concept 1 At-Grade Sepulveda BRT Improvements.
7. A 30% contingency is applied to the sub-total due to the conceptual nature of the study.
8. High Range Vehicle Cost Estimate from Table 2.3.1.

Table 3.1.3
Rough Order of Magnitude Capital Cost Estimate – Concept 3

Concept #3						
Highway Viaduct Managed Lanes						
Item	**Unit**	**Cost**	**Quantity**	**Transit**	**Highway**	
Elevated Guideway[1,2]	Miles	$ 111,000,000	9.8		$1,087,800,000	
Direct Access Ramp[3]	Each	$ 150,000,000	2		$ 300,000,000	
US 101 Direct Access Ramp	Each	$ 150,000,000	1		$ 150,000,000	
At-Grade BRT Improvements[4]	Each	$ 43,150,000	1	$ 43,150,000		
Sepulveda Direct Access Ramps	Each	$ 150,000,000	1		$ 150,000,000	
				$ -	$ -	**Total**
			Sub Total	$ 43,150,000	$1,687,800,000	$1,730,950,000
			30% Contengency[5]	$ 12,945,000	$ 506,340,000	$ 519,285,000
			Vehicle Costs[6]	$ 78,400,000		
			Total	**$ 134,495,000**	**$2,194,140,000**	**$2,328,635,000**

Assumptions:

1. Cost based on a structure 70' wide at $200 per square foot.
2. Cost per mile has been increased by 50% to cover management and programmatic costs.
3. Direct Access Ramps include construction and potential ROW costs and either end.
4. Concept 1 At-Grade Sepulveda BRT Improvements.
5. A 30% contingency has been applied to the sub-total due to the conceptual nature of the study.
6. High Range Vehicle Cost Estimate from Table 2.3.1.

Table 3.1.4

Rough Order of Magnitude Capital Cost Estimate – Concept 4

Concept #4 Tolled Highway Tunnel									
Item	Unit	Cost	Quantity	Low Range			High Range		
				Transit	Highway	Total	Transit	Highway	Total
58' Diameter Tunnel[1]	Miles	$1,044,000,000	9.2		$ 7,683,840,000			$ 9,604,800,000	
58' Diameter Portal & Approaches[2]	Each	$ 150,000,000	2		$ 300,000,000			$ 300,000,000	
				$ -	$ -		$ -	$ -	
			Sub Total	$ -	$ 7,983,840,000	$ 7,983,840,000	$ -	$ 9,904,800,000	$ 9,904,800,000
			30% Contengency[3]	$ -	$ 2,395,152,000	$ 2,395,152,000	$ -	$ 2,971,440,000	$ 2,971,440,000
			Vehicle Costs[4]	$78,400,000		$ 78,400,000	$78,400,000		$ 78,400,000
		Total		**$78,400,000**	**$ 10,378,992,000**	**$10,457,392,000**	**$78,400,000**	**$12,876,240,000**	**$12,954,640,000**

Assumptions:

1. Cost based on Alaskan Way Viaduct at $1.044B per mile. The High Range reflects $1.044B per mile while the low range takes into account a 20% reduction of the tunnel costs to reflect economies of scale.
2. Portal & Approaches include construction and potential ROW costs.
3. A 30% contingency has been applied to the sub total due to the conceptual nature of the study.
4. High Range Vehicle Cost Estimate from Table 2.3.1.

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3.1.5 Concept #5 - Fixed-Guideway Light Rail Transit Tunnel

Concept #5 proposes a rail transit line connecting the San Fernando Valley with West Los Angeles and LAX. Cost estimates have been developed for a light rail option and a heavy rail option. The line would stretch approximately 27 miles and connect the Sylmar/San Fernando Metrolink station in the north to the Century/Aviation station to the south. For the light rail option, the system would be constructed at-grade from Sylmar to Venice Blvd, tunneled through the Santa Monica Mountains to a portal south of Santa Monica Blvd, and then run at-grade to the Century/Aviation station on the south end of the project. For the heavy rail option, the entire alignment would be constructed in a tunnel. The line would include 14 stations spaced about 2 miles apart. The major components of the concept used to develop the rough order of magnitude cost estimate are:

- At-grade light rail
- At-grade transit stations
- Dual bore tunnels
- A maintenance facility
- Underground transit stations

The cost estimate for this alternative has been broken down into geographical regions due to the length of the concept. The geographical regions are the San Fernando Valley, the Sepulveda Pass, and the Westside.

Low range and high range estimates are presented for the tunnel alternatives. The low range estimate reduces the tunneling cost by 20% represent economies of scale associated with the length of tunnel. The Rough Order of Magnitude Capital Cost Estimate for Concept #5 is presented in Table 3.1.5.

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Table 3.1.5
Rough Order of Magnitude capital Cost Estimate – Concept 5

Concept #5									
Fixed-Guideway Light Rail Transit Tunnel									
	Item	Unit	Cost	5A - At-Grade Transit			5B - Underground Transit		
					Low Range[5]	High Range		Low Range[5]	High Range
				Quantity	Total	Total	Quantity	Total	Total
Segment 1 San Fernando Valley									
	At-Grade Light Rail[1]	Miles	$ 85,000,000	11.6	$ 986,000,000	$ 986,000,000			
	At-Grade Transit Station[2]	Each	$ 5,000,000	5	$ (40,000,000)	$ (40,000,000)			
	Two 20' Tunnels[3]	Miles	$ 504,000,000				11.6	$ 4,677,120,000	$ 5,846,400,000
	Underground Transit Station[4]	Each	$ 100,000,000				5	$ (800,000,000)	$ (800,000,000)
	Maintenance Facility[6]	Each	$ 100,000,000	1	$ 100,000,000	$ 100,000,000	1	$ 100,000,000	$ 100,000,000
	Sub Total				**$ 1,046,000,000**	**$ 1,046,000,000**		**$ 3,977,120,000**	**$ 5,146,400,000**
	30% Contengency[7]				**$ 313,800,000**	**$ 313,800,000**		**$ 1,193,136,000**	**$ 1,543,920,000**
	Total				**$ 1,359,800,000**	**$ 1,359,800,000**		**$ 5,170,256,000**	**$ 6,690,320,000**
Segment 2 Sepulveda Pass									
	Two 20' Tunnels	Miles	$504,000,000	7.5	$ 3,024,000,000	$ 3,780,000,000	7.5	$ 3,024,000,000	$ 3,780,000,000
	20' Diameter Portal	Each	$ 50,000,000	4	$ 200,000,000	$ 200,000,000	4	$ 200,000,000	$ 200,000,000
	Underground Transit Station	Each	$100,000,000	2	$ (500,000,000)	$ (500,000,000)	2	$ (500,000,000)	$ (500,000,000)
	Sub Total				**$ 2,724,000,000**	**$ 3,480,000,000**		**$ 2,724,000,000**	**$ 3,480,000,000**
	30% Contengency[7]				**$ 817,200,000**	**$ 1,044,000,000**		**$ 817,200,000**	**$ 1,044,000,000**
	Total				**$ 3,541,200,000**	**$ 4,524,000,000**		**$ 3,541,200,000**	**$ 4,524,000,000**

Metro

Table 3.1.5 (continued)
Rough Order of Magnitude capital Cost Estimate – Concept 5

Concept #5 — Fixed-Guideway Light Rail Transit Tunnel				5A - At-Grade Transit			5B - Underground Transit		
	Item	Unit	Cost	Quantity	Low Range[5] Total	High Range Total	Quantity	Low Range[5] Total	High Range Total
Segment 3 Westside	At-Grade Light Rail[1]	Miles	$ 85,000,000	8.7	$ 739,500,000	$ 739,500,000			
	At-Grade Transit Station[2]	Each	$ 5,000,000	5	$ 25,000,000	$ 20,000,000			
	Two 20' Tunnels[3]	Miles	$ 504,000,000	1.9	$ 957,600,000	$ 957,600,000	10.6	$ 4,273,920,000	$ 5,342,400,000
	Underground Transit Station[4]	Each	$ 100,000,000	2	$ 200,000,000	$ 200,000,000	7	$ (500,000,000)	$ (500,000,000)
	Sub Total				**$ 1,922,100,000**	**$ 1,922,100,000**		**$ 3,773,920,000**	**$ 4,842,400,000**
	30% Contengency[7]				**$ 576,630,000**	**$ 576,630,000**		**$ 1,132,176,000**	**$ 1,452,720,000**
	Total				**$ 2,498,730,000**	**$ 2,498,730,000**		**$ 4,906,096,000**	**$ 6,295,120,000**
				Sub Total	**$ 5,692,100,000**	**$ 6,448,100,000**		**$ 10,475,040,000**	**$13,468,800,000**
				30% Contengency[7]	**$ 1,707,630,000**	**$ 1,934,430,000**		**$ 3,142,512,000**	**$ 4,040,640,000**
				Total	**$ 7,399,730,000**	**$ 8,382,530,000**		**$ 13,617,552,000**	**$17,509,440,000**

Assumptions:

1. Cost is based on average per mile cost for Metro Light Rail Projects and assumes at-grade running section and grade separations at major intersections.
2. Assume frequency of one station per mile. Adjustment is made for number of stations assuming an at-grade station cost of $5M per station.
3. Tunnel cost is based on Metro Westside Subway Extension.
4. Assume frequency of one station per mile. Adjustment is made for number of stations assuming an underground station cost of $100M per station.
5. Tunnel cost have been reduced by 20% on the Low Range alternative to reflect economies of scale.
6. Assume that a maintenance facility will be located in the San Fernando Valley. Cost assumes facility and ROW costs.
7. A 30% contingency has been applied to the sub total due to the conceptual nature of the study.

3.1.6 Concept #6 - Highway/Private Shuttle Tunnels

Concept #6 is very similar to Concepts #4 and #5, as it consists of a bored highway tunnel through the Santa Monica Mountains and also includes a second tunnel for a private shuttle service. However, the highway tunnel would be longer than that proposed for Concept #4, with the northern portal at approximately Roscoe Boulevard and the southern portal in the LAX area, near Century Boulevard. The private shuttle tunnel involves longer tunnels for transit than in Concept #5. The major components of the concept used to develop the rough order of magnitude cost estimate are:

- A 45' tunnel from the northern highway portal to US 101
- A 58' diameter highway tunnel from US-101 to LAX
- Portals and approaches for the tunnels
- Dual bore tunnels for the transit component
- Underground transit station
- A maintenance facility

The cost estimate for this alternative has been broken down into geographical regions due to the length of the concept. The geographical regions are the San Fernando Valley, the Sepulveda Pass, and the Westside. Low range and high range estimates are presented for the tunnel alternatives. The low range estimate reduces the tunneling cost by 20% represent economies of scale associated with the length of tunnel. The Rough Order of Magnitude Capital Cost Estimate for Concept #6 is presented in Table 3.1.6.

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Table 3.1.6

Rough Order of Magnitude Capital Cost Estimate – Concept 6

Concept #6 Highway/Private Shuttle Tunnels										
	Item	Unit	Cost	Quantity	Low Range[7]			High Range		
					Transit	Highway	Total	Transit	Highway	Total
Segment 1 San Fernando Valley	One 45' Tunnel[1]	Miles	$ 629,000,000	4.0		$ 2,012,800,000			$ 2,516,000,000	
	Two 20' Tunnels[2]	Miles	$ 504,000,000	4.5	$1,814,400,000			$2,268,000,000		
	45' Diameter Portal & Approaches[3]	Each	$ 150,000,000	1		$ 150,000,000			$ 150,000,000	
	20' Diameter Portal[3]	Each	$ 50,000,000	1	$ 50,000,000			$ 50,000,000		
	Underground Transit Station[4]	Each	$ 100,000,000	1	$ (400,000,000)			$(400,000,000)		
	Maintenance Facility[5]	Each	$ 100,000,000	1	$ 100,000,000			$ 100,000,000		
	Sub Total				$ 1,564,400,000	$ 2,162,800,000	$ 3,727,200,000	$2,018,000,000	$ 2,666,000,000	$ 4,684,000,000
	30% Contengency[8]				$ 469,320,000	$ 648,840,000	$ 1,118,160,000	$ 605,400,000	$ 799,800,000	$ 1,405,200,000
	Total				$ 2,033,720,000	$ 2,811,640,000	$ 4,845,360,000	$2,623,400,000	$ 3,465,800,000	$ 6,089,200,000
Segment 2 Sepulveda Pass	58' Diameter Tunnel[6]	Miles	$1,044,000,000	9.2		$ 7,683,840,000			$ 9,604,800,000	
	Two 20' Tunnels[2]	Miles	$ 504,000,000	5.6	$ 2,257,920,000			$2,822,400,000		
	58' Diameter Portal & Approaches[3]	Each	$ 150,000,000	2		$ 300,000,000			$ 300,000,000	
	Underground Transit Station[4]	Each	$ 100,000,000	1	$ (800,000,000)			$(800,000,000)		
	Sub Total				$ 1,457,920,000	$ 7,983,840,000	$ 9,441,760,000	$2,022,400,000	$ 9,904,800,000	$11,927,200,000
	30% Contengency[8]				$ 437,376,000	$ 2,395,152,000	$ 2,832,528,000	$ 606,720,000	$ 2,971,440,000	$ 3,578,160,000
	Total				$ 1,895,296,000	$10,378,992,000	$12,274,288,000	$2,629,120,000	$12,876,240,000	$15,505,360,000

Table 3.1.6 (continued)
Rough Order Magnitude Capital Cost Estimate – Concept 6

Concept #6 Highway/Private Shuttle Tunnels										
	Item	Unit	Cost	Quantity	Low Range[7]			High Range		
					Transit	Highway	Total	Transit	Highway	Total
Segment 3 Westside	58' Diameter Tunnel[6]	Miles	$1,044,000,000	7.8		$ 6,514,560,000			$8,143,200,000	
	Two 20' Tunnels[2]	Miles	$ 504,000,000	10.6	$ 4,273,920,000			$5,342,400,000		
	58' Diameter Portal & Approaches[3]	Each	$ 150,000,000	2		$ 300,000,000			$ 300,000,000	
	Underground Transit Station[4]	Each	$ 100,000,000	2	$ (600,000,000)			$(600,000,000)		
	Sub Total				**$ 3,673,920,000**	**$ 6,814,560,000**	**$10,488,480,000**	**$4,742,400,000**	**$ 8,443,200,000**	**$13,185,600,000**
	30% Contengency[8]				**$ 1,102,176,000**	**$ 2,044,368,000**	**$3,146,544,000**	**$1,422,720,000**	**$ 2,532,960,000**	**$ 3,955,680,000**
	Total				**$ 4,776,096,000**	**$ 8,858,928,000**	**$13,635,024,000**	**$6,165,120,000**	**$10,976,160,000**	**$17,141,280,000**
				Sub Total	$ 6,696,240,000	$16,961,200,000	$23,657,440,000	$8,782,800,000	$21,014,000,000	$29,796,800,000
				30% Contengency[8]	$ 2,008,872,000	$ 5,088,360,000	$7,097,232,000	$2,634,840,000	$ 6,304,200,000	$ 8,939,040,000
				Total	**$ 8,705,112,000**	**$ 22,049,560,000**	**$30,754,672,000**	**$11,417,640,000**	**$27,318,200,000**	**$38,735,840,000**

Assumptions:

1. Cost is based on average per mile cost for Metro Westside Subway Extension alternative Tunneling Method Study.
2. Tunnel cost is based on Metro Westside Subway Extension.
3. Portal & Approaches include construction and potential ROW costs.
4. Assume frequency of one station per mile. Adjustment is made for number of stations assuming an underground station cost of $100M per station.
5. Assume that a maintenance facility will be located in the San Fernando Valley. Cost assumes facility and ROW costs.
6. Cost based on Alaskan Way Viaduct at $1.044B per mile. The High Range reflects $1.044B per mile while the low range takes into account a 20% reduction of the tunnel costs to reflect economies of scale.
7. Tunnel cost have been reduced by 20% on the Low Range alternative to reflect economies of scale.
8. A 30% contingency has been applied to the sub total due to the conceptual nature of the study.

4 ROUGH ORDER OF MAGNITUDE CAPITAL COST SUMMARY

Table 3.2.1 provides a summary of the capital and vehicle cost estimates for Concept #1 through Concept #6. The capital cost estimate is obtained by taking the construction cost from Concept #1 through Concept #6 and adding the associated vehicle cost estimate to the transit portion of the project. In addition, values have been given to reflect a Low Range and a High Range of the Rough Order of Magnitude cost for the concepts that include a tunnel component.

The Rough Order of Magnitude (ROM) capital cost estimates for each systems planning concept presented in this report reflect the conceptual nature of the study and should be used as a high level metric to compare the alternatives against one another. The cost estimate will need to be refined as the concepts are further developed and additional studies are undertaken.

Table 3.2.1
Rough Order Magnitude Cost Estimates

Table 3.2.1 Summary of ROM Capital Cost Estimates

		Capital Cost Estimate[1]		Total
		Transit	Highway	
Concept 1	At-Grade Sepulveda BRT	$ 162,542,500	$ -	$ 162,542,500
Concept 2	At-Grade Freeway Managed Lanes	$ 524,495,000	$ 1,127,880,000	$ 1,680,422,500
Concept 3	Highway Viaduct Managed Lanes	$ 134,495,000	$ 2,194,140,000	$ 2,328,635,000
Concept 4	Tolled Highway Tunnel (Low Range)	$ 78,400,000	$ 10,378,992,000	$10,457,392,000
Concept 4	Tolled Highway Tunnel (High Range)	$ 78,400,000	$ 12,876,240,000	$12,954,640,000
Concept 5A	Fixed-Guideway At-Grade Light Rail Transit (Low Range)	$ 7,399,730,000	$ -	$ 7,399,730,000
Concept 5A	Fixed-Guideway At-Grade Light Rail Transit (High Range)	$ 8,382,530,000	$ -	$ 8,382,530,000
Concept 5B	Fixed-Guideway Heavy Rail Tunnel (Low Range)	$13,617,552,000	$ -	$13,617,552,000
Concept 5B	Fixed-Guideway Heavy Rail Tunnel (High Range)	$17,509,440,000	$ -	$17,509,440,000
Concept 6	Highway/Private Shuttle Tunnels (Low Range)	$ 8,705,112,000	$ 22,049,560,000	$30,754,672,000
Concept 6	Highway/Private Shuttle Tunnels (High Range)	$11,417,640,000	$ 27,318,200,000	$38,735,840,000

Assumptions:
1. Capital Cost Estimates include construction and vehicle cost estimates.

4.1 Operating and Maintenance Cost Estimate

Operating and Maintenance cost estimates were developed using operating and maintenance costs from the Metro Proposed Budget Fiscal Year 2013 July 1, 2012 – June 30, 2013 and results from the Demand Modeling Task Order. The projected operating and maintenance costs for each Concept are presented below in Table 4.1.1.

Table 4.1.1: Projected Operating and Maintenance Costs

Operating Costs	Concept 1: Van Nuys / Sepulveda BRT	Concept 2: BRT in At-Grade Fwy Managed Lanes	Concept 4: BRT with Tolled Highway Tunnel	Concept 5A: Fixed Guideway LRT	Concept 5B: Fixed Guideway Heavy Rail	Concept 6: Highway / Private Shuttle Tunnel
Average Weekday Passenger Miles	482,715	690,820	636,954	797,708	1,056,681	586,549
Operating Cost per Passenger Mile	$0.63	$0.63	$0.63	$0.56	$0.56	$0.56
Average Weekday Operating Costs	$304,110	$435,217	$401,281	$446,716	$591,741	$328,467
Average Annual Operating Cost	$96,433,424	$138,007,184	$127,246,211	$141,653,796	$188,173,752	$104,157,025

Typically, the next step in the planning process would be an Alternatives Analysis or similar effort that would screen alternatives based on established performance measures for the corridor and then develop conceptual engineering plans for a smaller set of alternatives. For this Study, a very robust transit service plan with a very high frequency of service over the Pass was modeled. Future studies will need to explore ways to refine transit service routes and operating plans in a manner that reduces operating costs while maintaining high ridership. In a corridor such as the Sepulveda Pass, which appears to have a large, untapped transit demand, it will be important to equilibrate transit headways to transit demand.

Further studies would also establish alignments and station locations for the different transit alternatives and would establish lane configurations, ramp, and direct connector locations for freeway alternatives. Based on the conceptual engineering plans, conceptual operating plans for transit services could be established that would take into account the effects of grades, curves, and station spacing on anticipated operating speeds, as well as grade-crossing delay for any at-grade alternatives.

Appendix 1 – Draft Guideway Technology Alternatives for Charette One Sepulveda Pass Systems Planning Corridor Study

Draft Guideway Technology Alternatives for Charette One
Sepulveda Pass Systems Planning Corridor Study

Project ROM Cost per Route Mile					
	1	**2**	**3**	**4**	**4/13/2012**
	All Surface Alternatives	Tunnel Alternatives			
		All Transit Tunnel	All Highway Tunnels	Transit and Highway	NOTES
1	No Build (HOV Lane): $ -				
2	2 Express Lanes (Widening of Existing Freeway) **$ 12,000,000**				Metro HOT Lane average bids (mid point of construction = 2012)
3	4 Express Lanes (Widening of Existing Freeway) **$ 20,000,000**				Prorated from Metro HOT Lane average bids for 4 lanes (mpoc = 2012)
4		21 Foot Diameter (Dual Bore) **$ 504,000,000**			Metro Westside Subway Extension Project FTA SCC Funding Schedule (2012)
5		46 Foot Diameter (Single Bore) **$ 629,000,000**			Metro Westside Subway Extension Alternative Tunneling Method Study (escl 2012)
6			43 Foot Diameter (Dual Bore) **$ 1,333,000,000**	Forty Foot Diameter **No less than Highway Tunnel $**	Port of Miami Tunnel project estimate (mpoc = 2012)
7			Fifty Foot Diameter **$ 1,000,000,000**	Fifty Foot Diameter **No less than Highway Tunnel $**	Approximate proration.
8			57 Foot Diameter (Single Bore Stacked) **$ 1,044,000,000**	60 Foot Diameter **No less than Highway Tunnel $**	Alaskan Way Seattle Project average bids (mpoc = 2012)
			57 Foot Diameter (Dual Bore Stacked) **$ 860,000,000**	**No less than Highway Tunnel $**	InfraConsult study for Metro' SR710 North-2 TBMs (escl 2012)

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Appendix 2 – Concept #5 Aerial Viaduct Preliminary Cost

Memo

To: Roger Martin, AICP
Transportation Planning Manager
LACMTA

From: Nathan Burgess, PE
Senior Project Manager
HNTB Corporation

Date: 11/7/2012

Re: Sepulveda Pass Corridor Systems Planning Study – Concept #5 Aerial Viaduct

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The Sepulveda Pass Corridor Systems Planning Study identified six planning concepts that were advanced and developed as part of the study's planning process. Concept #5 was a rail alternative that was initially conceived as a light rail alternative. The concept was conceptualized to run at-grade from the northern terminus at Sylmar to approximately Ventura Boulevard. In the vicinity of Ventura Boulevard, it would enter a tunnel through the Sepulveda Pass to south of Santa Monica Boulevard, and then return to an at-grade configuration south of Santa Monica Boulevard to Los Angeles International Airport.

After receiveing input at the Planning Charrette #2, a heavy rail alternative was also added to address carrying capacity concerns. The heavy rail alternative would be similar to the Red Line in configuration and would operate in a tunnel the entire length from Sylmar to Los Angeles International Airport.

The at-grade running light rail and the underground running heavy rail were the two options carried forward for the remainder of the planning study.

Upon completion of the study, a question was raised regarding the feasibility of an aerial heavy rail option for the northern and southern portions of the study corridor. The Civil and Transportation Engineering team compiled the following cost information to help inform the project team and that can be further developed and refined in future phases of study. The costs presented below should be used for informational purposes only and do not take into account environmental impacts or constructability issues.

Average Construction Cost for Aerial Guideway

- Average of projects without stations - $50,000,000/mile
- BART SFO Aerial Guideway without stations
  - $8,500/ft. x 5280 ft./mile = $44,880,000
  - Adjusted for inflation (2003 – 2012) = $56,443,190
  - Use $60M/mile w/o stations
- Aerial Stations - $20,000,000/Station
- Recommended Construction Value to use for Sepulveda Pass
  - $60M +$40M/2 (end stations) = $80,000,000/mile

Average Professional Service (Project Management, Construction Management, etc…)

- 50% of construction costs

Recommended Aerial Guideway Programmatic Cost

- $80,000,000 x 1.5 = **$120,000,000/mile**

Using the same format presented in the Preliminary Cost Report, the aerial heavy rail viaduct option would result in the following approximate, rough-order-of-magnitude costs shown in the table on the following page.

Concept #5

Fixed-Guideway Light Rail Aerial Viaduct (Not Studied)

				5C - Aerial Guideway		
	Item	**Unit**	**Cost**	**Quantity**	**Low Range[5] Total**	**High Range Total**
Segment 1 San Fernando Valley						
	At-Grade Light Rail[1]	Miles	$ 85,000,000			
	Aerial Guideway	Miles	$120,000,000	11.6	$ 1,392,000,000	$ 1,392,000,000
	At-Grade Transit Station[2]	Each	$ 5,000,000			
	Two 20' Tunnels[3]	Miles	$504,000,000			
	Underground Transit Station[4]	Each	$100,000,000			
	Maintenance Facility[6]	Each	$100,000,000	1	100,000,000	$ 100,000,000
			Sub Total		**$ 1,492,000,000**	**$ 1,492,000,000**
			30% Contengency[7]		**$ 447,600,000**	**$ 447,600,000**
			Total		**$ 1,939,600,000**	**$ 1,939,600,000**
Segment 2 Sepulveda Pass						
	Two 20' Tunnels	Miles	$504,000,000	7.5	$ 3,024,000,000	$ 3,780,000,000
	20' Diameter Portal	Each	$ 50,000,000	4	$ 200,000,000	$ 200,000,000
	Underground Transit Station	Each	$100,000,000	2	$ (500,000,000)	$ (500,000,000)
			Sub Total		**$ 2,724,000,000**	**$ 3,480,000,000**
			30% Contengency[7]		**$ 817,200,000**	**$ 1,044,000,000**
			Total		**$ 3,541,200,000**	**$ 4,524,000,000**
Segment 3 Westside						
	At-Grade Light Rail[1]	Miles	$ 85,000,000			$ -
	Aerial Guideway	Miles	$120,000,000	8.7	$ 1,044,000,000	$ 1,044,000,000
	At-Grade Transit Station[2]	Each	$ 5,000,000		$ -	$ -
	Two 20' Tunnels[3]	Miles	$504,000,000	1.9	$ 957,600,000	$ 957,600,000
	Underground Transit Station[4]	Each	$100,000,000	2	$ 200,000,000	$ 200,000,000
			Sub Total		**$ 2,201,600,000**	**$ 2,201,600,000**
			30% Contengency[7]		**$ 660,480,000**	**$ 660,480,000**
			Total		**$ 2,862,080,000**	**$ 2,862,080,000**
				Sub Total	**$ 6,417,600,000**	**$ 7,173,600,000**
				30% Contengency[7]	**$ 1,925,280,000**	**$ 2,152,080,000**
				Total	**$ 8,342,880,000**	**$ 9,325,680,000**

Assumptions:

1. Cost is based on average per mile cost for Metro Light Rail Projects and assumes at-grade running section and grade separations at major intersections.
2. Assume frequency of one station per mile. Adjustment is made for number of stations assuming an at-grade station cost of $5M per station.
3. Tunnel cost is based on Metro Westside Subway Extension.
4. Assume frequency of one station per mile. Adjustment is made for number of stations assuming an underground station cost of $100M per station.
5. Tunnel cost have been reduced by 20% on the Low Range alternative to reflect economies of scale.
6. Assume that a maintenance facility will be located in the San Fernando Valley. Cost assumes facility and ROW costs.
7. A 30% contingency has been applied to the sub total due to the conceptual nature of the study.

Appendix 3 – Initial Operating Segment

Metro Interoffice Memo

Date	November 7, 2012
To	Roger Martin, David Mieger
From	Alex Moosavi
Subject	Initial Segment vs. Full Length Costs

The Sepulveda Pass Corridor Systems Planning Study identified six planning concepts to alleviate congestion and increase transit mode share along an approximately 30-mile corridor, extending from the Sylmar Metrolink Station and the I-5/I-405 Interchange in Sylmar to Los Angeles International Airport (LAX) in the southern Los Angeles Basin. While the Preliminary Cost Report includes capital costs for all full-length concepts, Metro Planning staff explored the potential for shorter, and less expensive, infrastructure improvements in the core/middle section of the Sepulveda Pass Study Area, from approximately the Metro Orange Line and U.S. 101 in the San Fernando Valley to the Metro Expo Line and La Grange Avenue in West Los Angeles. This core/middle segment of the entire 30-mile corridor, which focuses on connecting the housing-rich San Fernando Valley with the jobs-rich Westside region of Los Angeles through the Sepulveda Pass itself, has demonstrated the highest potential for increased ridership and automobile usage (per mile) at much lower costs than the full length concepts examined in the Preliminary Cost Report and other Study reports.

While the full 30-mile long Sepulveda Pass Study Area/corridor is in need of transit and/or highway improvements, Metro Planning staff chose to explore a segment of the corridor with the greatest need, based on the segment of the corridor that has demonstrated the highest transit ridership (between the Metro Orange Line in the San Fernando Valley to the Metro Expo Line in West LA) and highest vehicle throughput (between the U.S. 101 in the San Fernando Valley and La Grange Avenue/Santa Monica Blvd in West LA). Rough Order of Magnitude (ROM) cost estimates for this initial segment were calculated based on unit costs utilized in the Preliminary Cost Report for the full-length concepts, and were adjusted based on the shorter length of these "Initial Segments."

Concept 1 (Table C-1) – Van Nuys/Sepulveda BRT: The "initial segment" would extend from the Metro Orange Line/Van Nuys Station to the Metro Expo Line Sepulveda Station, a length of approximately 12.5 miles. Concept 1's initial segment would include 3 Bus Rapid Transit (BRT) stations, versus 8 for the full length concept. The initial segment would include roughly 40 priority treatments at intersections and 3 Intersection/Median reconfigurations versus 85 priority treatments and 5 reconfigurations under the full length concept. In addition, the initial segment would only require approximately 5 Queue Jump Lanes versus 20 for the entire concept. The Initial Segment of Concept 1 would cost approximately $146 million versus $163 million for the full length Concept.

Concept 2 (Table C-2) – BRT in At-Grade Freeway Managed Lanes: The "initial segment" would extend from U.S. 101 in the San Fernando Valley to the La Grange Avenue in West LA, a distance of approximately 10.5 miles, versus 29 miles for the entire concept. This reduces the cost of construction of the Express/HOT Lanes to $210 million versus $418 million for the entire corridor/concept. The initial segment would require 2 Direct Access Ramps, versus 3 DARs for the full length concept. The Initial Segment of Concept 2 would cost approximately $1.18 billion versus $1.68 billion for the full length Concept.

Concept 3 (Table C-3) – BRT with Aerial Viaduct Managed Lanes: Since Concept 3 is already focused on capital improvements through the Sepulveda Pass itself, the initial segment is almost exactly similar in length and cost. The only difference is that a Direct Access Ramp at Sepulveda/I-405 (near LAX) would not be constructed under the Initial Segment, thereby lowering its cost to about $2.13 million versus $2.33 million for the full length concept.

Concept 4 (Table C-4) – BRT with Tolled Highway Tunnel: Since this concept's major capital improvement includes the construction of a 9.1-mile tunnel through the Sepulveda Pass, between U.S. 101 and La Grange Avenue, the "initial segment" cost is the same.

Concept 5A (Table C-5A) – Fixed-Guideway LRT: The "initial segment" would run from the Metro Orange Line Van Nuys Station to the Metro Expo Line Sepulveda station in West LA, a distance of 10.2- miles. The "initial segment" would include a 9.4-mile twin bore tunnel through the Sepulveda Pass and Westwood Village, as well as the tunnel portals and all 4 underground transit stations included in the full length concept. The at-grade portion of the route would extend for 2.7 miles (2 miles in the San Fernando Valley and 0.7 miles in the Westside/Westwood, versus 20.3 miles of at-grade light rail (11.6 miles in the San Fernando Valley and 8.7 miles from Westside to LAX) under the full length concept. The "initial segment" includes 2 at-grade stations versus 10 at-grade transit stations under the full length concept. The Initial Segment of Concept 5A would cost approximately $5.49 billion versus $7.40 billion for the full length Concept.

Concept 5B (Table C-5B) – Fixed Guideway HRT: The "initial segment" would run from the Metro Orange Line Van Nuys Station to the Metro Expo Line Sepulveda station in West LA, a distance of 10.2 miles. The "initial segment" would include 10.2 miles of twin bore tunnels, including 4 portals and 5 underground transit stations, versus the full length concept, which would include 29.7 miles of twin bore tunnel, 4 portals, and 14 underground transit stations. The Initial Segment of Concept 5B would cost approximately $5.10 billion versus $13.62 billion for the full length Concept.

Concept 6 (Table C-6) – Toll Tunnel and Rail Tunnel: The highway "initial segment" consists of a 58 ft. diameter tunnel from U.S. 101 in the San Fernando Valley to La Grange Avenue in West LA, a distance of 9.2-miles, and will include 2 portals and approaches to the tunnel, versus 4 portals and approaches under the full length concept. The initial segment would not require the 45 ft. diameter tunnel, portals and approaches, since these would be located north of U.S. 101 and south of La Grange Avenue.

The transit "initial segment" would include twin bore tunnels from the Metro Orange Line Van Nuys Station, to the Metro Expo Line Sepulveda station, a distance of 10.2-miles, versus 20.7 miles of twin bore tunnels for the full length concept. The "initial segment" includes 3 underground stations versus 5 underground stations under the full length concept.

The Initial Segment of Concept 6 (including the rail and toll tunnel) would cost approximately $16.10 billion versus $30.75 billion for the full length Concept.

Table 3-1: Shoulder Running BRT

Improvement/Item	Unit	FULL LENGTH (30 miles)		INITIAL LENGTH (12.5 miles)	
		Quantity	Cost	Quantity	Cost
Shoulder Improvements	Miles	8.4	$21,000,000	8.4	$21,000,000
BRT Stations	Each	8	$8,000,000	3	$3,000,000
OG Turnaround	Each	1	$1,250,000	1	$1,250,000
Priority Treatments at Intersections	Each	85	$3,400,000	40	$1,600,000
Intersection/Median Reconfiguration	Each	5	$2,500,000	3	$1,500,000
Queue Jump Lanes	Each	20.0	$7,000,000	5.0	$1,750,000
SUBTOTAL			$43,150,000		$30,100,000
Programmatic Adjustment			$21,575,000		$21,575,000
30% Contingency			$19,417,500		$15,502,500
Vehicle Costs			$78,400,000		$78,400,000
TOTAL			**$162,542,500**		**$145,577,500**

Table 3-2: BRT in At-Grade Freeway Managed Lanes

Improvement/Item	Unit	FULL LENGTH (29 miles)		INITIAL LENGTH (10.5 miles)	
		Quantity	Cost	Quantity	Cost
Construction of Express Lanes	Miles	29	$417,600,000	10.5	$210,000,000
Direct Access Ramps	Each	3	$450,000,000	2	$300,000,000
U.S. 101 Direct Access Ramps	Each	1	$300,000,000	1	$300,000,000
At-Grade BRT Improvements	Each	1	$64,725,000	1	$51,675,000
SUBTOTAL			$1,232,325,000		$861,675,000
30% Contingency			$369,697,500		$244,777,500
Vehicle Costs			$78,400,000		$78,400,000
TOTAL			**$1,680,422,500**		**$1,184,852,500**

Table 3-3: Aerial/Viaduct Managed Lanes with BRT

Improvement/Item	Unit	FULL LENGTH (9.8 miles)		INITIAL LENGTH (10.5 miles)	
		Quantity	Cost	Quantity	Cost
Elevated Guideway	Miles	9.8	$1,087,800,000	9.8	$1,087,800,000
Direct Access Ramps	Each	4	$600,000,000	3	$450,000,000
At-Grade BRT Improvements	Each	1	$43,150,000	1	$43,150,000
SUBTOTAL			$1,730,950,000		$1,580,950,000
30% Contingency			$519,285,000		$474,285,000
Vehicle Costs			$78,400,000		$78,400,000
TOTAL			**$2,328,635,000**		**$2,133,635,000**

Table 3-4: Tolled Highway Tunnel with BRT

Improvement/Item	Unit	FULL LENGTH (9.2 miles)		INITIAL LENGTH (9.2 miles)	
		Quantity	Cost	Quantity	Cost
58 ft. Diameter Tunnel	Miles	9.2	$7,683,840,000	9.2	$7,683,840,000
58 ft. Diameter Portal and Approaches	Each	2	$300,000,000	2	$300,000,000
SUBTOTAL			$7,983,840,000		$7,983,840,000
30% Contingency			$2,395,152,000		$2,395,152,000
Vehicle Costs			$78,400,000		$78,400,000
TOTAL			**$10,457,392,000**		**$10,457,392,000**

Table 3-5A: Fixed Guideway LRT

Improvement/Item	Unit	FULL LENGTH (27.8 miles)		INITIAL LENGTH (10.2 miles)	
		Quantity	Cost	Quantity	Cost
Tunnel Segment - Two 20 ft. Tunnels	Miles	9.4	$3,981,600,000	9.4	$3,981,600,000
20 ft. Diameter Portal	Each	4	$200,000,000	4	$200,000,000
Underground Transit Stations	Each	4	-$300,000,000	4	-$300,000,000
At-Grade Light Rail (SF Valley portion)	Miles	11.6	$986,000,000	2.0	$170,000,000
At-Grade Light Rail (Westside to LAX portion)	Miles	8.7	$739,500,000	0.7	$59,500,000
At-Grade Transit Stations	Each	10	-$15,000,000	2	$10,000,000
Maintenance Facility	Each	1	$100,000,000	1	$100,000,000
SUBTOTAL			$5,692,100,000		$4,221,100,000
30% Contingency			$1,707,630,000		$1,266,330,000
TOTAL			**$7,399,730,000**		**$5,487,430,000**

Table 3-5B: Fixed Guideway HRT

Improvement/Item	Unit	FULL LENGTH (29.7 miles)		INITIAL LENGTH (10.2 miles)	
		Quantity	Cost	Quantity	Cost
Tunnel Segment - Two 20 ft. Tunnels	Miles	29.7	$11,975,040,000	10.2	$4,112,640,000
20 ft. Diameter Portal	Each	4	$200,000,000	4	$200,000,000
Underground Transit Stations	Each	14	-$1,800,000,000	5	-$500,000,000
Maintenance Facility	Each	1	$100,000,000	1	$100,000,000
SUBTOTAL			$10,475,040,000		$3,912,640,000
30% Contingency			$3,142,512,000		$1,173,792,000
TOTAL			**$13,617,552,000**		**$5,086,432,000**

Table 3-6: Toll Tunnel and Rail Tunnel

Improvement/Item	Unit	FULL LENGTH (21 miles)		INITIAL LENGTH (9.2 - 10.2 miles)	
		Quantity	Cost	Quantity	Cost
Highway					
58 ft. Diameter Tunnel	Miles	17	$14,198,400,000	9.2	$7,683,840,000
58 ft. Portal and Approaches	Each	4	$600,000,000	2	$300,000,000
45 ft. Tunnel	Miles	4	$2,012,800,000	n/a	n/a
45 ft. Diameter portal & Approaches	Each	1	$150,000,000	n/a	n/a
SUBTOTAL HIGHWAY			$16,961,200,000		$7,983,840,000
30% Contingency			$5,088,360,000		$2,971,440,000
TOTAL			**$22,049,560,000**		**$10,955,280,000**
Transit					
20 ft. Diameter Portal	Each	1	$50,000,000	1	$50,000,000
Two 20 ft. Tunnels	Miles	20.7	$8,346,240,000	10.2	$4,112,640,000
Underground Stations	Each	5	-$1,800,000,000	3	-$800,000,000
Maintenance Facility	Each	1	$100,000,000	1	$100,000,000
SUBTOTAL TRANSIT			$6,696,240,000		$3,462,640,000
30% Contingency			$2,008,872,000		$1,677,240,000
TOTAL			**$8,705,112,000**		**$5,139,880,000**
CONCEPT 6 TOTAL	_	_	**$30,754,672,000**	_	**$16,095,160,000**

Summary Table: Full Length vs. Initial Segment Costs

Concept	Initial Segment Cost (9.2 to 12.5 miles)	Full Length Cost (21 to 30 miles)
1 - Shoulder Running BRT	$145,577,500	$162,542,500
2 - BRT in At-Grade Freeway Managed Lanes	$1,184,852,500	$1,680,422,500
3 - Aerial/Viaduct Managed Lanes with BRT	$2,133,635,000	$2,328,635,000
4 - Tolled Highway Tunnel with BRT	$10,457,392,000	$10,457,392,000
5A - Fixed Guideway LRT	$5,487,430,000	$7,399,730,000
5B - Fixed Guideway HRT Tunnel	$5,086,432,000	$13,617,552,000
6 - Toll Tunnel and Rail Tunnel	$16,095,160,000	$30,754,672,000

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APPENDIX A – ENVIRONMENTAL ISSUES TECHNICAL PAPER

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Sepulveda Pass Corridor Systems Planning Study

Environmental Issues Technical Paper

Prepared for:

Metro

Prepared by:

AECOM

October 2012

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1. INTRODUCTION

The Los Angeles County Metropolitan Transportation Authority (Metro) is conducting the Sepulveda Pass Corridor Systems Planning Study to identify a broad range of reasonable multi-modal systems planning concepts for the Sepulveda Pass corridor which include highway and transit improvements. The study identifies potential connections to other existing and future transit lines that traverse the study area and considers various systems planning concepts, grade-separated tunnel systems, and multi-modal transit and express toll road facilities.

The purpose of this paper is to use the findings of the Environmental Planning Team's existing environmental conditions report within the study corridor to preliminarily analyze the environmental challenges of each concept plan.

2. BACKGROUND INFORMATION

The current Sepulveda Pass Corridor Systems Planning Study evaluates a 30-mile corridor and provides a much-needed, north-south link from the northern San Fernando Valley to the Los International Airport (LAX). Within this corridor, the Sepulveda Pass extends seven miles connecting the San Fernando Valley to West Los Angeles via the San Diego Freeway (I-405) and Sepulveda Boulevard. It begins just south of Ventura Boulevard in the San Fernando Valley, and extends through the Santa Monica Mountains to Brentwood and Westwood. It is an important regional transportation corridor, providing a crucial link between the heavy concentration of households in the San Fernando Valley and major employment and activity centers of Los Angeles County's Westside Region.

3. SYSTEMS CONCEPTS AND PHYSICAL IMPROVEMENTS

A set of systems concepts was refined and presented at the Planning Charrette #2. The following physical changes were identified for each concept.

3.1. CONCEPT #1: AT-GRADE SEPULVEDA BOULEVARD BUS RAPID TRANSIT

This 29.7-mile concept anticipates a Bus Rapid Transit (BRT) which connects the San Fernando Valley from the Sylmar/San Fernando Metrolink Station to the Century/Aviation Metro Rail station near LAX. The concept would share a guideway with the East San Fernando Valley Transit Corridor from the Sylmar Metrolink station along San Fernando Boulevard and Van Nuys Boulevard, and then utilize 4.5 miles of existing shoulder on the I-405 freeway through the Sepulveda Pass during peak periods. The BRT would enter the I-405 at Burbank Boulevard and exit at Getty Center Drive. The southern route would utilize Sepulveda Boulevard down to the Century/Aviation station.

Physical improvements would include:

- Conversion of the median along Van Nuys Boulevard in the San Fernando Valley to a dedicated busway.

3.2. CONCEPT #2: AT-GRADE FREEWAY MANAGED LANES

This 29-mile concept would have a managed lanes component along the I-405 and a BRT route utilizing the proposed guideway for the East San Fernando Valley Transit Corridor from the Sylmar Metrolink station. Direct access ramps would be constructed at the Orange Line busway, US-101/I-405 interchange, La Grange Avenue, and Sepulveda Boulevard/Howard Hughes Parkway. To obtain the 5+2 configuration through the Sepulveda Pass, potential spot widening would be required west of the I-405 (southbound direction) between Sepulveda Boulevard and Wilshire Boulevard.

Physical improvements would include:

- Direct access ramp connecting to the Orange Line busway for BRTs (Figure 1)
- Direct access ramp connections from eastbound US-101 to southbound I-405 and northbound I-405 to westbound US-101 (Figure 2)
- Direct access ramp at La Grange Avenue, south of Santa Monica Boulevard and treatments to adjacent local streets, Beloit Avenue and Cotner Avenue (Figure 3)
- Direct access ramp at Sepulveda Boulevard, south of SR-90, (Figure 4) or Howard Hughes Parkway (Figure 5)

Figure 1. Orange Line Busway Direct Access Ramp

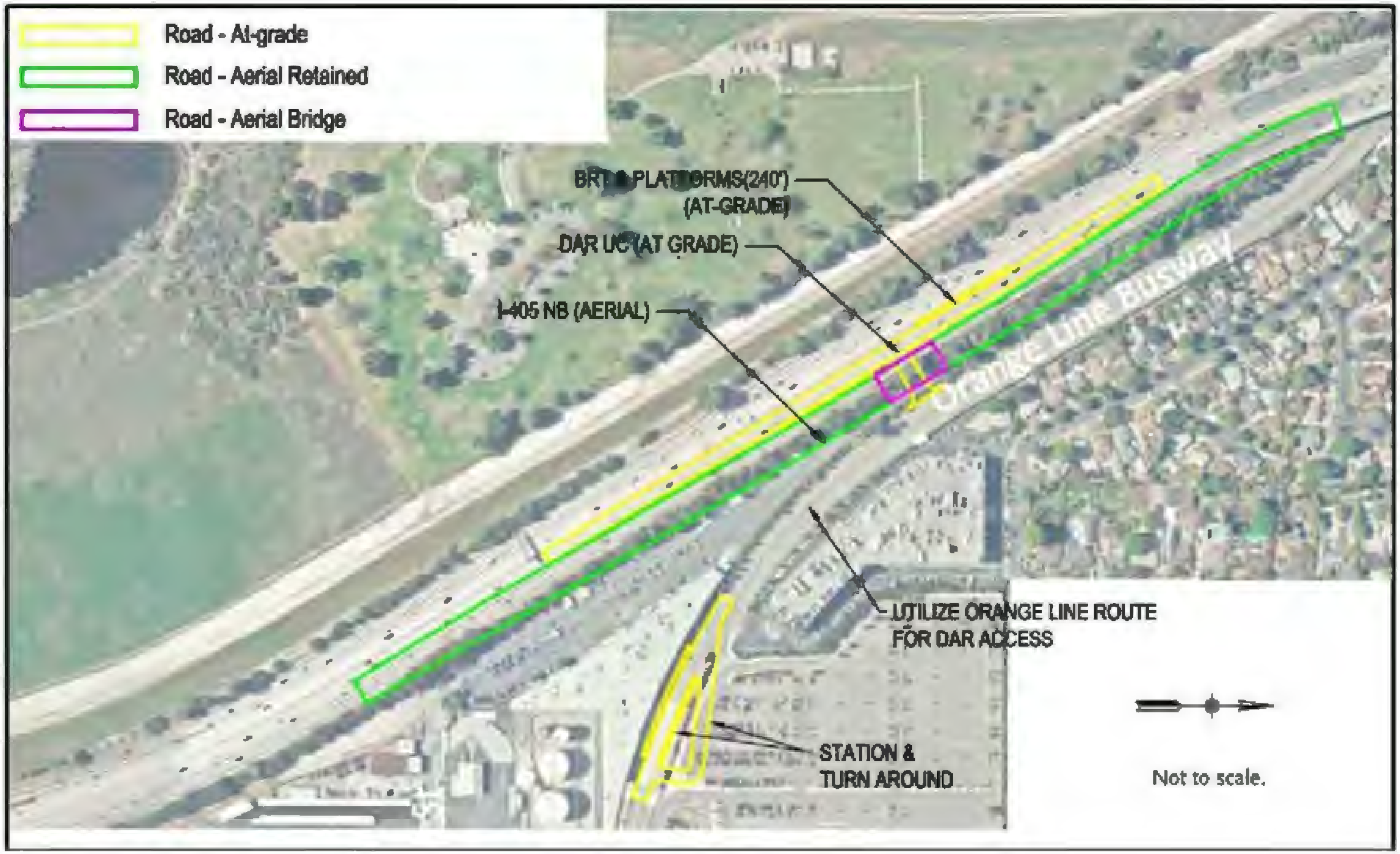

Figure 2. US-101/I-405 Direct Access Ramp Connectors

Figure 3. La Grange Avenue Direct Access Ramp

Figure 4. Sepulveda Boulevard Direct Access Ramp

Figure 5. Howard Hughes Parkway Direct Access Ramp

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3.3. CONCEPT #3: HIGHWAY VIADUCT MANAGED LANES

This concept would construct an approximately 9.9-mile, 4-High Occupancy Toll (HOT)-lane highway viaduct above the I-405 from the US-101 to I-10. Direct access ramps would be located just north of the US-101 at Burbank Boulevard, at the US-101/I-405 interchange, and at Pico Boulevard. The BRT service would utilize existing or planned footprints, including the existing High Occupancy Vehicle (HOV) lanes on I-405.

Physical improvements would include:

- An 66-foot wide elevated guideway above the median of the I-405 between US-101 and I-10 supported by 10-foot wide columns
- Instead of widening the existing I-405 footprint, 5-feet of shoulder from the exiting northbound and southbound directions would be used for the column supports
- Direct access ramp at Burbank Boulevard (Figure 6)
- Direct access-ramps at the US-101/I-405 interchange (Figure 6)
- Direct access ramp at Pico Boulevard (Figure 7)

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Figure 6. Direct Access Ramps at Burbank Boulevard and US-101/I-405 Interchange

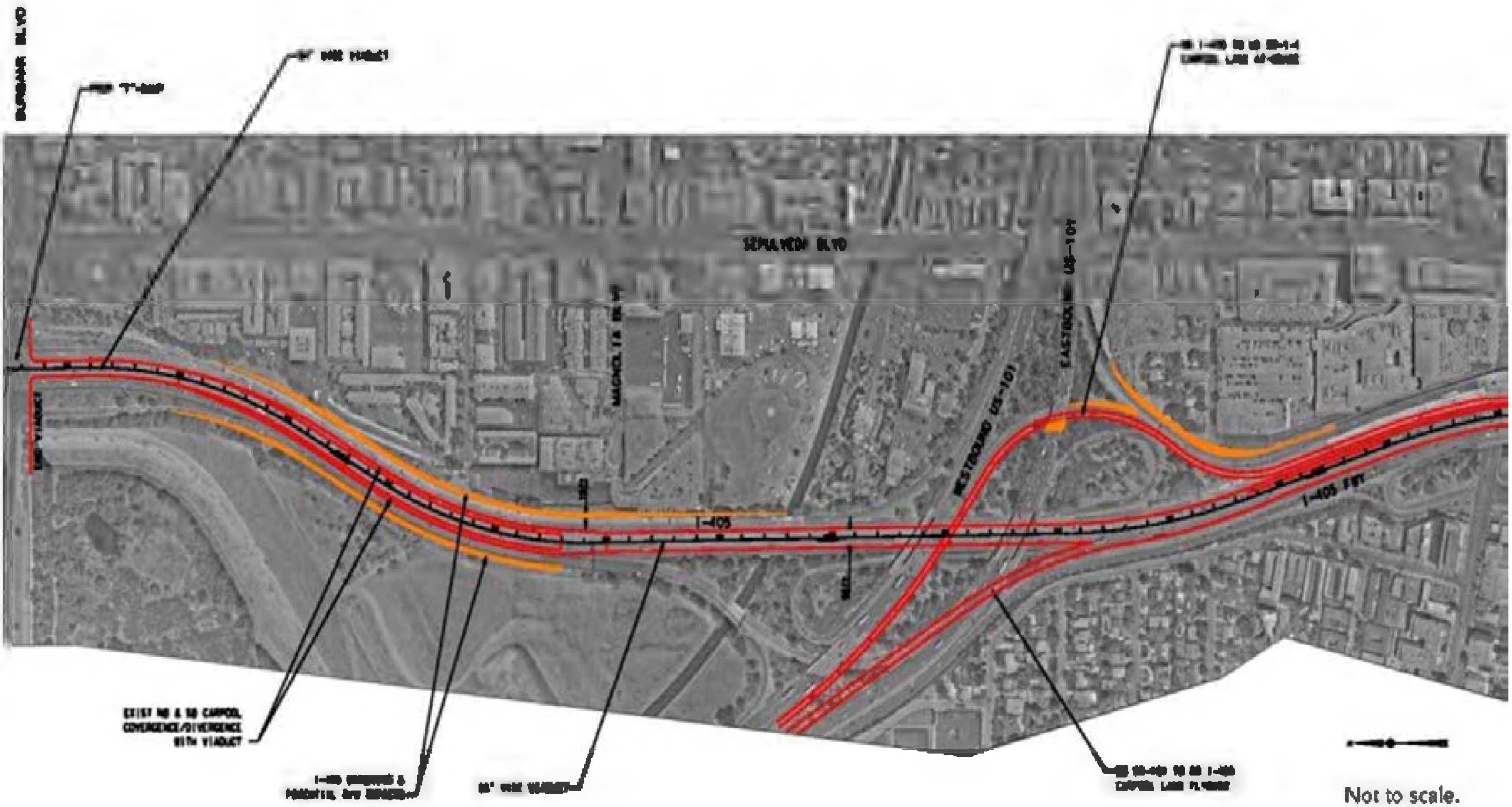
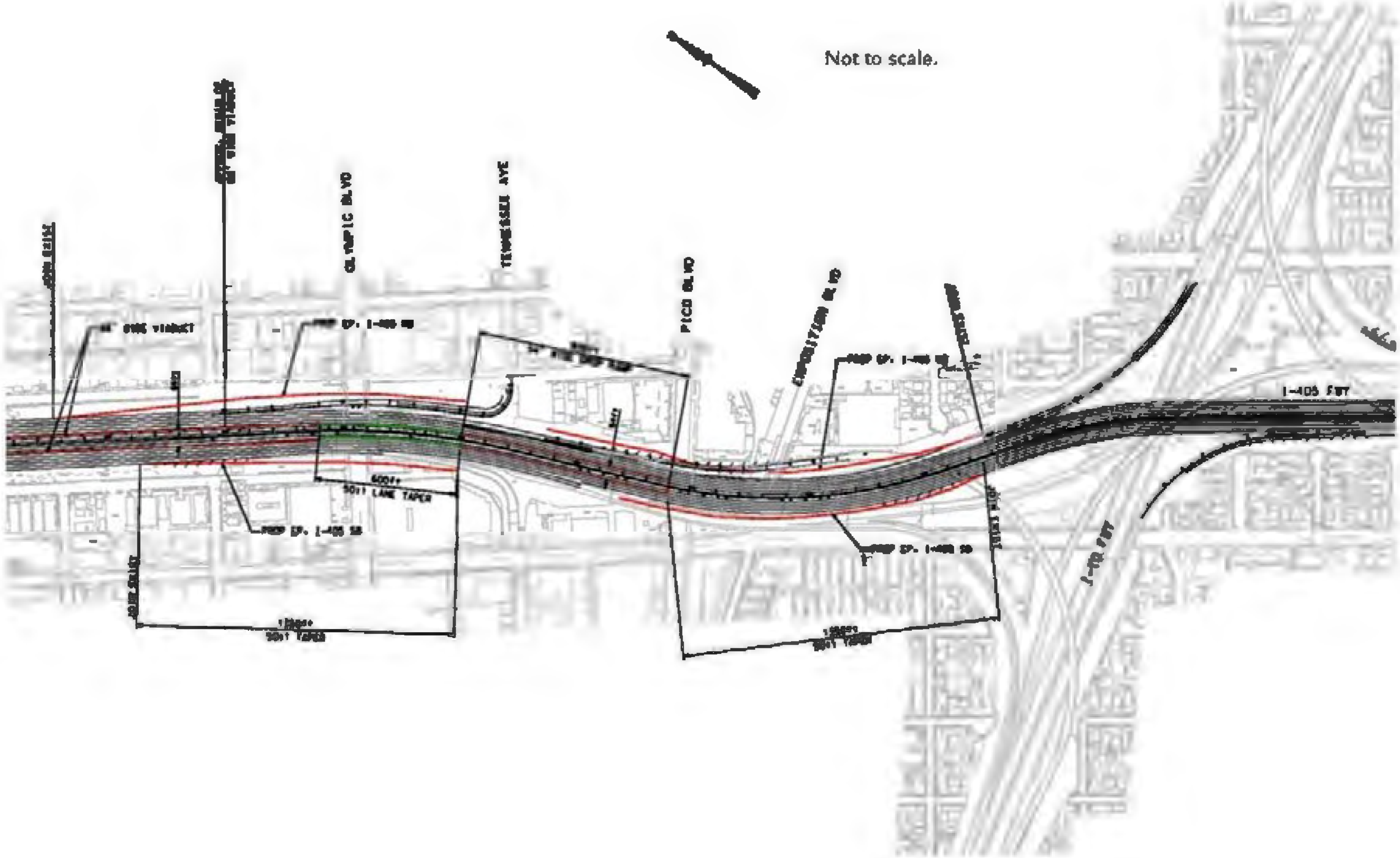


Figure 7. Direct Access Ramp at Pico Boulevard



3.4. CONCEPT #4: TOLLED HIGHWAY TUNNEL

This concept would construct a 10.5-mile, 4-lane tunnel through Sepulveda Pass. The northern and southern portals would be constructed north of US-101 and at La Grange Avenue, respectively. Direct connectors from eastbound US-101 and southbound I-405 would also be constructed.

Physical improvements would include:

- A bored tunnel (approximately 45 to 60 feet in diameter) under the Santa Monica Mountains with a northern terminus at the US-101/I-405 interchange (Figure 8) and a southern terminus at La Grange Avenue (Figure 9)

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Figure 8. Tunnel Northern Terminus at US-101/I-405 Interchange

Figure 9. Tunnel Southern Terminus at La Grange Avenue

3.5. Concept #5: Fixed-Guideway Rail Transit Tunnel

This concept would construct a 27.8-mile light rail transit (LRT) line from the Sylmar Metrolink on local roads north of the Sepulveda Pass (along Ventura and Van Nuys Boulevards) through Sepulveda Pass in a 6-mile tunnel, to Century/Aviation on local roads south of the Sepulveda Pass (along Westwood Boulevard, Overland Avenue, and Sepulveda Boulevard). The local road alignment would be at-grade in a dedicated median-running right-of-way. Additionally, this concept also includes an alternate heavy rail transit (HRT) option with fully grade-separation and at-grade-separation at major arterials on the same alignment.

Physical improvements would include:

- Conversion of the median along Van Nuys Boulevard, in the San Fernando Valley, Westwood Boulevard, Overland Avenue, and Sepulveda Boulevard to a dedicated LRT alignment running mostly at-grade or a fully separated HRT alignment fully separated or at-grade separated at major arterials
- Twin bore tunnels through the Santa Monica Mountains with a northern terminus at Ventura Boulevard and Van Nuys Boulevard and a southern terminus within the UCLA campus north of Westwood Boulevard

3.6. Concept #6: Highway/Private Shuttle Tunnels

This concept would combine elements of Concepts 4 and 5 and provide separate highway and private rail shuttle tunnels (each approximately 21 miles long) from US-101 to the Century/Aviation station of the Crenshaw/LAX and Green Lines. The highway tunnel would have northern and southern portals at Roscoe Boulevard and Century Boulevard, respectively, and 3 intermediate access points at US-101/I-405 Interchange or Ventura Boulevard, La Grange Avenue, and Howard Hughes Parkway. The private shuttle would tunnel through the Sepulveda Pass with northern and southern portals at the Van Nuys Metrolink station and Century/Aviation station, respectively, and in-line stations at the Orange Line (Oxnard Street/Van Nuys Boulevard), Purple Line (Wilshire Boulevard/Westwood Boulevard), and Expo Line (Expo Boulevard/Sepulveda Boulevard).

Physical improvements would include:

- A longer bored highway tunnel, with a northern terminus at Roscoe Boulevard (Figure 10) and a southern terminus at Century Boulevard (Figure 11)
- Additional portal locations at US-101/I-405 Interchange (Figure 8), La Grange Avenue (Figure 9), and Sepulveda Boulevard (Figure 12)
- An additional bored tunnel for a private shuttle service

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Figure 10. Tunnel Northern Terminus at Roscoe Boulevard

Figure 11. Tunnel Southern Terminus at Century Boulevard

Figure 12. Portal Location at Sepulveda Boulevard

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4. ENVIRONMENTAL CHALLENGES

This section will describe the environmental challenges each concept would encounter given the physical improvements for each concept footprint. The environmental analysis is divided into three main categories: Human, Natural, and Physical Environments.

The Human Environment encompasses concerns associated with the community and local populations. This category comprises of the following environmental issues:

- Environmental Justice
- Relocations
- Section 4f (including Cultural Resources and Recreational Resources)
- Visual Resources

The Natural Environment comprises of the biological and hydrological concerns of the area and includes the following environmental issues:

- Biological Resources (including Wildlife Corridors and Sensitive Species)
- Hydrology and Water Quality[1]

The Physical Environment addresses ambient concerns that effect both the human and natural environment. This category comprises of the following environmental issues:

- Air Quality
- Hazards and Hazardous Materials
- Noise

Table 1 summarizes the environmental challenges for the six concepts. The following lists the top five findings regarding environmental challenges for the Sepulveda Pass Corridor Systems Planning Study. Each concept will be discussed in more detail in the section below.

1. **Minimal environmental impacts for Concepts 1 and 2.** Concepts 1 and 2 could be constructed with minimal environmental impacts. Concept 1 would involve virtually no disturbance to environmental resources and Concept 2 would have only minor disturbances. The only environmental concerns raised with Concept 1 are associated with the dedicated busway that may be located along the median of Van Nuys Boulevard; at the far northern end of the project limits, the proposed busway may

[1] According to the I-405 Sepulveda Pass Widening Project Final Environmental Impact Report/ Environmental Impact Statement and Section 4(f) Evaluation (January 2008), six treatment Best Management Practice (BMP) features including two infiltration trenches, one infiltration/detention basin, and three bio-filtration swales will be incorporated into the existing system.

impact landscaping in the median and farther south, the busway may interfere with the "unofficial" use of the median as a loading/unloading zone for the car dealerships. Concept 1 would not cause any concerns for the natural environment and would have only very minor, intermittent effects on the physical environment associated with the noise of the buses traveling on the shoulder. Similar to Concept 1, Concept 2 would have only minor concerns for the physical environment related to air quality and noise as a result of traffic moving closer to receptors as vehicles move to use the outer pavement along the I-405. Concept 2 would only raise concerns for the natural environment if widening outside of existing pavement through the Sepulveda Pass is included. For the human environment, the concerns with Concept 2 are again, relatively minor, and would include the need to avoid Section 4(f) resources near the Sepulveda Basin, localized traffic concerns in the vicinity of the direct access ramps and the need to work with the community regarding issues such as aesthetics and property acquisitions.

2. **Tunnel/Direct Access Ramp Components (Concepts 2, 4, 5, and 6).** The concepts that involve tunnel work (Concepts 4, 5, and 6) would raise concerns regarding the placement of ventilation outflows along the tunnel corridor. Additional environmental analysis would be needed as potential sites for ventilation are selected in order to avoid Section 4(f), natural, and community resources through the Sepulveda Pass. The tunnel portals and the location of direct access ramps would also need to be carefully designed in order to minimize and avoid, to the extent feasible, concerns related to local traffic circulation, localized noise and air quality effects, and potential property acquisitions. One advantage to tunnel options is that potential permanent noise and visual impacts within the Sepulveda Pass itself would be contained in the tunnel. During construction, the hauling of excavated material away from the site would need to be carefully coordinated in order to best minimize potential noise and community effects.

3. **Above-Ground Components (Concepts 1, 2, 3, 4, 5, and 6).** As previously discussed, Concepts 1 and 2 would have no to minor environmental concerns. Concept 3 was not studied in detail as a part of this effort due, in part, to concerns with noise, visual, and community acceptance. The remaining concepts all involve some degree of above-ground work. The primary concerns associated with the above-ground components would be related to noise, air quality, property acquisition and aesthetics. The heavy rail option under Concept 5 would raise greater noise concerns than a light rail option and depending upon the power source for the trains, a heavy rail option may also raise additional air quality concerns. Grade separations for the options with rail would also need further environmental analysis for issues such as visual (design and heights of structures), noise (how would the potential elevation of the trains affect noise) and property acquisitions (would grade separations require additional right of way).

4. **Community Involvement.** The communities along the Sepulveda Pass and the I-405 corridor currently under construction would be particularly sensitive to any new

proposed project in the area. Going forward, it will be extremely important to work the community in the development of design plans and the environmental document. Low-income and minority populations have been identified along the corridor, notably in the location of the direct access ramp near Roscoe Boulevard; environmental justice concerns would need to be further investigated.

5. **Section 4(f) and Federal Lands.** The study area contains several properties that should be avoided as the proposed concepts continue into further development. The Sepulveda Basin, located northwest of the I-405/US-101 interchange, contains several resources protected by Section 4(f), including a wildlife refuge and multiple recreation areas. Portions of the Santa Monica Mountains and associated recreational trails are also protected by Section 4(f). In the vicinity of the I-405 and Wilshire Boulevard, federal lands associated with the Veteran's Administration buildings and national cemetery also serve as major constraints on the proposed project and some facilities located on that federal land are also protected as historical sites under Section 4(f).

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Table 1. Summary of Environmental Challenges

	1 Sepulveda BRT	2 Managed Lanes* Caltrans ROW within Existing Pavement	2 Managed Lanes* Caltrans ROW but Outside Pavement	3 Highway Viaduct	4 Toll Tunnel	5 Fixed-Guideway Rail	6 Highway and Shuttle Tunnel
Human Environment	Along Van Nuys Boulevard • Visual concerns due to loss of landscaped median • Loss of "unofficial loading zone" for car dealerships	Orange Line Direct Access Ramp • Some property acquisition needed from businesses along I-405 (i.e., LAFD training facility and local business parking areas) Southern Direct Access Ramp • Traffic concerns to residences and businesses	At US 101/I-405 Interchange • Must stay within Caltrans right of way or risk Section 4(f) use If spot widening outside of pavement through the Sepulveda Pass along southbound I-405 • Visual concerns • Potential community controversy	Widening south of Burbank Boulevard • Property acquisition of businesses • Environmental justice concerns • Use of Sepulveda Basin would trigger Section 4(f) • Potential community controversy Viaduct structure • Substantial visual intrusion	Widening at tunnel termini • Some property acquisition needed from businesses along I-405 (i.e., LAFD training facility, local business parking areas, West LA businesses at La Grange Avenue) Portal locations • Traffic concerns to residences and businesses • Potential community controversy	Tunnel portals • Visual concerns • Property acquisitions likely • Potential community controversy Along Van Nuys Boulevard • Visual concerns due to loss of landscaped median • Loss of "unofficial loading zone" for car dealerships	Tunnel portals • Environmental justice concerns near Roscoe Boulevard • Property acquisitions likely • Must stay within Caltrans right of way at US 101/ I-405 or risk Section 4(f) use • Traffic concerns to residences and businesses • Visual concerns • Potential community controversy
Natural Environment	No physical improvements anticipated outside of existing pavement, therefore no concerns associated with the natural area would occur.	Addition of lanes and increase in vehicular capacity • Minor water quality and stormwater concerns	At US 101/I-405 Interchange • Must stay within Caltrans right of way or risk use of wildlife refuge If spot widening outside of pavement through the Sepulveda Pass along southbound I-405 • Concerns with coastal sage scrub, a sensitive vegetation community • Concerns with 3 existing wildlife corridors in area	At US 101/I-405 Interchange • Must stay within Caltrans right of way or risk use of wildlife refuge Addition of lanes and increase in vehicular capacity • Minor water quality and stormwater concerns	At US 101/I-405 Interchange • Must stay within Caltrans right of way or risk use of wildlife refuge Addition of lanes and increase in vehicular capacity • Minor water quality and stormwater concerns	Portal locations may have potential concerns; more detailed design and analysis would be needed	At US 101/I-405 Interchange • Must stay within Caltrans right of way or risk use of wildlife refuge Addition of lanes and increase in vehicular capacity • Minor water quality and stormwater concerns
Physical Environment	The addition of buses traveling on the shoulder lane would move traffic closer to sensitive receptors for air quality and noise.	• Hazardous materials may be present in area Addition of lanes and increase in vehicular capacity • Move traffic closer to sensitive receptors for air quality and noise	• Hazardous materials may be present in area Addition of lanes and increase in vehicular capacity • Move traffic closer to sensitive receptors for air quality and noise	• Hazardous materials may be present in area Addition of lanes and increase in vehicular capacity • Potential noise and air quality concerns; soundwalls may not be feasible on viaduct structure and would increase visual concerns	• Hazardous materials may be present in area Addition of lanes and increase in vehicular capacity • Ventilation and air quality concerns • Increased noise mostly contained within tunnel	• Hazardous materials may be present in area With the exception of the underground transit-only tunnel, the alignment would occur within existing footprints • Increased noise mostly contained within tunnel	• Hazardous materials may be present in area Addition of lanes and increase in vehicular capacity • Ventilation and air quality concerns • Increased noise mostly contained within tunnel

* The Managed Lanes Concept 2 analysis provides two rankings: 1) for all improvements within the **existing pavement**, and 2) for all improvements within **Caltrans right of way** but necessitating some work outside of existing pavement. Environmental challenges for improvements within Caltrans right of way but outside pavement would include all environmental challenges listed under Caltrans right of way within the existing pavement.

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4.1. CONCEPT #1

For the At-Grade Sepulveda Boulevard BRT Concept, the alignment would primarily stay within the existing paved footprint. As such, there are minimal environmental challenges to the natural and physical environments. However, because the median along Van Nuys Boulevard would be converted into a dedicated busway, there are potential environmental concerns associated with the human environment. Specifically, the loss of the landscaped median would raise visual concerns (Figure 13a) as well as the loss of the unofficial loading zone for car dealerships located in the vicinity of Van Nuys Boulevard and Burbank Boulevard (Figure 13b).

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Figure 13a. Environmental Concerns at the Van Nuys Boulevard Median

Figure 13b. Environmental Concerns at the Van Nuys Boulevard Median

4.2. CONCEPT #2

For the At-Grade Freeway Managed Lanes Concept, the alignment could either stay within the existing pavement of the Caltrans right-of-way, or stay within the Caltrans right-of-way but require spot widening outside of the existing pavement along southbound I-405 through the Sepulveda Pass.

For both alignments, the following environmental challenges would occur:

- Human Environment
    - Property acquisition would be required from businesses along I-405, including the Los Angeles Fire Department (LAFD) training facility and local business parking areas, for construction of the Orange Line Direct Access Ramp (Figure 14a)

- Natural Environment
    - Minor water quality and stormwater concerns would arise due to the addition of lanes and an increase in vehicular capacity

- Physical Environment
    - Hazardous materials may be present in areas where direct access ramps would be constructed
    - Addition of lanes and increase in vehicular capacity would move traffic closer to sensitive receptors for air quality and noise (Figure 14b)

If construction is required outside of the existing pavement of the Caltrans right-of-way (i.e., spot widening along southbound I-405), the following environmental challenges would occur in addition to the ones previously listed:

- Human Environment
    - Construction at the US-101/I-405 interchange must stay within the Caltrans right-of-way or risk Section 4(f) use
    - Widening and new construction would have visual concerns and generate community controversy

- Natural Environment
    - Construction at the US-101/I-405 interchange must stay within Caltrans right-of-way or risk use of the Sepulveda Basin Wildlife Refuge
    - Concerns with coastal sage scrub, a sensitive vegetation community, and three existing wildlife corridors would occur in areas requiring spot widening through the Sepulveda Pass along southbound I-405 (Figure 14c)

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Figure 14a. Environmental Concerns at the US-101/I-405 Interchange

Figure 14b. Environmental Concerns at the La Grange Direct Access Ramp

Figure 14c. Environmental Concerns through the Sepulveda Pass

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4.3. CONCEPT #3

For the Highway Viaduct Managed Lanes Concept, an elevated aerial guideway would be constructed above the I-405, within the existing right-of-way, between US-101 and I-10.

The following environmental challenges would occur with this concept:

- Human Environment
  - Widening south of Burbank Boulevard for the direct access ramp would
    - Require property acquisition of businesses
    - Potentially displace environmental justice populations
    - Trigger Section 4(f) if Sepulveda Basin is used
    - Generate community controversy
  - Substantial visual intrusion with the physical construction of the aerial viaduct

- Natural Environment
  - Construction of the direct access ramps at the US-101/I-405 interchange must stay within Caltrans right-of-way or risk use of the Sepulveda Basin Wildlife Refuge
  - Minor water quality and stormwater concerns would arise due to the addition of lanes and an increase in vehicular capacity

- Physical Environment
  - Hazardous materials may be present in areas where direct access ramps would be constructed
  - Addition of lanes and increase in vehicular capacity would move traffic closer to sensitive receptors for air quality and noise
  - Soundwalls may not be feasible on the viaduct structure and would increase visual concerns

4.4. CONCEPT #4

For the Tolled Highway Tunnel Concept, an underground tunnel would be constructed through the Sepulveda Pass from the US-101/I-405 interchange to La Grange Avenue.

The following environmental challenges would occur with this concept:

- Human Environment
  - Property acquisition would be required from businesses along I-405, including the LAFD training facility, local business parking areas, and West Los Angeles businesses at La Grange Avenue for widening at the tunnel termini (Figures 15a and 15b)

- Traffic concerns may arise for residential areas along the local streets adjacent to La Grange Avenue (Figure 15b)
- If ventilation shafts are needed, there could be Section 4(f) use through the Santa Monica Mountains and also community controversy regarding their placement
- Construction of the portals and tunnel would generate community controversy

- Natural Environment
  - Construction of the portals at the US-101/I-405 interchange must stay within Caltrans right-of-way or risk use of the Sepulveda Basin Wildlife Refuge (Figure 15a)
  - Minor water quality and stormwater concerns would arise due to the addition of lanes and an increase in vehicular capacity

- Physical Environment
  - Hazardous materials may be present in areas where portals would be constructed
  - Addition of lanes and increase in vehicular capacity would move traffic closer to sensitive receptors for air quality and noise
  - Increased noise would mostly be contained within the tunnel

Figure 15a. Environmental Concerns at the US-101/I-405 Interchange Portals

Figure 15b. Environmental Concerns at the La Grange Avenue Portal

4.5. CONCEPT #5

The Fixed-Guideway LRT or HRT Tunnel Concept would construct an LRT or HRT line from the Sylmar Metrolink to LAX within the existing local road footprint and through Sepulveda Pass with an underground transit-only tunnel.

The following environmental challenges would occur with this concept:

- Human Environment
  - Conversion of the median to an LRT or HRT would
    - Raise visual concerns associated with the loss of the landscaped median (Figure 13a)
    - Displace the unofficial loading zone for car dealerships located in the vicinity of Van Nuys Boulevard and Burbank Boulevard (Figure 13b)
  - Construction of the tunnel portals at Ventura Boulevard and Van Nuys Boulevard and within the UCLA campus would
    - Create visual concerns
    - Require property acquisition of residences and/or businesses
    - Generate community controversy

- Natural Environment
  - Portal locations may have potential biological concerns. Additional environmental analysis would be required in the future to fully address any concerns raised by these options.

- Physical Environment
  - Hazardous materials may be present in areas where portals would be constructed
  - Increased noise would mostly be contained within the tunnel

4.6. CONCEPT #6

The Highway/Private Shuttle Tunnels Concept combines Concepts 4 and 5 and provides separate highway and private rail shuttle tunnels from US-101 to LAX. The highway tunnel would have 5 portal locations between Roscoe Boulevard and Century Boulevard. The private shuttle would have in-line stations between the northern portal at the Van Nuys Metrolink station and the southern portal at the Century/Aviation station.

The following environmental challenges would occur with this concept:

- Human Environment
  - Construction of both the highway or private shuttle tunnel portals would
    - Require property acquisition of residences and/or businesses

        - Potentially displace environmental justice populations (especially near Roscoe Boulevard) (Figure 16)
        - Trigger Section 4(f) of Sepulveda Basin if construction does not stay within the Caltrans right-of-way at the US-101/I-405 interchange
        - Substantial visual intrusion with the construction of portals
        - Generate community controversy

- Natural Environment
    - Construction of the portal at the US-101/I-405 interchange must stay within Caltrans right-of-way or risk use of the Sepulveda Basin Wildlife Refuge
    - Minor water quality and stormwater concerns would arise due to the addition of lanes and an increase in vehicular capacity

- Physical Environment
    - Hazardous materials may be present in areas where portals would be constructed
    - Addition of lanes and increase in vehicular capacity would move traffic closer to sensitive receptors for air quality and noise
    - Air quality concerns may occur with the addition of lanes and an increase in vehicular capacity
    - Increased noise would mostly be contained within the tunnel

Figure 16. Environmental Concerns at the Roscoe Boulevard Portal

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5. NEXT STEPS

More detailed environmental analysis would occur as the alignments are better refined for the next phase of study. As the concepts are moved forward in the planning process, the Sepulveda Pass Corridor Project would need to undergo the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) review.

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APPENDIX B – GEOTECHNICAL EVALUATION MEMORANDUM

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Sepulveda Pass Corridor Systems Planning Study

Geotechnical Evaluation Memorandum

Prepared for:

Metro

Prepared by:

HNTB Corporation
in collaboration with Parsons Brinckerhoff, EMI, IBI Group, and VA

July 2012

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1.0 INTRODUCTION

1.1 Purpose and Scope of Works

The Sepulveda Pass Corridor Systems Planning Study area extends approximately twenty seven miles from the San Fernando Valley in Sylmar near the I-405 and I-5 interchange, southerly across the Santa Monica Mountains through the Sepulveda Pass to Culver City and Inglewood in the Los Angeles Basin to the I-405 and 105 freeway interchange near Los Angeles International Airport (LAX). The project concepts are shown on Figures 1-1 to 1-6. The purpose of this geotechnical memorandum is to assist the planning team to analyze and assess the geologic and geotechnical conditions associated with each conceptual alternative. Our scope of work included the following tasks:

- Reviewing available pertinent geological and geotechnical reports in our database;
- Evaluating potential geologic and seismic hazards along the subject corridor;
- Preparing this geotechnical memorandum to summarize the findings of our evaluation of each concept by physiographic regions due to the diverse geologic conditions associated with each of the regions within the study area. These regions are the San Fernando Valley, Sepulveda Pass (Santa Monica Mountains) and the Los Angeles Basin (West Los Angeles).

1.2 Proposed Conceptual Alternatives

The Sepulveda Pass Corridor Systems Planning Study is being conducted for the purpose of identifying the most cost-effective transportation investment using a range of conceptual highway and/or transit transportation improvements. Six (6) conceptual alternatives were developed in an effort to determine a high-level transportation plan along the study area. The alternative Systems planning concepts and methods include but are not limited to fixed rail, bus rapid transit service, highway improvements and toll lanes/tollways, grade separated tunnel and/or elevated guideway along I-405 or parallel facilities, and multi-modal grade separated transit and express toll road facility. These six concepts are discussed in the following subsections.

1.2.1 Concept #1 - At-Grade Sepulveda Boulevard Fixed Guideway Bus Rapid Transit (BRT)

The first conceptual option is called the At-Grade Sepulveda Boulevard Bus Rapid Transit (BRT) and the associated alignment would span from the San Fernando Valley to Los Angeles International Airport (LAX). The BRT would travel southeast from the San Fernando Metrolink Station in Sylmar along San Fernando Boulevard to Van Nuys Boulevard. The BRT would then turn south along Van Nuys Boulevard to Burbank Boulevard. The route continues west along Burbank Boulevard until it enters the I-405 heading south. The BRT will then travel along the I-405 freeway shoulder during peak hours with buses eventually exiting at Getty Center Drive where it connects with Sepulveda Boulevard heading south. The BRT remains on Sepulveda Boulevard with priority treatment until it reaches the southern terminus at Century/Aviation Station of the Metro Crenshaw/LAX Transit Corridor. Concept #1 improvements would be limited to some pavement design and minor roadway spot widening. See Figure 1-1 for the concept map.

1.2.2 Concept #2 - At-Grade Freeway Managed Lanes

The second conceptual alternative involves a Managed Lanes (ML) corridor along the I-405 freeway between Rinaldi Street in San Fernando Valley and Los Angeles International Airport. The managed lanes would incorporate High Occupancy Toll (HOT) lanes along I-405. In areas both north and south of the Santa Monica Mountains, two HOT lanes would be used, while only one HOT lane would be available through the Sepulveda Pass.

A BRT would provide service along the ML corridor between San Fernando Valley and West LA. The BRT would maintain three routes originating from three different locations in San Fernando Valley (Sylmar, Chatsworth, and North Hollywood) with a transfer point at the Sepulveda Orange Line Station.

All three routes will utilize the ML corridor to connect between San Fernando Valley and West Los Angeles. Creating the additional lane space would require re-striping and some spot widening along the freeway as well as some direct access ramps at La Grange Avenue and the Howard Hughes Center. The subsequent proposed improvements involved with Concept #2 include spot widening along I-405 with potential for widening along BRT arterial streets as well as proposed direct access ramp related structures and improvements. Concept #2 is shown in Figure 1-2.

1.2.3 Concept #3 - Highway Viaduct Managed Lanes

The third conceptual alternative would incorporate a proposed elevated viaduct above the I-405 median between the US-101 freeway to the north and the I-10 freeway to the south with some potential for widening and direct access ramp improvements. The viaduct would provide two HOT lanes in each direction allowing for the existing HOV lanes to become dedicated lanes for BRT service. The BRT service would extend between Sylmar/San Fernando Metrolink Station to the north and the Sepulveda Expo Line Station to the south. Concept #3 is shown on a map in Figure 1-3.

Similar to Concept #2, the portions north and south of the viaduct would act as ML corridors with two HOT lanes. At the transition points with the viaduct, the ML routes would drop the second HOT lane and transition into the single-HOV (converted to HOT) lane.

1.2.4 Concept #4 - Tolled Highway Tunnel

A four-lane toll tunnel is proposed as part of the fourth conceptual alternative. The tunnel is proposed to be loosely aligned with the I-405 freeway through Santa Monica Mountains between Magnolia Boulevard at the north portal and either Santa Monica Boulevard or Venice Boulevard at the south portal (Figure 1-4). The tunnel would provide service to buses and private automobiles, with service for carpools requiring a toll. The associated improvements would include a bored tunnel section along with trench sections and potential fly-over structures for direct access from major freeways and arterials.

1.2.5 Concept #5 - Fixed Guideway Light Rail Transit Tunnel

This conceptual alternative employs a Light Rail Transit (LRT) that will span from the San

Fernando Valley to LAX (Figure 1-5). The majority of the alignment would remain at-grade with the exception of a tunnel segment extending between Ventura Boulevard and Van Nuys Boulevard at the north portal and Strathmore Place and Westwood Plaza at the south portal. The tunnel would be a transit-only tunnel that would loosely parallel the I-405. The non-tunnel segments will generally extend along an at-grade median-running right of way along arterials including San Fernando Boulevard, Van Nuys Boulevard, Westwood Boulevard, Overland Avenue, and Sepulveda Boulevard.

The associated improvements with the fixed light rail concept include a bored tunnel through the Sepulveda Pass and associated portal structures and trench sections. Other improvements include a new at-grade track alignment and any new station structures or platforms associated with the LRT.

1.2.6 Concept #6 - Highway/Private Shuttle Tunnel

Concept #6 consists of two separate tunnel alignments, a new highway and private shuttle rail alignment. Each alignment will have its own tunnel that cuts through the Sepulveda Pass. Both the toll highway tunnel and transit tunnel would loosely parallel the I-405 with the transit tunnel aligned further east. The alignments are shown on Figure 1-6. The highway tunnel would extend between Roscoe Boulevard to the north and Century Boulevard to the south. The transit rail alignment will extend between Van Nuys Metrolink Station and Century/Aviation Station. The highway tunnel will maintain direct access points at both the portals as well as near major freeway junctions including the 101 freeway, I-10, and highway 90. The private shuttle tunnel will have in-line stations at Wilshire Boulevard and at the junction with the Orange Line in San Fernando Valley.

The major improvements associated with Concept #6 include the two tunnels which include both bored sections as well as trench and cut and cover segments. Other improvements include associated portal structures and new stations.

CONCEPT 1

At-Grade Sepulveda Blvd BRT

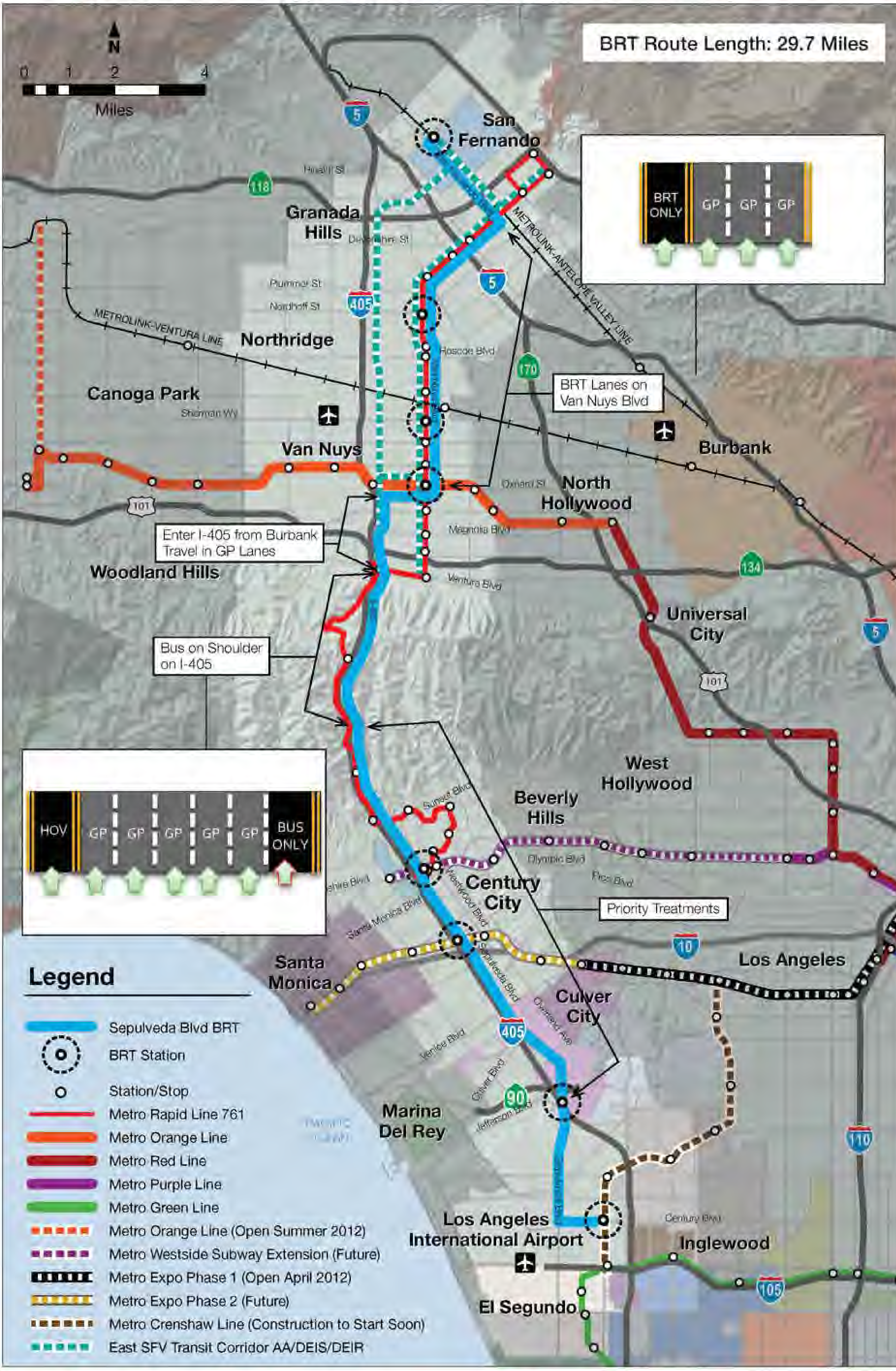

Figure 1-1

Planning Charrette #1 - May 2, 2012

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Sepulveda Pass Corridor Systems Planning Study

CONCEPT 2

At-Grade Freeway Managed Lanes

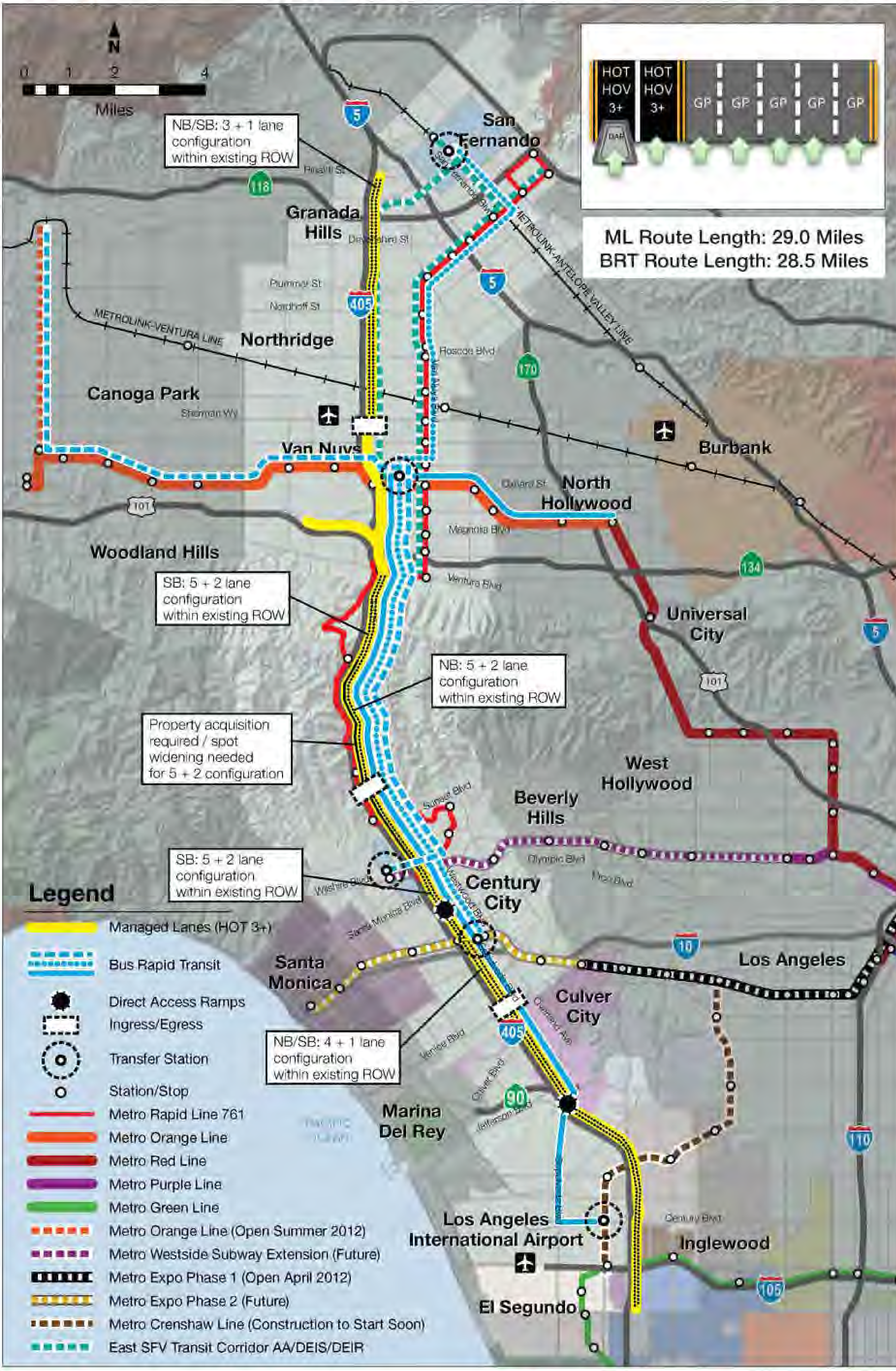

Figure 1-2

Planning Charrette #1 - May 2, 2012

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CONCEPT 3

Highway Viaduct Managed Lanes

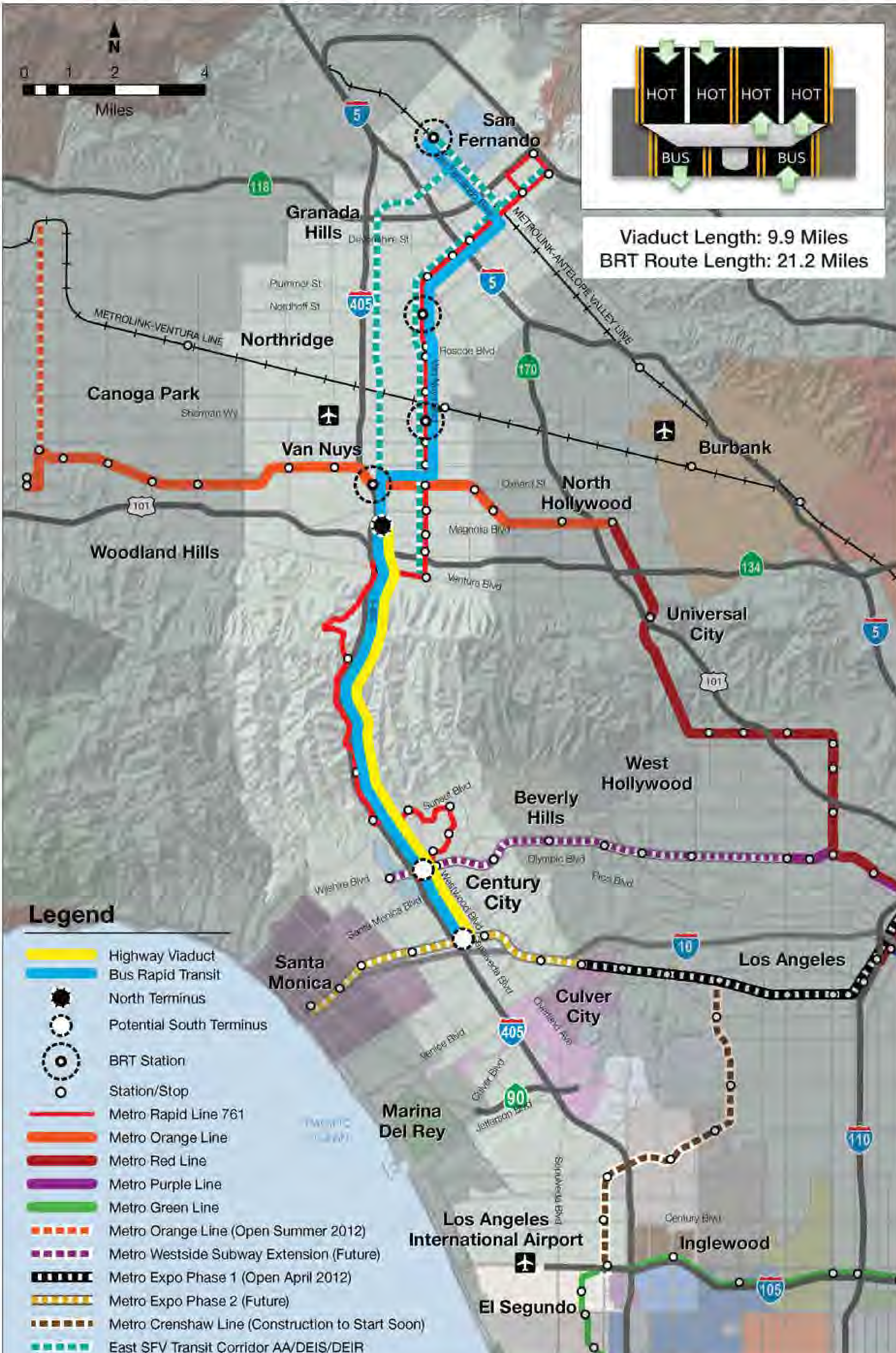

Figure 1-3

Planning Charrette #1 - May 2, 2012

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Sepulveda Pass Corridor Systems Planning Study

CONCEPT 4

Tolled Highway Tunnel

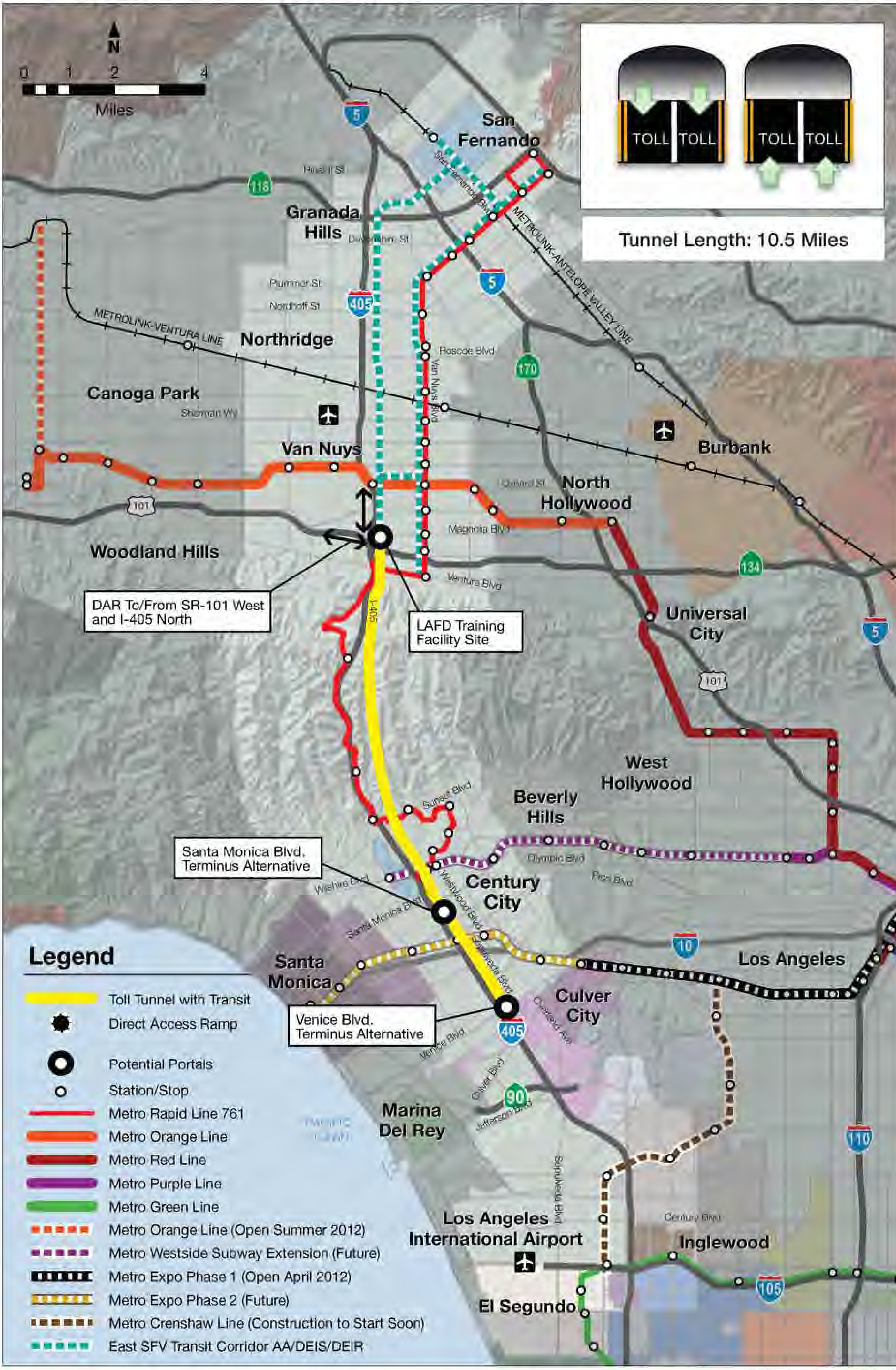

Figure 1-4

Planning Charrette #1 - May 2, 2012

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Sepulveda Pass Corridor Systems Planning Study

CONCEPT 5

Fixed-Guideway Light Rail Transit Tunnel

Figure 1-5

Planning Charrette #1 - May 2, 2012

Metro

Sepulveda Pass Corridor Systems Planning Study

CONCEPT 6

Highway/Private Shuttle Tunnels

Figure 1-6

Planning Charrette #1 - May 2, 2012

2.0 DATA COLLECTION AND LITERATURE REVIEW

In order to perform the geotechnical evaluation, a comprehensive compilation and review of available publications, reports, and data was performed for all areas along the proposed corridor concepts. The purpose for the data collection and literature review was to gather and assess existing information to develop an initial understanding of the geologic, faulting, hydrogeological, environmental, and geotechnical considerations for each conceptual alternative.

Data were compiled by acquiring readily available reports and publications from public agencies including:

- United States Geological Survey (USGS)
- California Department of Transportation (Caltrans)
- California Geological Survey (CGS)
- California Division of Oil and Geothermal Resources (CDOGR)
- Southern California Earthquake Center (SCEC)
- City of Los Angeles Department of Public Works (LADPW) - Geotechnical and Materials Engineering Division
- Los Angeles County Department of Public Works (LACDPW)
- California Department of Water Resources (CDWR)
- Dibblee Foundation

A complete list of the geologic references compiled and reviewed is presented in the reference section of this report (Section 9.0). In addition, unpublished reports available in company and personal files, and available technical reports issued by other consultants were compiled and reviewed Data and reports from current projects along the alignment provided recent comprehensive geotechnical data as part of the literature review. These projects include the Caltrans I-405 Sepulveda Pass Widening Design-Build Project and the Metro Crenshaw/LAX Corridor Project.

3.0 REGIONAL GEOLOGY

3.1 Physiography

The proposed Sepulveda Pass Corridor extends north-south along I-405 freeway between the I-5 interchange to the north near Sylmar and the I-105 freeway to the south near LAX. The project corridor extends through numerous geologic/geomorphic regions of southern California. The northern portion of the alignment cuts through the San Fernando Valley and continues south through the Santa Monica Mountains into the Los Angeles Basin. The physiography of the corridor is shown on Figure 3-1.

The San Fernando Valley is a triangular east-west trending structural depression located within the Transverse Ranges physiographic/geologic province. The Transverse Ranges province trends east-west from the offshore Channel Islands (Santa Rosa, Santa Cruz, Anacapa, etc) to the eastern Mojave Desert. The province is characterized by east-west trending mountain ranges such as the Santa Monica Mountains, San Gabriel Mountains, and San Bernardino Mountains) and separated by similar trending intermontane valleys. The San Fernando Valley is bordered on the east by the Verdugo Mountains, on the north by the San Gabriel and Santa Susana Mountians, on the east by the Simi Hills and finally on the south by the Santa Monica Mountains. The mountains that bound the San Fernando Valley are actively deforming anticlinal ranges bounded by thrust faults. As the ranges have risen and deformed, the valley has subsided and accumulated sediment to create the elongate basin.

The Santa Monica Mountains are an east-west trending linear mountain range within the western Transverse Ranges physiographic/geologic province. Major east-trending folds, reverse faults, and left-lateral strike-slip faults reflect regional north-south compression and are characteristic of the Transverse Ranges. The Santa Monica Mountains are being actively uplifted along a series of segmented frontal reverse faults on the south side of the range extending from Arroyo Sequit in the west to Glendale in the east. These faults include the Malibu Coast fault, the Santa Monica fault, and the Raymond (Hill) fault. This fault system is aligned with the Santa Cruz Island fault, which it may join somewhere in the Santa Barbara Channel. The Los Angeles Basin on the south side of the range is one of a series of basins forming a transition zone between the Transverse Ranges and the northwest-southeast trending Peninsular Ranges physiographic/geologic province to the south.

The Los Angeles Basin is a large low-lying coastal plain bordered by the Santa Monica Mountains on the north, the Repetto and Puente Hills on the northeast, the Santa Ana Mountains on the east, and the San Joaquin Hills on the south. The western margin of the basin is open to the Pacific Ocean except for one prominent hill, the Palos Verdes Peninsula. The floor of the Los Angeles Basin is a relatively flat surface rising gently from sea level along the coastline to an apron of uplifted terrain along the base of the surrounding mountains which rise abruptly to a few thousand feet above the plain. The flat basin floor is interrupted in a few localities by small hills, the most prominent of which are a northwest-southeast trending alignment of hills and mesas extending from the Newport Beach area on the south to the Beverly Hills area on the north.

3.2 Structure

The regional tectonics of the Los Angeles region is one of north-northeast/south-southwest compression. This is indicated by geomorphology, earthquake focal mechanisms, and geodetic measurements that yield crustal shortening at rates of about 5 to 9 mm/year. The Santa Monica Mountains comprise a relatively young (late Pleistocene-age ~ 500,000 years old) mountain range uplifted by folding and faulting resulting from this north-south crustal shortening. The range is essentially an upward fold (anticline) with rocks along the north flank of the range dipping toward the San Fernando Valley and rocks along the south flank dipping toward the Los Angeles Basin on the south. The range has a long record of structural deformation within Tertiary time and appears to have been uplifted and eroded several times in the ancient geologic past as indicated by major angular stratigraphic unconformities

The range is bounded by major reverse or thrust faults along the south flank; these faults dip northerly under the range. The major faults are the Santa Monica fault and the Hollywood fault (Figure 4-1a). Both of these faults are believed to be active and portions of them have been designated as Alquist-Priolo Earthquake Fault Zones by the California Geological Survey. Some geoscientists consider the Hollywood fault to be primarily a strike-slip fault (lateral shifting) in spite of the large vertical uplift of the mountain range. Also, a relatively prominent scarp in the Santa Monica Plain is thought to represent the surface expression of the Santa Monica fault but has not been clearly proven to be the major fault and there may be other deeper northerly dipping faults. Another major fault, the Benedict Canyon fault lies south of the project area and traverses the Santa Monica Mountains from the Brentwood area on the southwest to the North Hollywood area on the northeast. This fault appears to be a left-lateral, strike-slip fault and is not known to be active.

3.3 Stratigraphy

The stratigraphy and structure of the Sepulveda Pass Corridor study area is quite complex due to multiple episodes of folding and faulting. The basic stratigraphy is characterized by Quaternary alluvium unconformably overlying a sequence of Quaternary and Tertiary marine sediments and sedimentary rocks that unconformably overlie middle Tertiary to Cretaceous marine sedimentary rocks (Dibblee, 1991; Yerkes and Campbell, 2005). All of these, in turn, unconformably overlie metamorphic basement rocks of the Santa Monica slate which forms the core of the Santa Monica Mountains along with Cretaceous-age igneous intrusive rocks. The multiple unconformities indicate several periods of uplift and erosion. The stratigraphic sequence is further complicated by faulting which has offset the geologic formations both laterally and vertically. The vertical displacements have thrust the Santa Monica slate over the Tertiary sedimentary rocks (Dibblee, 1991; Wright, 1991).

The study area is generally underlain by nearly horizontal Quaternary sediments overlying Tertiary-age sediments and sedimentary rocks that have been deformed into folds and offset by faults. The sedimentary strata lap onto the Santa Monica slate that forms the core of the Santa Monica Mountains; bedrock units on the south flank generally dip southerly and bedrock units on the north flank generally dip northerly. Along the higher elevations within the project corridor, particularly through the Santa Monica Mountains, sedimentary and metamorphic bedrock are exposed at the surface with some localized colluvial and alluvial soils within tributary valleys.

Thick alluvial deposits are found in the valley/basin portions of the project corridor. This includes the areas north and south of the Santa Monica Mountains. The San Fernando Valley to the north is underlain by up to 2,000 feet of alluvial sediment, with Cretaceous-aged crystalline bedrock below the thick alluvium (Norris and Webb, 1990). The southern portion of the corridor extends into the Los Angeles Basin. This area of the project corridor is directly underlain by unconsolidated Quaternary-age sandy sediments. These generally could be subdivided into loose unconsolidated Holocene-age sediments which cover the bulk of the basin, and late-Pleistocene materials which comprise the surface over much of the uplifts of the Newport Inglewood Structural Zone and the marginal plains. Hard rocks occur only in the mountains surrounding the basins and at depths ranging from about 5,000 feet to as much as 30,000 feet in the deepest part of the central basin. Figure 3-2 shows a geologic map of the study area.

3.4 Groundwater

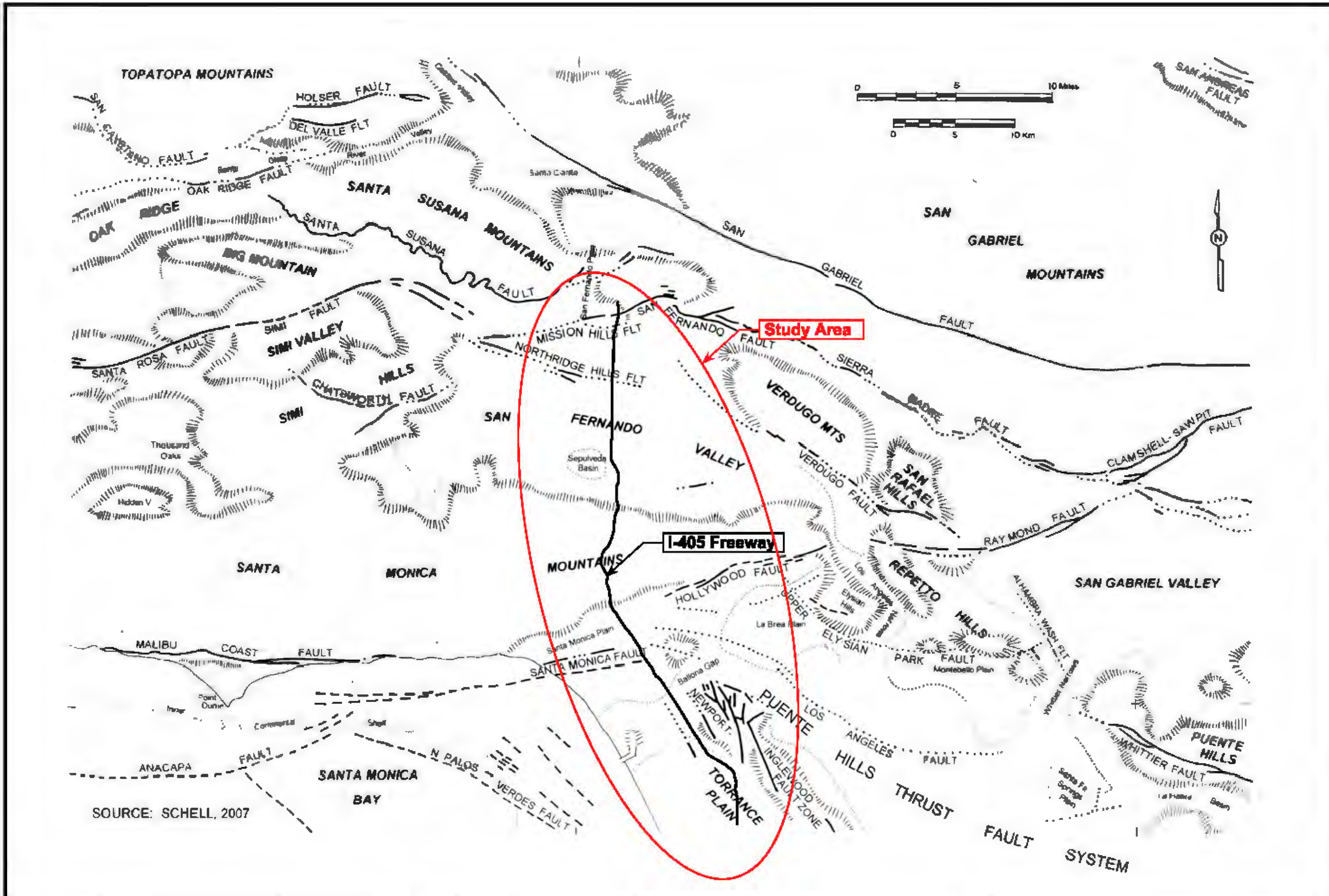
Groundwater is highly variable along the extent of the project corridor. The highest historical groundwater is partly documented by the California Geological Survey (CGS, 1997 and 1998b) as shown on Figures 3-3a and 3-3b.

The historical high groundwater map of the Inglewood quadrangle (CGS, 1999) shows the groundwater depths for the southern end of the corridor. The map indicates that groundwater in the southerly portion of the project alignment is at approximately 40 feet below grade. As the corridor extends northward, the groundwater deepens to 50 feet below grade through Inglewood, just south of Manchester Boulevard along I-405. Data from the Crenshaw/LAX Transit Corridor Project show the areas along the southern portion of the project corridor to have measured groundwater depths ranging from 40 to 90 feet below grade. This area covers the southern end of the corridor north to Manchester Boulevard crossing. As the corridor bends northwest the groundwater becomes shallow (depth of 10 feet or less) through the section of I-405 between Manchester Boulevard to the south and I-90 freeway to the north.

The historical high groundwater maps of the Venice (CGS, 1998) and Beverly Hills quadrangles (CGS, 1998) indicate groundwater continuing to be shallow (depth of 10 feet) heading north along I-405 from the 90 freeway. Starting at approximately Culver Boulevard to just north of Venice Boulevard along I-405, the groundwater depths progressively deepen from 10 feet to approximately 40 feet below grade. According to the groundwater map, once the groundwater reaches 40 feet, it plateaus along the corridor extending northward until approximately halfway between Wilshire and Sunset Boulevards. The groundwater becomes shallower at about 30 feet between Santa Monica Boulevard and Wilshire Boulevards and then deepens to 40 feet at the base of the Santa Monica Mountains.

Much of the I-405 corridor in Sepulveda Canyon through the Santa Monica Mountains is not known to have shallow groundwater. However, the nature of the canyon with non-indurated young alluvial deposits filling the axis is such that it receives runoff from the adjacent steep slopes and during times of high precipitation may temporarily pond groundwater in low spots and pockets. Shallow groundwater may also be present along canyons in the Santa Monica Mountains where relatively shallow impermeable bedrock is present (CGS, 1997). According to data collected in the I-405 Widening project in 2008 and 2009, groundwater was encountered at depths greater than 70 feet below the freeway surface. However, higher groundwater elevations were measured during drilling between 1958 and 2007 for as-built data at bridge locations along the existing Sepulveda Pass. This data includes groundwater depths ranging from 2 to 78 feet below existing grade.

The historical high groundwater maps of the San Fernando (CGS, 1998) and Van Nuys quadrangles (CGS, 1997) exhibit groundwater to be progressively shallower northward from the base of the Santa Monica Mountains where the groundwater is 40 feet below grade and ascends to 0 feet below grade at the point where the corridor intersects the 101 freeway along the Los Angeles River. From the 101 freeway north along the corridor, the groundwater increases in depth progressively northward along alignment up to approximately 220 feet below grade, where it reaches an abrupt groundwater barrier at the location of the Mission Hills fault. At this point, where the I-405 meets SR-118, the groundwater jumps to 40 feet below grade. North of the groundwater barrier, groundwater contours end, though a zone historical liquefaction is denoted. This area is where the San Fernando fault exists and groundwater data is probably not sufficient enough to show accurate contours due to the extensive faulting and deformation within the area.



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

SEPULVEDA PASS CORRIDOR STUDY

Project No. 12-103

Date: July 2012

Regional Physiographic Map

Figure 3-1

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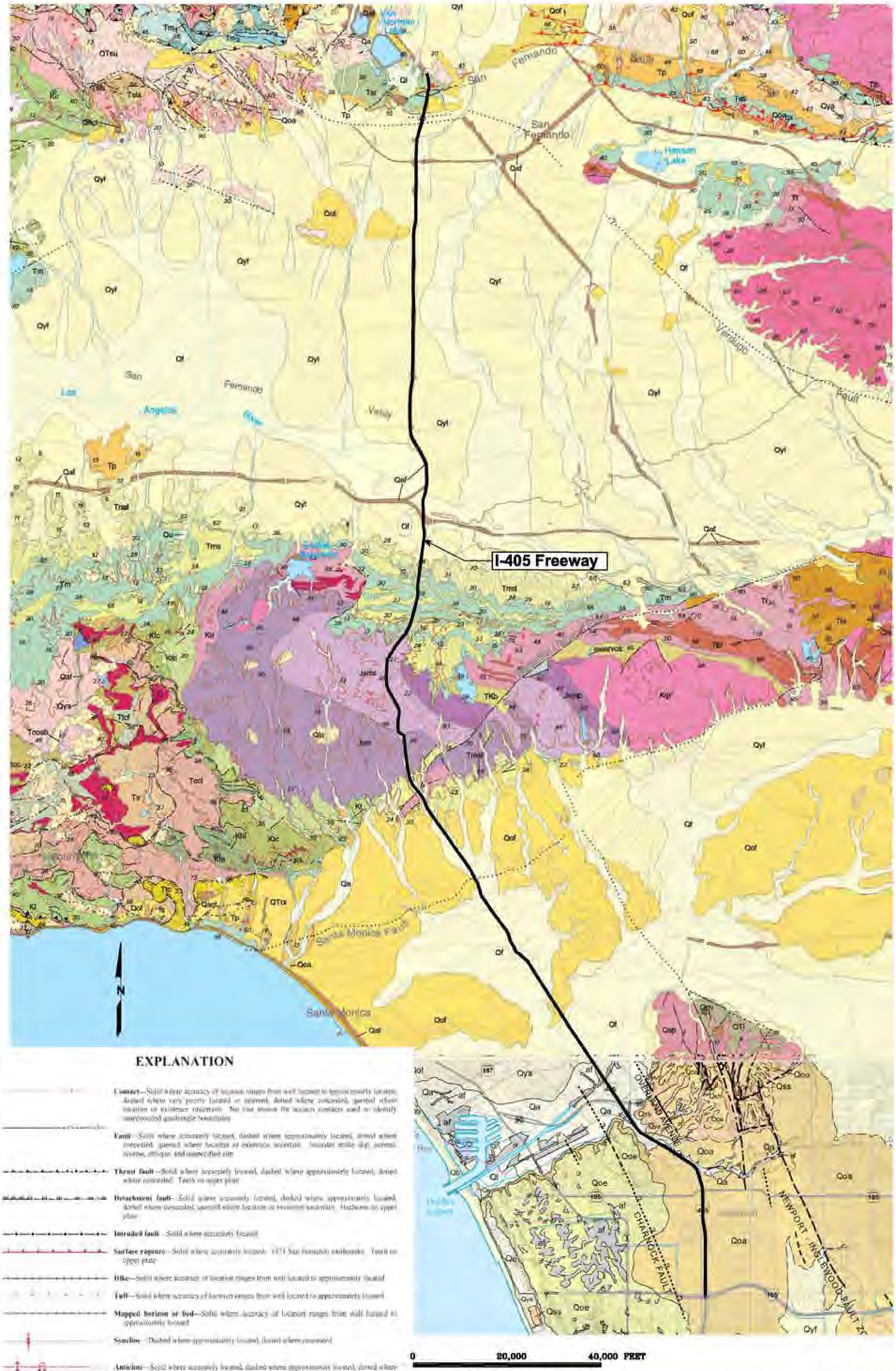

Figure 3-2

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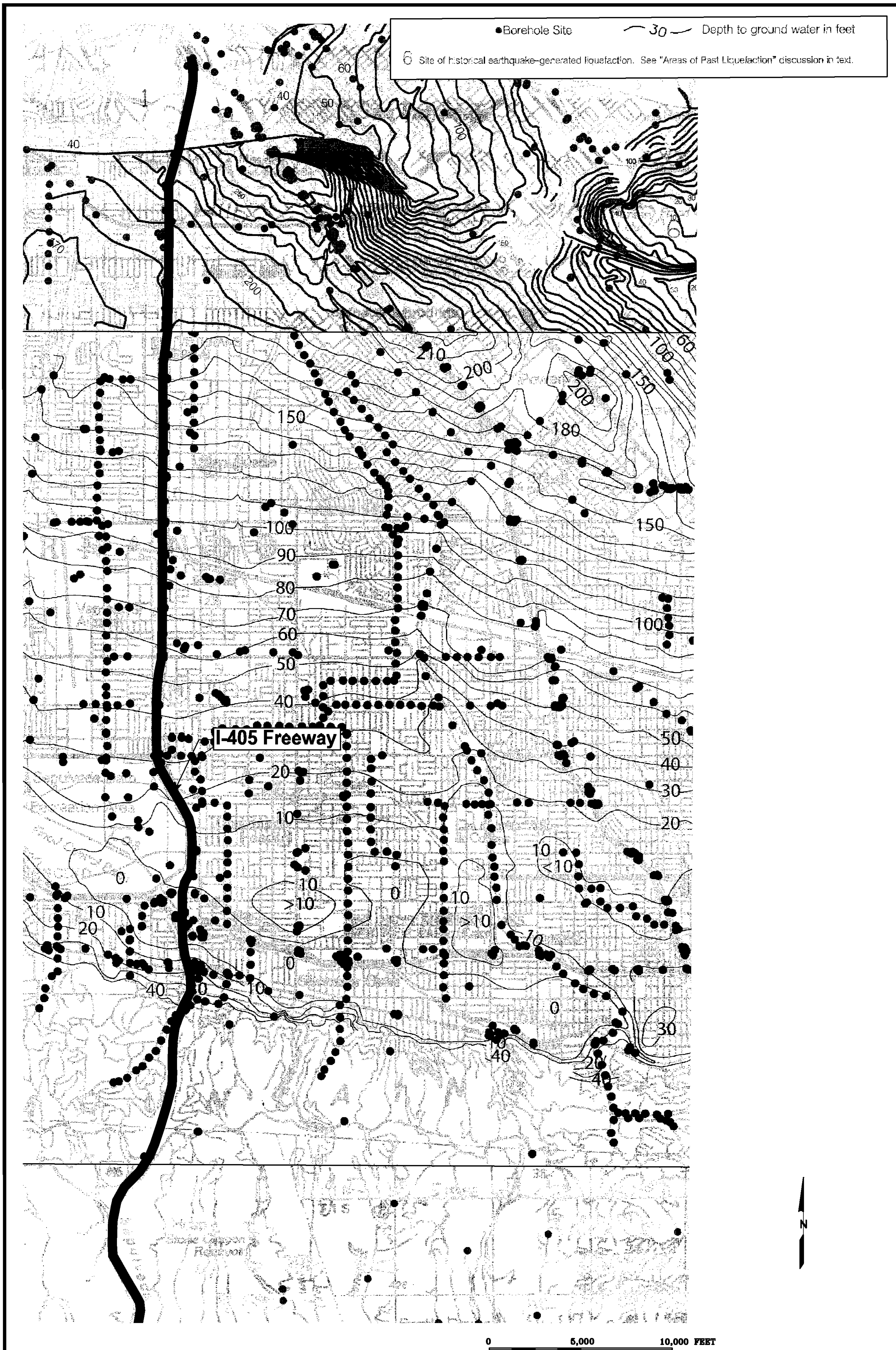
SEPULVEDA PASS CORRIDOR STUDY

Project No. 12-103 | Date: July 2012

REGIONAL GEOLOGIC MAP

REFERENCE: Yerkes and Campbell, Preliminary Geologic Map of Los Angeles 30 X 60 Quadrangle, USGS Open File Report 2005-1019 (2005). Roffers and Bedrossian, Geologic Compilation of Quaternary Surficial Deposits in Southern California On Shore Portion of the Long Beach 30 X 60 Quadrangle, CGS Special Report 217 Plate 0 (2010).



Sheet 1 of 2

Figure 3-3a

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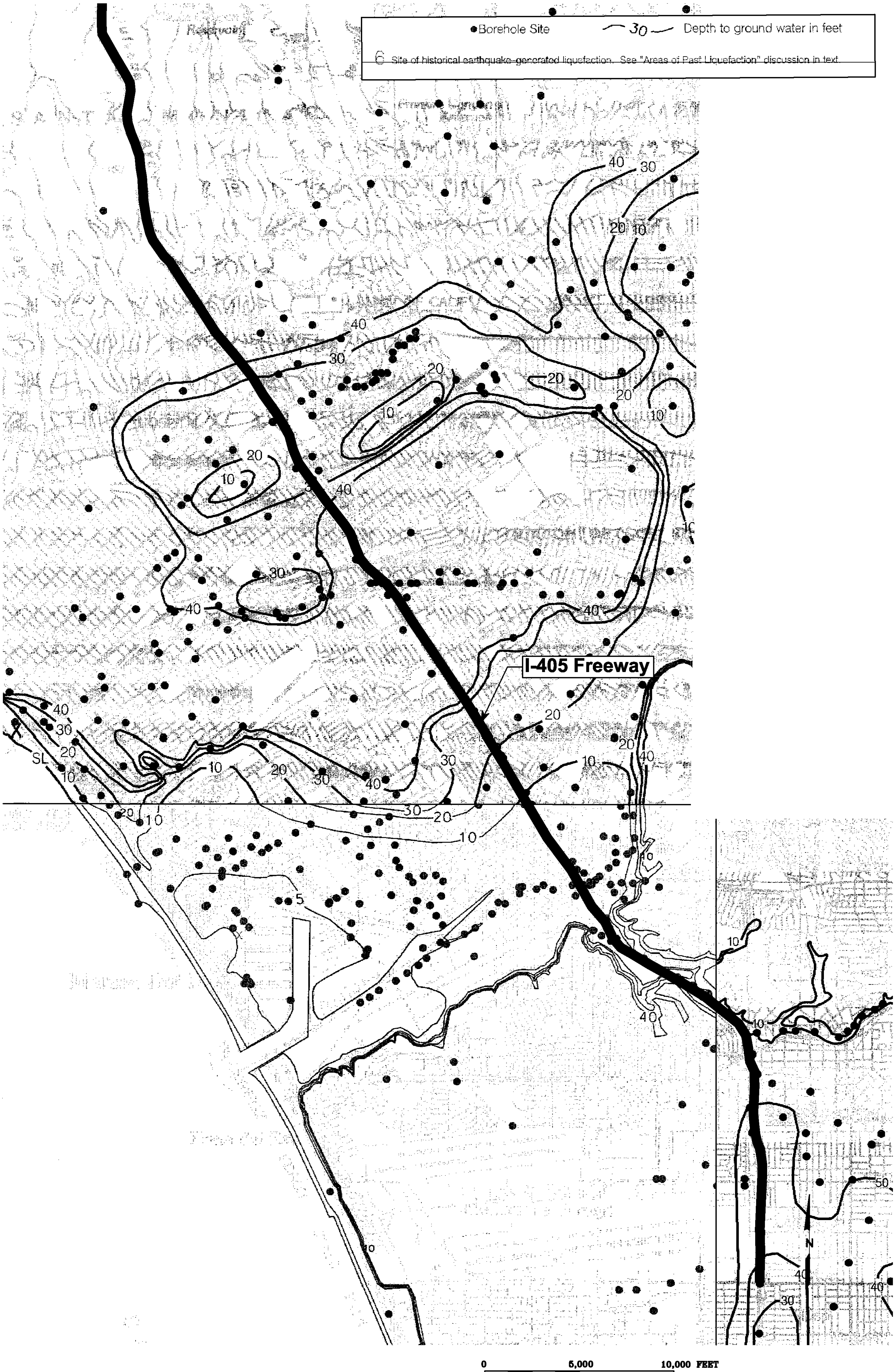
SEPULVEDA PASS CORRIDOR STUDY

Project No. 12-103 | Date: July 2012

CGS Groundwater Map

REFERENCE: California Geological Survey, Seismic Hazard Zone Reports
- San Fernando Quadrangel (1998), Van Nuys Quadrangle (1997), Beverly Hills Quadrangle (1998), Venice Quadrangle (1998), and Inglewood Quadrangle (1998).



Sheet 2 of 2

Figure 3-3b

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SEPULVEDA PASS CORRIDOR STUDY

Project No. 12-103

Date: July 2012

CGS Groundwater Map

REFERENCE: California Geological Survey, Seismic Hazard Zone Reports
- San Fernando Quadrangel (1998), Van Nuys Quadrangle (1997), Beverly Hills Quadrangle (1998), Venice Quadrangle (1998), and Inglewood Quadrangle (1998).

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4.0 FAULTING AND SEISMICITY

4.1 Faulting

According to regional geologic publications and geotechnical reports, the major faults in the project corridor vicinity are the San Fernando, Mission Hills, Verdugo, Santa Monica, Hollywood, Benedict Canyon, and the Newport-Inglewood Structural Zone. These major faults in the project corridor vicinity are shown on the Regional Geotechnical/Geologic Hazard Map (Figures 4-1a and 4-1b).

4.1.1 San Fernando Fault

The San Fernando fault is a left-lateral/reverse frontal fault that extends along the southern margin of the Santa Susana Mountains. The 1971 San Fernando earthquake in Sylmar produced a 15 km long surface rupture that is now recognized as the San Fernando fault zone. According to Tsutsumi and Yeats (1999), the San Fernando fault is a flexural-slip fault that formed on the south flank of the Mission Hills syncline and Merrick syncline during folding deformation.

Based on fault trenching by Bonilla (1973), a previous pre-historic rupture occurred less than 200 years prior to 1971. Additionally, Fumal et al. (1995) found evidence of only two ruptures within the last 3500 to 4000 years. The project corridor crosses the San Fernando fault zone just south of the I-5 interchange with I-405 freeway. The entire area around the interchange is designated as an Alquist Priolo Earthquake Fault as shown on Figure 4-1a.

4.1.2 Mission Hills Fault

The Mission Hills fault is a north-dipping (40 to 50 degrees) reverse fault that extends east-west along the southern edge of Granada Hills and Mission Hills. Both Granada Hills and Mission Hills have been uplifted by long term reverse displacement of the hanging wall. The fault extends eastward toward the eastern edge of the hills near the I-5 freeway. Here the fault is believed to turn southeastward toward the Verdugo fault (Tsutsumi and Yeats, 1999). According to Tsutsumi and Yeats (1999), the thickness of the Fernando Formation is the same on both sides, meaning that the slip movement began after Fernando deposition. The Mission Hills is considered active though it is not zoned by the Alquist Priolo Earthquake Fault Zone maps. It is believed that the Mission Hills fault is the southwestern extension of the San Fernando fault. The project corridor crosses the Mission Hills fault trace near the 118 freeway crossing with I-405 freeway.

4.1.3 Northridge Hills Fault

The Northridge Hills fault is a steeply north-dipping reverse fault that cuts through the central part of the San Fernando Valley. It is described as a series of discontinuous low hills that extend from near the town of Chatsworth east-southeast to the San Diego Freeway, which marks the crest of a south-vergent fault-propagation fold above the blind, north-dipping, 15-km-long Northridge Hills thrust (Tsutsumi and Yeats, 1999). The fault has no topographic expression east of the San Diego Freeway, where its presence is based on subsurface oil-well data (Tsutsumi and Yeats, 1999). Hence, the fault does cross underneath the proposed project corridor. The fault is believed to intersect and either merge with or is truncated by the Verdugo fault at the Pacoima

Oil Field (Tsutsumi and Yeats, 1999). It is also believed to be an extension of the Oak Ridge fault to the west.

4.1.4 Verdugo Fault

The Verdugo fault is a near vertical, north-dipping reverse fault that extends along the southern base of the Verdugo Mountains. The approximately 13 mile long (21 km) fault extends through Sun Valley, Burbank and Glendale. According to the Fault Activity Map by Jennings (1994), fault activity occurs within Holocene age deposits along the western flank of the Verdugo Mountains in the Burbank area. The Verdugo fault does not cross the project corridor, but extends subparallel with the alignment approximately 5 miles east of the north-south I-405 freeway, extending through the San Fernando Valley.

4.1.5 Santa Monica Fault

The Santa Monica fault extends from Pacific Palisades to West Los Angeles, where it merges with the Hollywood fault by means of the West Beverly Hills Lineament in Beverly Hills. Although the fault is believed to be a major element of the southern boundary fault system of the Santa Monica Mountains, it is poorly known and even less well understood. The fault crosses the project corridor in West Los Angeles. The fault is recognized in oil wells as forming the contact between the Santa Monica Slate and the Tertiary sedimentary rocks. The fault has been considered by many geologists to be represented on the surface by a series of east-west trending escarpments on the Santa Monica Plain. However, several geological trenching investigations (Crook et al., 1992: Pratt et al., 1998), have found small vertical faults, although they have not been successful in finding a major thrust fault.

A recent geophysical investigation by Catchings et al. (2008) suggests that the Santa Monica fault zone consists of multiple strands, both vertical and thrust, at shallow depths. They interpreted seismic-reflection data in the Veterans Administration Hospital area (between Santa Monica Boulevard and Wilshire Boulevard) as showing two low-angle fault strands and multiple near-vertical (~85^{o}) faults in the upper 300 feet. One of the low-angle faults dips northward at about 28^{o} and approaches the surface at the base of the topographic scarp on the grounds of the VA hospital. The other principal fault dips northward at about 20^{o} and projects to about 600 feet south of the topographic scarp to near Santa Monica Boulevard. One of the more important conclusions of their study for this project is that neither the seismic imaging studies nor the trenching studies are consistent with the presence of a reverse fault directly associated with the topographic scarp at the Veterans Administration hospital grounds. According to Dolan et al., 2000, a recent earthquake event probably occurred on this section of the Santa Monica fault between 1000 and 3000 years ago. Geomorphic analysis and fault trench studies by Dolan et al. have shown the Santa Monica fault to be recurrently active during the late Quaternary and probably Holocene.

Information from greater depths such as the oilfield data (Tsutsumi et al., 2001, Wright, 1991; Dibblee, 1991) provides information to much greater depths (~10,000 feet) and indicates that there are other deeper branches to the Santa Monica fault system. Data from the Sawtelle Oil field indicate that there is a fault(s) at about 9,500 feet depth dipping at shallow angles (~ 30^{o}) like those discussed by Catchings et al, but at much greater depths. These faults project much farther south than the area of the surface scarps, perhaps south of the Santa Monica Freeway.

These relationships are similar to those in the offshore area of Santa Monica Bay where geophysical data suggest that there is a deep low-angle branch to the Santa Monica fault system. Catchings et al. (2008) suggest that such deeper branches are not active, but there are abundant small earthquakes in the region that indicate seismically active faults well south of the surficial southern boundary fault system represented by the Malibu Coast-Santa Monica-Hollywood fault system. The Santa Monica fault does cross the project corridor and does cross some of the concept alignments, see Figure 4-1b.

4.1.6 Hollywood Fault

The Hollywood fault extends east from its junction with the Santa Monica fault at the West Beverly Hills Lineament to the east to the Los Angeles River and the Raymond fault. Studies of the Hollywood fault indicate that it is an oblique, reverse left-lateral fault (Dolan et al 1997). The Hollywood fault segment of the southern boundary fault system is steeply dipping to the north. Along most of its length, the Hollywood fault is located near the base of the Hollywood Hills portion of the Santa Monica Mountains. Towards the west, in the area of Beverly Hills, the location of the fault is poorly expressed geomorphically. Due to its location in a heavily urbanized area, the Hollywood fault has not been extensively studied by use of trenching activities. Therefore, the slip rates and recurrence intervals are not well constrained. Dolan speculates that earthquakes larger than moment magnitude (Mw) 6.6 would involve simultaneous rupture of the Hollywood fault in conjunction with other segments of the Transverse Ranges Southern Boundary fault system.

4.1.7 West Beverly Hills Lineament

The West Beverly Hills Lineament (WBHL) is a northwest trending topographic escarpment that extends parallel, but several hundred meters west of, the northern projection of the Newport-Inglewood fault through City of Los Angeles, Century City, and Beverly Hills. The lineament is speculated to be a late Quaternary folding or dip-slip fault or a right-lateral strike-slip extension of the Newport Inglewood Structural Zone. As part of the Westside Subway extension Project, a fault study which includes geophysical data determined that the fault is the extension of the NISZ and is considered active. Other recent reports have refuted that the feature is not an active fault but rather a product of ancient erosion. Due to the lack of definitive data, the fault should be considered potentially active. The WBHL does not cross through any of the proposed concept alignments but is located approximately 2 to 3 miles east of the study corridor.

4.1.8 Benedict Canyon Fault

The Benedict Canyon fault extends from the Kenter Canyon area to the west of the project corridor to the northeast, where it becomes concealed in alluvial deposits of the San Fernando Valley in the area of Universal City. It is considered to be a splay to the Santa Monica fault and consists of a near vertical trace with secondary sub-parallel traces. The fault exhibits oblique left lateral traces with possible reverse components. Studies performed by Robinson (2003) of calcite filled joints and fractures within the bedrock units involved in faulting indicate that calcite cementation is pre-Pleistocene. Though the fault is not considered active, the fault zone does cross the project corridor (Figure 4-1b).

4.1.9 Newport-Inglewood Structural Zone (NISZ)

The Newport Inglewood Structural Zone (NISZ) is a northwest-trending structural zone expressed by a series of discontinuous low-lying hills along the surface. The onshore portion extends approximately 44 miles (70 km) long between Culver City to the north and Newport Beach to the south. The NISZ comprises a zone of faults and folds transecting the Los Angeles Basin. The geologic structures within the NISZ form a broad en echelon pattern in the north; the zone narrows and becomes more linear in the Seal Beach area, and widens again to the south in the Costa Mesa-Newport Beach-San Joaquin Hills area where the NISZ is represented by a system of sub parallel branches. The NISZ is believed to continue offshore to about the Dana Point area. The fault zone is generally considered to be a right-lateral strike-slip. The NISZ has had numerous earthquakes occur within recent time including the Long Beach earthquake in 1933, Inglewood in 1920, Gardena in 1941, and Torrance-Gardena in 1941. According to Wright et al. (1973), maximum displacement measured at Huntington Beach oil field was 4 km while at the Inglewood oil field maximum displacement measured was 1.4 km. The NISZ is designated as an Alquist Priolo Earthquake Fault Zone, though only the portions that can be mapped at the surface are actually zoned. The project corridor does not cross the NISZ, though the southern portion of the alignment extends parallel to the NISZ approximately 2 miles west of the fault zone.

4.1.10 Other Faults

Secondary faults in the project vicinity include the Charnock and Overland faults. These faults sub-parallel the NISZ and are considered secondary features to the NISZ. These faults have not been fully studied but are considered to be right-lateral strike-slip faults with some component of near vertical displacement. Both of these faults are considered potentially active. Additional studies of the Charnock fault by Poland et al. (1959) indicate that it is a partial ground water barrier in its northern extents. Both faults are proximal to the project corridor as they are both mapped less than 1 mile from the project corridor.

In addition to the known surface faults, the Los Angeles region is underlain by buried thrust and reverse earthquake faults. These are poorly understood features with unknown locations and orientations. The 1987 Whittier earthquake occurred on one of these buried faults under the Puente and Repetto Hills. None of these known or suspected features (except the Santa Monica fault) appear to be significant with respect to the project.

4.2 Seismicity

The Sepulveda Pass Corridor is located within the seismically active area of Southern California, with some portions located in a Fault Hazard Zone as defined by the Alquist-Priolo Earthquake Hazards Act (APEHA) of 1972 and revised in 1994. The San Fernando Fault Zone, which crosses at the northern end of the project corridor, near the I-5 and I-405 interchange, is active and is zoned by the Alquist Priolo (AP) Earthquake Fault Zone maps. Though not located in an AP zone, the Santa Monica fault is considered active. The Mission Hills fault and the Verdugo fault are also considered active though are not mapped within an AP Fault Hazard Zone. The Newport-Inglewood fault is mapped within a Fault Hazard Zone, though it does not cross the project corridor.

Historical epicenter maps show widespread seismicity throughout the region. Although the historical earthquakes occur in proximity to known faults, they are difficult to directly associate with mapped faults. Part of this difficulty is due to the fact that the basin is underlain by several subsurface thrust faults (blind faults). Earthquakes in the Los Angeles region occur primarily as loose clusters along the Newport-Inglewood Structural Zone, along the southern margin of the Santa Monica Mountains, the margin between the Santa Susana-San Fernando Valley and the southern margin of the San Gabriel Mountains, and in the Coyote Hills-Puente Hills area.

The largest historical earthquakes in the region were the 1994 Northridge and the 1971 San Fernando earthquake. The 1994 earthquake had a moment magnitude (M_W) of about 6.7, and occurred on a southerly dipping subsurface fault which was unknown prior to the earthquake. The epicenter of the event was near the corner of Nordhoff Street and Reseda Boulevard. The main shock occurred at a depth of about 19 km. Earthquake aftershocks clearly defined the rupture surface dipping about 35 degrees southerly from a depth of about 2 or 3 km to 23 km (Hauksson et al, 1995). The causative fault was never identified with certainty. The event may have occurred on an eastern extension of the Oakridge fault (Yeats and Huftile, 1995), a south-dipping feature fault bounding the Ventura Basin and the Santa Susana Mountains.

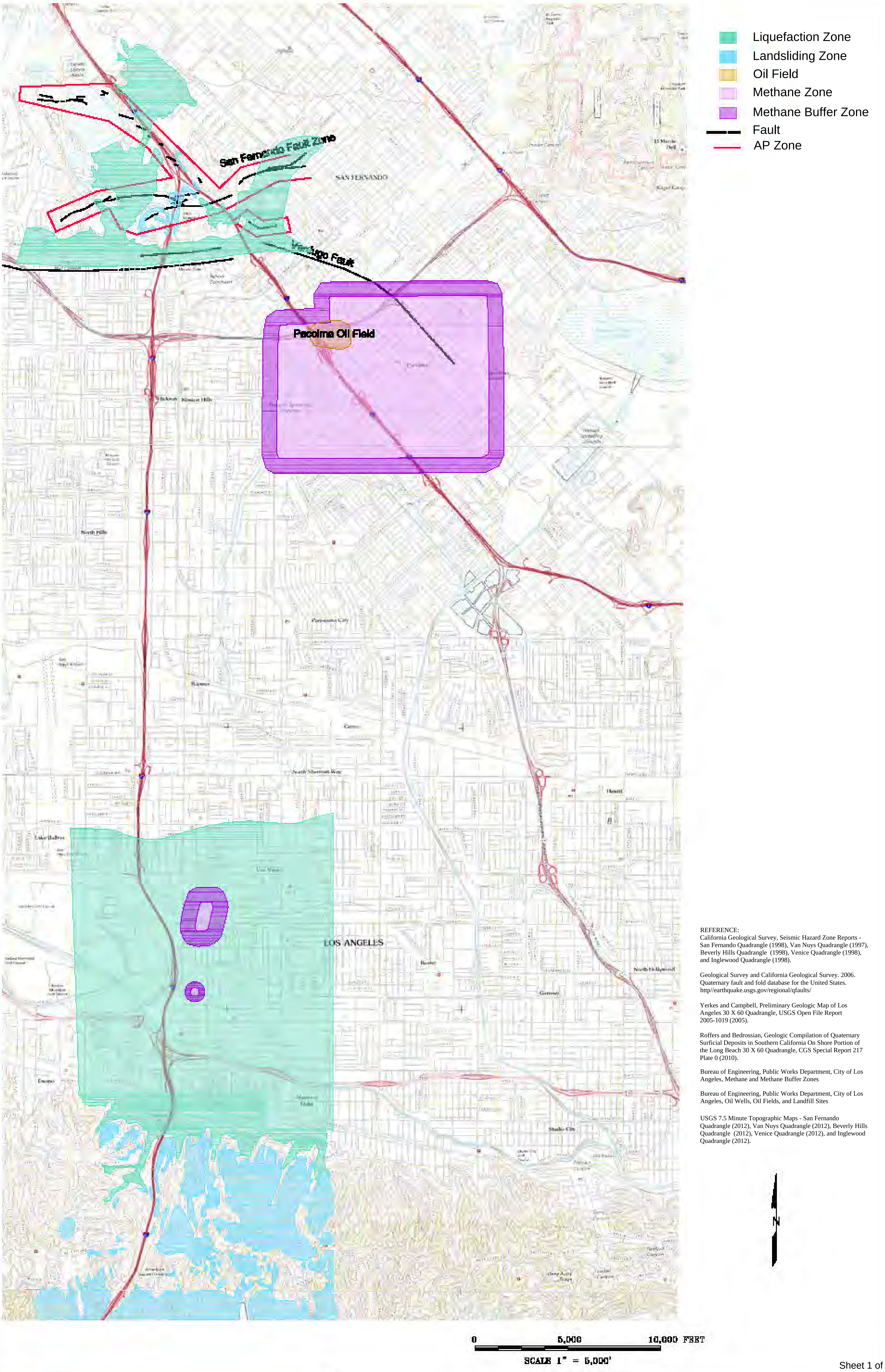
The 1971 San Fernando earthquake was of similar size (moment magnitude, M_W= 6.7; surface wave magnitude, M_S= 6.4; and local magnitude, M_L= 6.4) to the 1994 event but did involve surface rupture. The 1971 event occurred on a north dipping thrust fault that extends from the northern side of the San Fernando Valley to a depth of about 15 km under the San Gabriel Mountains. Several mapped surface faults were involved including the Sylmar fault, Tujunga fault, and Lakeview fault. These faults are commonly considered to be part of the Sierra Madre fault system, which extends easterly from the San Fernando Valley to the north side of the San Gabriel Valley, and to the Cucamonga fault in the San Bernardino area.

Another major historical earthquake in the Los Angeles region was the 1933 Long Beach event which had a magnitude of about M_W= 6.4 (M_L= 6.3). This earthquake did not rupture the surface but is believed to have been associated with the NISZ (Benioff, 1938). The association was based on abundant ground failures along the NISZ trend, but no unequivocal surface rupture was identified. Reevaluation of the seismicity data by Hauksson and Gross (1991) relocated the 1933 earthquake hypocenter to a depth of about 6 miles below the Huntington Beach-Newport Beach city boundary (Hauksson and Gross, 1991).

The 1987 Whittier earthquake (M_L= 5.9, M_W= 5.9) occurred on subsurface faults dipping under the Puente Hills to about 10 miles beneath the San Gabriel Basin (Shaw and Shearer, 1999). This event did not rupture the ground surface.

Another significant earthquake in the region was the 1812 earthquake which caused damage at the San Juan Capistrano Mission. The location and magnitude of the 1812 earthquake are unknown because of the sparse population at the time, but recent geological studies (Jacoby et al, 1988; Fumal et al, 1993; Weldon et al., 2004) postulated that it did not occur in the Capistrano area, but rather was a large (M> 7.0) distant event on the San Andreas fault in the Wrightwood area of the San Gabriel Mountains.

The earliest documented earthquake in the region was reported by the Portola expedition as they camped near the Santa Ana River in 1769. This event has been attributed by various geoscientists to just about every fault in the Los Angeles area but it could just as well have been a distant event that shook a wide area as did the 1971 San Fernando, the 1987 Whittier, and the 1994 Northridge events, as well as many other more-distant events (for example, 1992 Landers event).



REFERENCE:

California Geological Survey, Seismic Hazard Zone Reports - San Fernando Quadrangle (1998), Van Nuys Quadrangle (1997), Beverly Hills Quadrangle (1998), Venice Quadrangle (1998), and Inglewood Quadrangle (1998).

Geological Survey and California Geological Survey. 2006. Quaternary fault and fold database for the United States. http//earthquake.usgs.gov/regional/qfaults/

Yerkes and Campbell, Preliminary Geologic Map of Los Angeles 30 X 60 Quadrangle, USGS Open File Report 2005-1019 (2005).

Roffers and Bedrossian, Geologic Compilation of Quaternary Surficial Deposits in Southern California On Shore Portion of the Long Beach 30 X 60 Quadrangle, CGS Special Report 217 Plate 0 (2010).

Bureau of Engineering, Public Works Department, City of Los Angeles, Methane and Methane Buffer Zones

Bureau of Engineering, Public Works Department, City of Los Angeles, Oil Wells, Oil Fields, and Landfill Sites

USGS 7.5 Minute Topographic Maps - San Fernando Quadrangle (2012), Van Nuys Quadrangle (2012), Beverly Hills Quadrangle (2012), Venice Quadrangle (2012), and Inglewood Quadrangle (2012).

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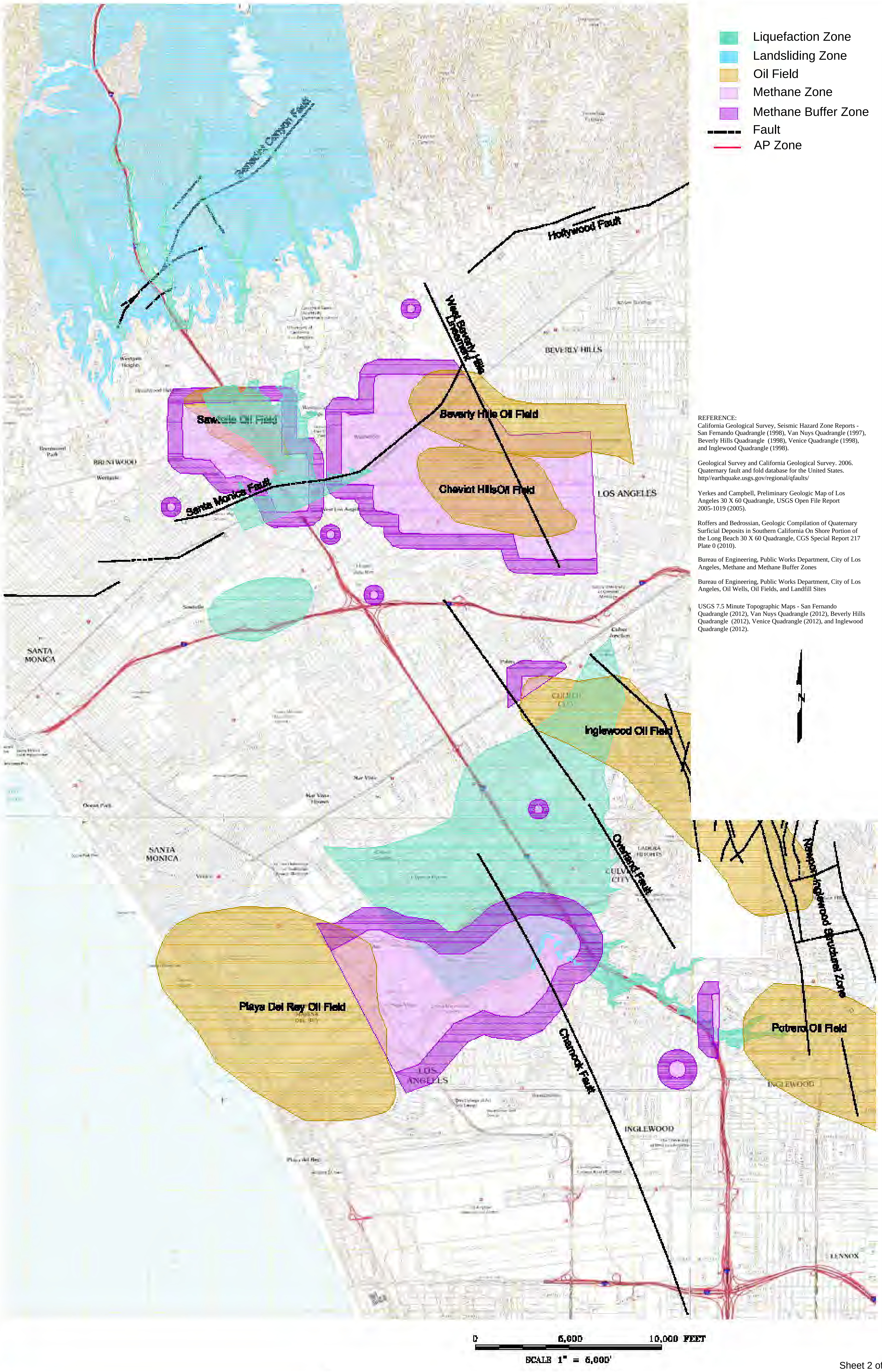
Project No. 12-103
Date: July 2012

Regional Geotechnical/Geologic Hazard Map

Figure 4-1a



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Bureau of Engineering, Public Works Department, City of Los Angeles, Oil Wells, Oil Fields, and Landfill Sites

USGS 7.5 Minute Topographic Maps - San Fernando Quadrangle (2012), Van Nuys Quadrangle (2012), Beverly Hills Quadrangle (2012), Venice Quadrangle (2012), and Inglewood Quadrangle (2012).

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Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	**SEPULVEDA PASS CORRIDOR STUDY** Project No. 12-103 Date: July 2012	Regional Geotechnical/Geologic Hazard Map Figure 4-1b

5.0 GEOLOGIC AND SEISMIC HAZARDS

5.1 Geologic Hazards

5.1.1 Landslides

The project corridor is subject to landsliding as it extends along the Sepulveda Canyon within the Santa Monica Mountains. Steep slopes, out of slope bedding, and poorly indurated bedrock are all common features of the Santa Monica Mountains. Most landslides are usually associated with water as soil saturation increases the unit weight and decreasing the internal strength of the materials. The probability of a landslide occurring becomes greater with increases in slope gradient, looseness of materials, unfavorable bedding (out of slope), clay content of the bedrock, underground springs, unfavorable slope orientation with existing fault boundaries, human disturbance of the landslide or its boundaries, increases in groundwater elevation, earthquake forces helping to mobilize the mass, looseness of materials in-situ, increases in water content, and disturbance of the lateral confining forces and/ or the toe of a slope.

According to CGS Landslide Inventory maps shown on Figure 5-1, there are many documented landslides located along the east and west flanks of the Sepulveda Canyon slopes that parallel the Sepulveda Pass Corridor (1997, 1998b). The northern and southern portions of the corridor are located in the San Fernando Valley and Los Angeles Basin where the topography is relatively flat. The landsliding hazard for the project is focused within the Santa Monica Mountains portion of the corridor. Aerial photo and field mapping may be necessary to determine the slope conditions specific to the proposed alignment.

5.1.2 Oil Field Related Hazard

According to the California Division of Oil and Geothermal Resources, the Sawtelle Oilfield is located in the Wilshire area of the project corridor study area. In general, the oilfield is located on the east and west side of the I-405 Freeway, and to the north and south of Wilshire Boulevard. The Sawtelle Oilfield was one of the earlier oil discovery sites in the Los Angeles basin and is currently active, though to a much smaller degree than in the early 1900s. The oilfield is tapping into structural traps formed in the underlying Monterey Formation by the Santa Monica and related faults. Oilfield-related geologic hazards of concern are subsidence, soil contamination and methane gas migration. Other oil field that are within the vicinity of the project corridor include the Pacoima Oil Field, Playa Del Rey Oil Field, Cheviot Hills Oil Field, Beverly Hills Oil Field, Inglewood Oil Field, and Potrero Oil Field (Figures 4-1a and 4-1b).

The extraction of fluids (water or petroleum) from sedimentary source rocks can cause the permanent collapse of the pore space previously occupied by the removed fluid. The compaction of subsurface sediment caused by fluid withdrawal can cause subsidence of the ground surface overlying a pumped reservoir. If the volume of water or petroleum removed is sufficiently great, the amount of resulting subsidence may be sufficient to damage nearby engineered structures. For the Sawtelle Oilfield, the level of extraction has not reached a point of inducing subsidence. Thus, the risk of subsidence associated with the Sawtelle Oilfield is considered low.

Other common problems associated with oil field properties include methane and hydrogen sulfide gas, oil seepage, contaminated soils, leaking wells, and wells not plugged and abandoned to current standards. The presence of soil contamination as well as methane and hydrogen sulfide gas in the oilfield area should be anticipated. Naturally occurring methane can form from the decomposition of buried material that is associated with coal and oil as well as microbial decomposition of organic material. Also methane can migrate from deeper oil and gas bearing zones to the shallow subsurface soils. City of Los Angeles has developed requirements for methane gas testing for any new construction zones within a “Methane Zone” or “Methane Buffer Zone”. According to City of Los Angeles (2002), portions of all the proposed concepts are located within Methane and Methane Buffer zones in both the San Fernando Valley and Los Angeles Basin. (Figures 4-1a and 4-1b)

5.1.3 Hazardous Material

The project corridor is located within both the San Fernando Valley and Los Angeles Basin, both traverse through heavily urbanized areas of Los Angeles. As a result, man-made hazardous materials are likely to exist throughout the areas in and around the project alignment. Hazardous material associated with artificial contamination include petroleum hydrocarbons, volatile organic compounds, pesticides, and metals. These contaminants are usually associated with industrial and/or commercial land uses. As an example, soil and groundwater contamination is often found at gas stations, dry cleaners, and manufacturing facilities. Residential land uses can also lead to contamination through activities often associated with lead-based paints, asbestos, and pesticides. Contamination is most often derived from gasoline and solvents. Metals like lead, mercury, arsenic, and chromium are also common. The presence of hazardous material along the project corridor will need to be researched on a more localized basis.

According to the Environmental Protection Agency (EPA), the project study area is located in Pacific Southwest Region 9. As defined by the EPA, a Superfund site is an uncontrolled or abandoned place where hazardous waste is located, possibly affecting local ecosystems or people. The region maintains numerous Superfund National Priorities List (NPL) sites, none of which are located within the Sepulveda Pass Corridor Study area.

5.1.4 Rock Topple

Rock topple can occur when loose blocks of exposed bedrock are induced to move and travel downslope when set free by earthquake forces, undermining of supporting earth from erosion or animal disturbance. Generally, slopes with a gradient of greater than 3:1 (horizontal to vertical) are more susceptible to rock topple and rolling. The areas along the Sepulveda canyon within the Santa Monica Mountains present a rock topple hazard to the alignment. The weathered and fractured nature of the exposed bedrock throughout the canyon create for rock topple conditions along the steeper slopes. Most of the proposed improvements along the Sepulveda Pass canyon may be subject to potential rock topple hazard.

5.1.5 Expansive Soils

Expansive soils swell or heave with increases in moisture content and shrink with decreases in moisture content. Montmorillonitic clays are most susceptible to expansion. Expansive soils can be found almost anywhere particularly in coastal plains and low lying valleys such as the Los Angeles Basin and San Fernando Valley. Expansive clays can even be found in weathered bedrock along the Santa Monica Mountains. The Monterey Formation has diatomaceous claystone layers that can be weathered into highly expansive clays. Much of the northern section of the Santa Monica Mountains is in Monterey Formation. Based on researched data for the project corridor, the majority of fine grained deposits encountered in the previous consultant data exhibited low plasticity with very low to medium expansion potential. A more site specific investigation will be required to further assess the impact of expansive soils on site specific improvements along the corridor.

5.1.6 Collapsible Soils

Collapsible soils are soil layers that collapse (settle) when water is added under loads also known as hydro-consolidation. Natural deposits susceptible to hydro-consolidation are typically aeolian, alluvial, or colluvial materials with high apparent strength when they are dry. The dry strength of these materials may be attributed to the clay and silt constituents in the soil and the presence of cementing agents (i.e. salts). Capillary tension may tend to act to bond soil grains. Once these soils are subjected to excessive moisture and foundation loads, the constituency including soluble salts or bonding agents is weakened or dissolved, capillary tensions are reduced and collapse occurs resulting is settlement. Typical soils are light colored, low in plasticity, and have relatively low densities. Although, the literature review did not find any presence of collapsible soils in the researched geotechnical consultant data reports, a more comprehensive geotechnical investigation will be needed in the design phase to determine the impact of collapsible soils on site-specific structures along the corridor.

5.1.7 Flooding and Scour

According to the FEMA Flood Insurance Rate Map,the majority of the project alignment is within the zone determined to be outside the 0.2% annual chance flood plain. The only portions of the alignment that cross a 100-year flood plain and/or 500 year flood plain areas are at the Los Angeles River crossing near the 101 freeway and the Ballona Creek crossing near I-90 freeway junction (Department of City Planning Los Angeles, 1996). The risk related to flooding should be considered low as the project corridor extends along well-developed areas that maintain storm drainage and water run-off control. Only portions of the alignment in the less developed areas within the Santa Monica Mountains may require further review to determine the storm drainage and flood control for the project corridor. Scour is not considered a major potential hazard as most of the creeks and rivers in the vicinity of the project are confined in engineered facilities, including the largest crossings at Ballona Creek and the Los Angeles River.

5.2 Seismic Hazards

5.2.1 Liquefaction

Liquefaction occurs when a mass of saturated soil loses significant strength and stiffness due to applied stress, usually from an earthquake. It is more likely to happen where groundwater is moderate to shallow and the stratigraphy consists of loose, unconsolidated soils like fill and young alluvial deposits. With increasing overburden, density and increasing clay-content, the likelihood of liquefaction decreases. Liquefaction is generally considered possible when the depth to groundwater is within about 50 feet from the ground surface. Much of the portion of the corridor within the Santa Monica Mountains is not considered to be liquefiable as soil coverage is relatively thin and much of the area is underlain by bedrock. According to CGS, the low-lying portions of the Sepulveda Pass Corridor are located within areas of potential liquefaction. This includes both the north and south ends located in the San Fernando Valley and Los Angeles Basin, respectively, as shown on Figures 4-1a and 4-1b.

In the San Fernando Valley, areas of liquefaction hazard are focused in the area north of SR-118 along I-405 where the San Fernando fault zone is located. Also, liquefaction zones are present in the areas within the southern San Fernando Valley in Van Nuys, where historical high groundwater is contoured to be near the ground surface. This area is also underlain by alluvial soils associated with the San Fernando Valley basin, which may have some loose, unconsolidated material. The San Fernando Valley is seismically active with both the 1971 San Fernando earthquake and the 1994 Northridge earthquake occurring in this region. These conditions create a high potential for liquefaction in this area.

The areas of liquefaction potential in the Los Angeles Basin include tributary valleys along the base of the Santa Monica Mountains, and an area of moderate groundwater elevations along the corridor between Santa Monica Boulevard and Wilshire Boulevard. Another section of the corridor along I-405 between Venice Boulevard in Culver City and Florence Avenue in Inglewood, also shows potential for liquefaction. According to CGS, the area between Culver City and Inglewood has historical high groundwater as high as 10 feet below the ground surface. This area is in close proximity to numerous faults and fault zones including the Charnock fault, Overland fault, and NISZ. These faults generate groundwater barriers that create abrupt zones of shallow groundwater as shown in CGS groundwater maps. This area is also underlain by alluvial sediments associated with the Los Angeles basin which creates for ideal conditions for liquefaction. The hazard associated with liquefaction should be considered moderate to high due to the presence of certain areas along the corridor with historically high groundwater combined with alluvial soil conditions and the seismically active nature of the Los Angeles region.

5.2.2 Lateral Spreading

Lateral spread is the finite, lateral displacement of sloping ground (0.1 to < 6 percent) as a result of pore pressure buildup or liquefaction in a shallow, underlying soil deposit during an earthquake. Lateral spreading, as a result of liquefaction, occurs when a soil mass slides laterally on a liquefied layer, and gravitational and inertial forces cause the layer, and the overlying non-liquefied material, to move in a downslope direction. The magnitude of lateral spreading movements depends on earthquake magnitude, distance between the site and the seismic event, thickness of the liquefied layer, ground slope or ratio of free-face height to distance between the free face and structure, fines content, average particle size of the materials comprising the liquefied layer, and the standard penetration rates of the materials. The potential for lateral spreading to impact the project corridor is low as most of the areas with liquefaction potential are along relatively flat terrain and do not have a free face.

5.2.3 Seismic Settlement

Seismic settlement occurs in loose to medium dense unconsolidated soil above groundwater. The soils compress (settle) when subjected to seismic shaking. Uniform settlement beneath a given structure would cause minimal damage; however, because of variations in distribution, density, and confining conditions of the soils, seismic-induced settlement is generally non-uniform and can cause serious structural damage. For the areas of the corridor underlain by unconsolidated alluvial sediments, there is a potentially for seismically induced settlement as the entire corridor is within the seismically active region of Southern California.

5.2.4 Potential for Ground Shaking

The energy released during an earthquake propagates from its rupture surface in the form of seismic waves. The resulting strong ground motion from the seismic wave propagation can cause significant damage to structures. At any location, the intensity of the ground motion is a function of the distance to the fault rupture, the local soil/bedrock conditions beneath the structure, and the earthquake magnitude. Intensity is usually greater in areas underlain by unconsolidated material than in areas underlain by more competent rock.

Earthquakes are characterized by a moment magnitude, which is quantitative measure of the strength of the earthquake based on strain energy released during the event. The magnitude is independent of the site, but is dependent on several factors including the type of fault, rock-type, and stored energy. Moderate to severe ground shaking will be experienced in the project area if a large magnitude earthquake occurs on one of the nearby principal active faults and may cause structural damage to the on-site improvements. The project corridor is proximal to numerous sources for large magnitude earthquakes that span the entire length of the alignment.

5.2.5 Fault Related Ground Rupture

The California Geologic Survey (CGS) establishes criteria for faults as active, potentially active or inactive. Active faults are those that show evidence of surface displacement within the last 11,000 years (Holocene age). Potentially active faults are those that demonstrate displacement within the past 1.6 million years (Quaternary age). Faults showing no evidence of displacement within the last 1.6 million years may be considered inactive for most structures, except for critical or certain life-line structures. In 1972 the Alquist-Priolo Special Studies Zone Act (now known as the Alquist-Priolo Earthquake Fault Zone Act, 1994, or APEHA) was passed into law which requires studies within 500 feet of active or potentially active faults. The APEHA designs “active” and “potentially active” faults utilizing the same age criteria used by the CGS. However, the established policy is to zone active faults and only those potentially active faults that have a relatively high potential for ground rupture.

The only active fault recognized by the AP Earthquake Fault Zone Act that crosses the project corridor is the San Fernando fault. The fault presents a major concern for fault rupture hazard as surface rupture occurred on it during the San Fernando earthquake in 1971. The 6.7 magnitude earthquake generated the existing 15 km long fault rupture with an approximate fault zone width of 5 km. The Northridge Hills fault is a blind thrust fault that is considered active, but poses no major hazard of surface rupture. The Mission Hills fault is believed to be active, though no major evidence of surface rupture has been found.

Although the Santa Monica fault and Charnock faults are identified on the Caltrans seismic hazard map (Mualchin, 1996) as being seismically active (Figure 4-1b), these faults are not identified as active Alquist-Priolo Earthquake Fault Zones by the California Geological Survey. Both faults are identified on the Los Angeles County fault rupture map as potentially active. The Santa Monica fault crosses the alignment at the base of the Santa Monica Mountains in West Los Angeles while the Charnock fault crosses Sepulveda Boulevard at the southern end near the LAX airport.

The hazard associated with fault related ground rupture should be a concern, particularly in the northern end of the segment near Sylmar where as it crosses an active fault rupture zone (San Fernando fault) recognized by APEHA as an Earthquake Fault Zone. Any proposed improvements within the fault rupture zone should be subject to a site-specific surface fault rupture displacement hazard investigation and fault study in accordance with the guidelines of CGS Note 49. Potential fault rupture along the Charnock and Santa Monica faults will also need to be addressed.

5.2.6 Ground Lurching

Ground lurching is the development of ground fractures, cracks, and fissures produced by ground shaking, settlement, compaction, and sliding that can occur due to seismic ground acceleration. Ground lurching typically occurs in areas with high topographic relief, high ground accelerations, and usually near the source of an earthquake. The section of project corridor along the Santa Monica Mountains will have the most risk of susceptibility to ground lurching. Alluvial and colluvial soil deposits are more susceptible to ground lurching than bedrock, and thus the risk is considered low as most of the Santa Monica Mountains consist of bedrock with some minor alluvial soils within the tributary valleys.

5.2.7 Earthquake Induced Landslides

Earthquake induced landslides are slope failures/movements that occurs from shaking during an earthquake event. This includes landslides and rock topple which are discussed in the previous section. According to CGS Seismic Hazard Maps (1999), most of the Santa Monica Mountains are delineated with earthquake induced landslide potential. These zones are shown in the Regional Geotechnical/Geologic Hazard Map (Figures 4-1a and 4-1b).Due to the seismically active region in which the project corridor is located, seismically induced landsliding is a concern for the project corridor through the Santa Monica Mountains.

5.2.8 Seismically Induced Inundation

Seismically induced flood inundation is a potential hazard for portions of the alignment within the San Fernando Valley and Los Angeles Basin areas. Flood inundation would essentially be a result of earthquake-induced dam failures associated with the Upper and Lower Van Norman Lakes, Pacoima Reservoir, and Stone Creek Reservoir. The Los Angeles area does have a history of dam failures including the Baldwin Hills dam failure of December 14, 1963. The Van Norman Dam nearly collapsed during the 1971 San Fernando earthquake. But, since the San Fernando earthquake, federal, state, and local design standards were strengthened and retrofitting of existing facilities was required (Department of City Planning Los Angeles, 1996). During the 1994 Northridge earthquake, numerous dams were damaged including the Pacoima Dam, though the damage was considered low level due to previous retrofitting subsequent to the 1971 San Fernando earthquake. According to inundation maps, the alignment is within potential inundation areas within the San Fernando valley from Mission Hills south to Ventura Boulevard and within the Los Angeles Basin from Westwood southeast to the I-90 crossing (Department of City Planning Los Angeles, 1996).

Seismically induced inundation is a potential hazard as numerous dams (Van Norman, Pacoima, and Stone Creek Reservoir Dam) exist within the San Fernando Valley and Los Angeles Basin portions of the concept alignments. Unfortunately, no quantitative probability information has been found for dam failure hazards. However, due to increased standards and requirements, any dam known to have failure potential will have its water level reduced to allow for partial collapse without loss of water as required by the State Division of Safety of Dams and by safety protocols established by dam owners. As a result, unless the structure is regarded as an essential life-line, the scour and flood impact related to seismically induced inundation should be considered low.

5.2.9 Tsunamis

Tsunamis, or seismic sea waves, are large oceanic waves generated by earthquakes, submarine volcanic eruptions or large submarine landslides. They are capable of traveling long distances across ocean basins, and can force large quantities of water up onto shore at high velocities. The forces involved with tsunamis are of such large magnitude that the only positive means of protection is to avoid areas subject to tsunamis. According to the City of Los Angeles Safety Element (1996), the project alignment is located outside of any areas potentially impacted by a tsunami.

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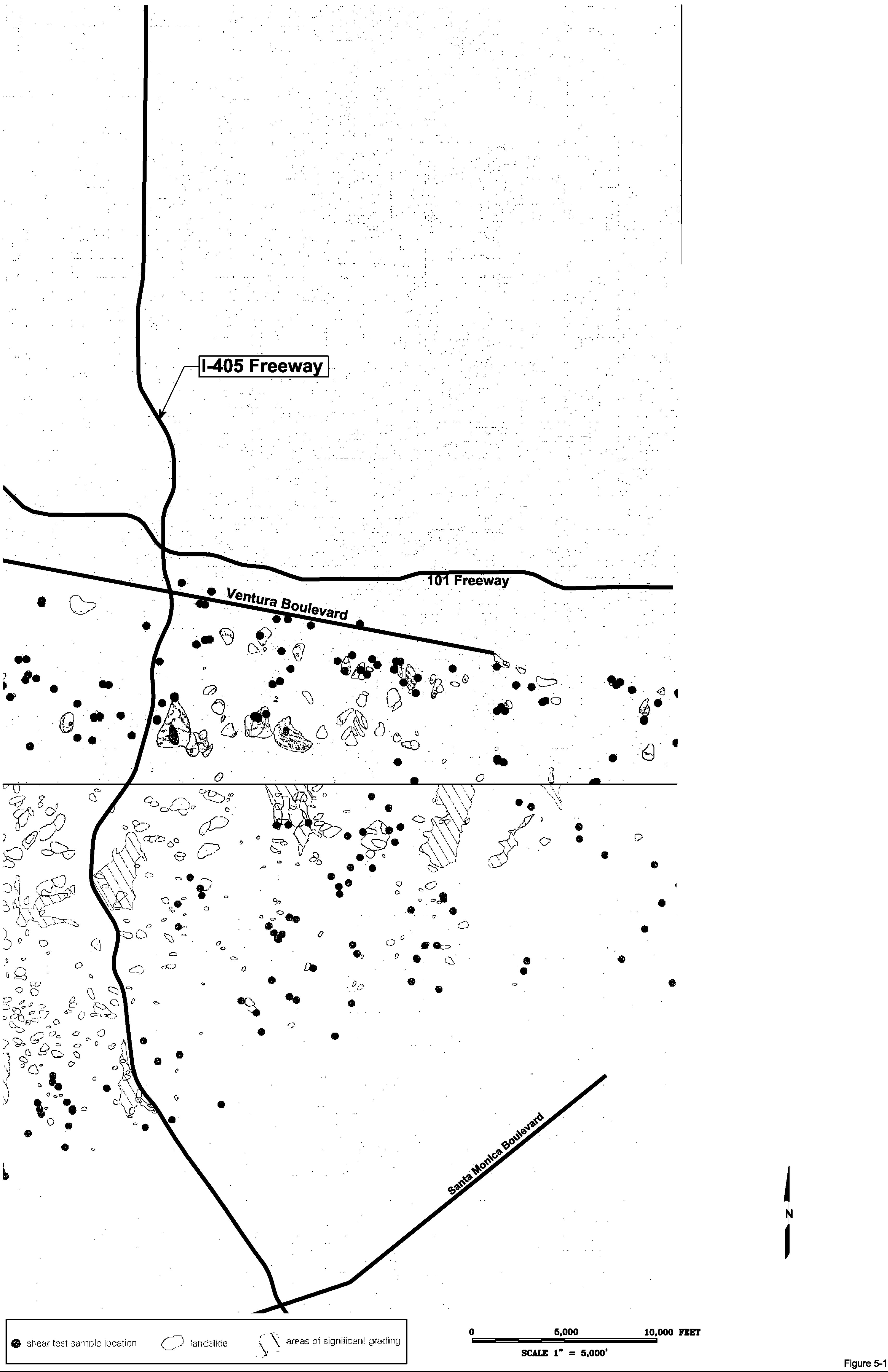

Figure 5-1

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

SEPULVEDA PASS CORRIDOR STUDY

Project No. 12-103

Date: July 2012

LANDSLIDE INVENTORY MAP
Santa Monica Mountains

REFERENCE: California Geological Survey, Seismic Hazard Zone Reports
- Van Nuys Quadrangle (1997) and Beverly Hills Quadrangle (1998)

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6.0 GEOTECHNICAL EVALUATIONS

All six (6) proposed concepts stretch across a corridor that extends through two major basins and across a segment of the Southern California fault and fold belt. Based on our evaluations of these concept alternatives, the major areas of geologic concern revolve around the corridor extending along seismically active regions within southern California. All of the concepts proposed include proposed improvements that are proximal to and/or cross numerous potentially active and active faults including the Santa Monica fault, the Newport-Inglewood fault, the Charnock fault, the San Fernando fault and the Northridge Hills fault. The latter two faults have had major earthquakes in recent time (1994 Northridge earthquake and 1971 San Fernando earthquake). As a result, conceptual improvements associated with the six (6) alternatives will be subjected to seismic hazard and geologic concerns that will require site-specific field explorations and engineering studies during the future design phase. Tunneling associated with Concepts #4, #5 and #6 will also have some important geologic and geotechnical considerations that are addressed in a later section.

6.1 Fault Rupture Considerations

Fault related ground rupture will be a major concern for design along the northern end of the project in Sylmar. Here the San Fernando fault is mapped across the proposed alignment with a 15 km long rupture surface that resulted from the 1971 San Fernando earthquake. Other active faults with fault rupture potential include the Charlock fault and the Santa Monica fault. Fault rupture can lead to significant damage to structures along the active fault zones.

None of the alternative concepts include any major proposed structures along the San Fernando fault zone. The only concept alignments that extend along Sepulveda Boulevard cross the Charnock fault (Concepts #1, #2, and #5), with improvements limited to at-grade pavement for BRT or at-grade track rail improvements. Thus, proposed fault rupture impacts along the Charnocks should be considered low. Improvements associated with Concepts #3 through #6 will have impact potential for fault rupture, as the proposed highway viaduct, LRT, and tunnel alignments will cross the Santa Monica fault in West Los Angeles. The Santa Monica fault is considered active and does have a potential for fault rupture. As a result, an additional site specific fault study and fault rupture analysis will need to be done within the area of any proposed tunnel, trench section and/or viaduct along the Santa Monica fault zone. All of the proposed improvements crossing the Santa Monica fault will need be designed to accommodate potential rupture in accordance with the a subsequent fault study and fault rupture displacement hazard analysis during the design phase.

6.2 Liquefaction Potential Considerations

In regards to liquefaction and lateral spreading, the two main areas of concern include the area in Van Nuys near the US-101 and I-405 interchange; and the portion of corridor that extends between Culver City and Inglewood via the I-405 freeway. Both areas have potentially high groundwater conditions and evidence of existing unconsolidated alluvial soils. Portions of the project located in liquefaction zones may need to account for loss of bearing capacity and excessive seismically induced settlement into the choice of foundation type.

Concepts #2 through #6 have proposed improvements within these zones of liquefaction.

Structures include support bents, walls, and abutments for direct access ramps for BRT and tunnel portal access as well as trench and/or cut and cover sections for tunneling Concepts #4, #5 and #6. A project specific soils investigation and analysis will be needed to determine the potential for settlement associated with liquefaction and lateral spreading.

Potential mitigation measures for liquefaction, lateral spreading, and seismic settlement of soils include site grading and/or soil improvement of the existing alluvial soils. Alternatively, project improvements can be designed with deepened foundations that are designed to resist applicable lateral and vertical loads, as well as derive support from competent soils and bedrock below the affected areas. Liquefaction will also impact the tunnel, particularly near the tunnel portals.

6.3 Strong Ground Motion Considerations

Seismic shaking is a potential hazard that is expected to affect the entire corridor, as there are major sources of potentially large earthquakes extending along and proximal to entire length of project corridor. However, strong seismic shaking is common for structures in southern California. Design and construction of all the proposed structures within the each of the concepts should be engineered to withstand the expected ground acceleration that may occur at the project site. The calculated design base ground motion for the site shall take into consideration the soil type, potential for liquefaction, and the most current and applicable seismic attenuation methods that are available. All on-site structures shall comply with applicable provisions of the current Metro Supplemental Seismic Design Criteria.

6.4 Slope Stability Considerations

Rock topple, landsliding and earthquake induced landsliding will be hazard concerns within the portion of project corridor within the Santa Monica Mountains. Portions of the project located within potential landslide areas present a potential for slope movement along or into the project alignment and/or associated structures. Rock topple also poses some potential damage hazard to portions of the alignment along the weathered rock slopes of the Santa Monica Mountains. Additional investigation and geotechnical analysis will need to be conducted to better assess the impacts of seismic shaking and slope movements on the project corridor. Proposed concept structures along the Sepulveda Pass section will need to be evaluated and investigated site specifically in order to determine the existing landsliding and rock topple risks and factors of safety. Concepts #2 through #6 all consist of potential proposed improvements located within the Sepulveda Pass. Potential mitigation measures include site grading, deepened or strengthened foundations for retaining walls, and slope drainage improvements for proposed structures.

6.5 Foundation Type Considerations

6.5.1 Aerial Structures

Although detailed structural plans are not available, the aerial structures are expected to be bridge structures with earth retaining systems supporting the approach fills. Foundation type for these structures can depend on various factors besides geotechnical conditions and its selection should be evaluated differently based on site-specific information. The underground structures are planned to be constructed by either bored tunneling or cut-and-cover method. The Metro design criteria for these structures are the latest AASHTO LRFD Bridge Design Specifications with California Amendments.

Due to the project corridor's seismicity, deep foundations are anticipated for the aerial structures and elevated stations due to high vertical and lateral load demands.

Piling is generally categorized according to its installation method into driven or cast-in-drilled-hole (CIDH) piles. In our opinion, unless it is restricted by environmental regulations because of the noise level and vibration during construction, driven piles appear to be a more suitable pile type than CIDH piles for the corridor due to the following reasons:

1. Possibility of using battered piles to resist large lateral loads at tall cantilever abutments,
2. Reliability of pile end bearing without cleanout effort,
3. Potential of encountering caving soils during drilling of CIDH piles cannot be precluded,
4. Possibility of future specified pile tip elevations may be below groundwater level,
5. No disposal of soil cuttings and groundwater (particularly for areas with potential contaminants) is necessary, and
6. Pile capacity can be verified by blowcounts and/or pile driving analyzer (PDA).

Among commonly available driven pile types are prestressed precast concrete pile, pipe pile, H-pile, and cast-in-steel-shell (CISS) pile. The prestressed precast concrete pile is regarded as a displacement pile, since it displaces surrounding soils during pile driving. Pipe pile, H-pile and CISS pile are non-displacement piles in this regard until a soil plug is formed. Prestressed precast concrete pile is generally the most economical pile type, while the CISS pile is the most expensive due to the ½ inch to ⅝ inch thick steel shell commonly used. Small diameter pipe pile is not favorable for the project, since the pile can be easily plugged and refusal can be encountered before reaching the specified pile tip elevations. In addition, the thin pile shell at the pile head is easy to be damaged during hard driving.

Although CIDH piles may have their shortcomings, CIDH piles, particularly large-diameter drilled shafts, can have some distinct advantages over driven piles under the following circumstances:

1. Restrictive noise and vibration levels during construction in sensitive neighborhoods,
2. Geometry limitation such as right-of-way or underground utilities to be protected in place that constraints foundation footprint, and
3. High lateral pile capacity to resist seismic demand.

6.5.2 Earth Retaining Structures

Conventional cast-in-place (CIP) retaining walls are generally designed for 1 inch of total settlement under the fully applied live and dead loads. We anticipated that bearing capacities for shallow foundations founded into the upper soils will be largely controlled by allowable settlement. For CIP walls with high calculated settlement, a deep foundation or a change in wall type to mechanically stabilized earth (MSE) wall may be necessary.

For U-sections with walls below existing grade, the bearing foundation stratum was pre-loaded with the full depth of excavated soil. The pre-loading serves as a surcharge in eliminating portion of load related settlement. In addition, since soil generally increases in relative density or consistency with depth at the locations of the proposed U-sections based on the findings of our geotechnical investigation, we expect that these below-grade retaining walls can mostly be supported on shallow footings to the planned wall heights. The success of a cantilever wall will depend on the tolerance of deflection, which can be successfully controlled by installing top struts.

MSE wall is particularly suitable for the anticipated subsurface conditions of the project because of its flexibility to allow higher settlement. It is not uncommon for MSE walls to be designed for total settlements up to 4 inches.

6.5.3 At-Grade Stations and Appurtenant Structures

Conventional shallow foundations are feasible for these lightly loaded surface structures. To limit settlement or volumetric changes due to moisture variations in expansive soil, some remedial grading can be performed if shallow foundations are to be used.

6.6 Hazardous Material Considerations

Hazardous materials are a potential hazard throughout most of the project study area. These contaminants are usually associated with industrial and/or commercial land uses common to the metropolitan area, which metals, petroleum hydrocarbons, volatile organic compounds and pesticides. Such industrial and commercial contamination is usually associated with shallow soils and can be mitigated. An Environmental Phase I assessment will be required to determine all the local potential hazardous sites located along the alignment. More site specific investigations will be needed to determine extent of contaminations and subsequent mitigation measures.

Superfund sites delineated by the EPA present a much larger concern in regards to hazardous material for any project site. According to the EPA NPL sites map, no major Superfund sites are located within the proposed corridor study area.

Oil field related hazardous material does pose a risk to the project in the form of hazardous gas, contaminated soil, seeps, and abandoned wells. Naturally occurring hydrogen sulfide gas and methane are often associated oil bearing formation and thus will be a potential hazard in regard to tunneling near the Sawtelle Oil field. Portions of the Sawtelle Oil field are located along the concept alignments in West Los Angeles. Concepts #4, #5 and #6 will include subsurface improvements that traverse through oil field zones in the form of cut and cover tunnel, trench section, and/or bored tunnel. Additional investigation and testing will be needed to determine the site specific impact of the oil field contaminants on the project. Proposed improvements located in Methane and Methane Buffer Zones (Figures 4-1a and 4-1b) may require specific testing and remediation in accordance with city standards. During construction, air monitoring and special safety procedures may be required for these structures as well.

6.7 Tunneling Considerations

Tunneling is a major aspects of Concepts #4, #5 and #6. The proposed bored tunnel(s) will cut through the Santa Monica Mountains between the San Fernando Valley to the north and West Los Angeles to the south. As discussed previously, the Santa Monica Mountains have varying geologic conditions that will need to be considered as part of the design and construction of the bored tunnel. The geologic and geotechnical evaluation of these conditions along with other geologic and geotechnical hazards regarding the tunnel is summarized below.

6.7.1 Geologic Formations

The tunnel excavation through the Santa Monica Mountains will likely encounter some soil formations as well as low-strength and high strength bedrock formations. These formations include alluvial soil, sedimentary rock which includes the Monterey and Topanga formations, and metamorphic basement rock known as the Santa Monica Slate. Both the Monterey and Topanga formations are inherently variable as they consist of stronger more cemented layers of sandstone and shale as well as low-strength units of siltstone, claystone mudstone, and highly weathered zones. These sedimentary formations also maintain distinct bedding structure that will impact tunneling excavations. The Santa Monica Slate is a massive, more uniformly high-strength, hard rock formation. A geotechnical investigation will be needed during the design phase in order to determine bedrock distribution and weathering conditions in relation to the proposed tunneling alignment. Each formation will need to be characterized and tested using methods that may include but won't be limited to packer testing, pressure meter testing, primary and shear wave logging, and rock quality designation (RQD). Such a range of conditions is likely to result in less-efficient tunneling operations and lower overall progress rates. Due to the variation of lithology across the Santa Monica Mountains, excavations will need to be done using a specialized machine for different types of geologic conditions or a combination of excavation methods.

6.7.2 Geologic Structure

The geologic structure will vary across the length of the tunnel as the tunnel will cut through an existing anticline. Tunnel portions excavated into the weaker sedimentary rock may encounter unfavorable bedding conditions depending on the strike and dip of the bedding in relation to the tunnel excavation. As a result there is chance of instability along tunnel walls where out-of-slope bedding and/or weathered and fracture rock are exposed. Structure within the weaker bedrock units may dictate a need for immediate support for tunnel excavations. Unfavorable bedding and weathering conditions could lead to tunnel wall instability. Additionally, fault zones of highly weathered rock and fault gouge will be encountered. Weathered zones may be subject to spalling and caving of large wedges of rock from the tunnel roof. Areas with fault gouge zones have the potential for ground squeezing and may require specialized tunnel support during construction and design. A geotechnical investigation will be needed during the design phase in order to determine structural conditions specific to the project alignment.

6.7.3 Groundwater

Groundwater depths and elevations are not well documented throughout the Santa Monica Mountains. Groundwater should be anticipated along the tunnel, particularly near the portals as high groundwater is present just north and south of the Sepulveda Pass. Groundwater will vary with differing rock strata and conditions. More porous strata, fracture zones, and fault zones will yield greater inflows locally. Tunneling that extends into the basins will encounter water saturated soil which has an even higher potential for moderate to heavy groundwater inflows than bedrock. As a result, groundwater control measures may be required, particularly for Concepts #4 and #6. Potential mitigation measures include pump systems, dewatering, grouting, and specialized tunnel lining and support systems. All the tunneling concepts have the potential to encounter potential groundwater inflow hazard.

6.7.4 Caving Soil

Saturated alluvial soils would likely be encountered in excavations for the portals, limited portions of shallow tunnels beyond the portal areas, and extended tunneling into the San Fernando Valley and West Los Angeles as part of alternative #4 and #6. The risks of open excavation and tunneling in saturated alluvium include high groundwater inflows, flowing ground conditions, loss of ground outside the excavation, and settlement of the ground surface. The amount of settlement would depend on a variety of factors including the tunnel excavation and support methods, ground characteristics, diameter of the tunnel, and cover above the tunnel (i.e., distance from the tunnel crown to the ground surface). Typically, a ground cover of at least two tunnel diameters is desirable for minimizing settlement magnitudes. To actively control settlement, ground loss should be controlled at the face of the tunnel so that the effects of that loss of ground do not propagate to the surface. Tunneling methods are available to handle saturated alluvium conditions. Control of unstable ground conditions and groundwater inflows can be provided by specialized tunneling machines with face control capabilities. These machines generally utilize either earth-pressure balance (EPB) or slurry methods.

6.7.5 Ground Settlement

During tunneling excavation, face instability can lead to loss of ground and subsequent ground settlement. Ground settlement is mainly a concern when tunneling through soils which has the potential to occur in Concepts #4, #5 and #6. Ground improvement measures may be required in saturated soil conditions. Ground settlement will impact the tunnel design and depth and should be determined based on site specific soil data and analysis.

6.7.6 Naturally Occurring Gas

Naturally occurring gas should be anticipated as numerous tunneling projects in the Los Angeles area have encountered naturally occurring hydrogen sulfide and methane gas during construction. These projects include the Northeast Interceptor Sewer (NEIS), the East Central Interceptor Sewer (ECIS), and the Metro Red Line and Gold Line Eastside Extension. City of Los Angeles methane and methane buffer zones are located within the concept alignments in West Los Angeles along the Sawtelle Oil field and near the Cheviot Hills and Beverly Hills Oil Fields. Figure 4-1a also shows small zones within the San Fernando Valley just north of the 101 freeway. Testing for hazardous material will need to be conducted during the investigation and design phase. During tunnel construction, continuous air monitoring will be required as well as respirators and other appropriate personal protective equipment (PPE). Special tunneling equipment and safety procedures may be necessary to mitigate exposure to hazardous gases.

6.8 Other Considerations

Numerous other geologic and seismic hazards were identified as part of this evaluation, though many of them should be considered localized conditions that will require additional research and supplemental data to better assess the more site specific impacts on the concerned locations of the project corridor. These hazards may include, expansive soils, existing fill, collapsible soils and flood and scour. All of these hazards are not uncommon and can be mitigated based on site specific conditions determined during the design phase of the project. As previously discussed, other hazards including seismically induced inundation, ground lurching and tsunamis are considered a low risk to the overall project.

7.0 DISCUSSIONS AND CONCLUSIONS

From a geologic and geotechnical standpoint, the six (6) concepts present a diverse mix of transportation improvements that would need further study in the later phases of the project. We summarized the geotechnical and geological issues that would challenge the development of these concepts in the following matrix. We address each concept by physiographic region due to the diverse geologic conditions associated with each of the regions within the study area. These regions within the study area include the San Fernando Valley, Sepulveda Pass (Santa Monica Mountains) and the Los Angeles Basin (West Los Angeles).

Region	Concept	Groundwater	Slope Stability	Liquefaction	Strong Ground Motion	Fault Rupture	Caving Soil	Ground Loss	Geologic Formation	Geologic Structures	Naturally Occurring Gas	Hazardous Materials
San Fernando Valley	1				•							•
	2			•	•							•
	3			•	•							•
	4	•		•	•		•	•			•	•
	5			•	•						•	•
	6	•		•	•		•	•			•	•
Sepulveda Pass	1		•		•							
	2		•		•							
	3		•		•							
	4	•						•	•	•	•	
	5	•						•	•	•	•	
	6	•						•	•	•	•	
Los Angeles Basin	1				•							•
	2			•	•	•						•
	3			•	•	•						•
	4	•		•	•		•	•			•	•
	5			•	•	•					•	•
	6	•		•	•		•	•			•	•

Other issues such as expansive soils and collapsible soils, etc. will need to be addressed on a case-by-case basis.

Concepts #1 and #2 are the least impacted alternatives in terms of geologic and geotechnical hazards and recommendations because these concepts involve the least new infrastructure development. Due to the limited improvements and new structures associated with Concepts #1 and #2, the scope of the geotechnical and geologic investigation in the design phase will be much smaller in comparison with some of the other concepts.

Concept #3 proposes a major highway viaduct along the I-405 alignment. Based on studies done by Caltrans, the viaduct concept has been previously eliminated due to seismic safety concerns as well as visual concerns for the public. As a result, evaluation of this concept is limited to the discussions in previous sections and no further consideration and/or analysis will be conducted on this concept.

Concepts #4, #5 and #6 utilize a proposed tunnel to improve the transportation infrastructure through the Sepulveda Pass. Tunneling as discussed in Section 6.7 will have numerous geologic and geotechnical considerations with regard to design and construction. All of the tunnel concepts will encounter highly variable conditions resulting in more complex and adverse drilling operation and a decline in progress. Due to the potentially highly variable conditions that may be encountered during tunneling, a very comprehensive investigation and geotechnical data report will be required as part of the design phase. Evaluation of tunneling methods will be needed to address all of the potential complications associated with the geologic and geotechnical conditions. Tunnel design should be based on these conditions with tunnel design elevations set above static groundwater where feasible in order to reduce potential complications associated with groundwater inflows. All of tunnel concepts will also need to address the potential for naturally occurring gas for tunnel design and construction. Concepts #4 and #6 will also need to address oil-related hazards including methane gas for tunneling portions through the Los Angeles Basin and San Fernando Valley.

Concept #4 consists almost entirely of tunnel related improvements. Portions of the tunnel alignment do extend outside the Sepulveda Pass, particularly on the south side where the tunnel will extend potentially as far as Venice Boulevard. Thus there will be some segments that will need to be either bored through alluvial basin soils or constructed as trench or cut and cover sections depending on the design and depth. The concerns with boring a tunnel through alluvial soils include ground settlement and water saturated soils which are discussed in the previous section. Flowing conditions in alluvial soils can lead to loss of ground and potential surface settlement. Dewatering methods and/or water tight initial support systems and lining may be required for tunneling in saturated alluvial soils. Concept #4 will also need to address the fault rupture potential along the tunnel portion that crosses the Santa Monica fault near Wilshire. Special tunnel design to account for the fault rupture will be required. Another option would be to re-design the tunnel along the fault to be an at-grade crossing.

Concept #5 consists of major improvements that extend nearly the entire length of the study corridor. Of the concepts that require tunneling, Concept #5 will require the least amount of tunneling footage. The tunnel is confined to the Santa Monica Mountains portion of the corridor, while all other improvements will be at-grade track and LRT stations traversing the San Fernando Valley and Los Angeles Basin. Geologic and geotechnical concerns regarding the at-grade portion of the proposed LRT are far less impacting on the proposed design and construction than the concerns related to the proposed tunnel.

Concept #6 will require the most tunneling of any of the concepts as it not only has the longest tunnel alignment, but it also includes two separate tunnels. Improvements related to this concept are exclusively related to tunneling as the only structures at the surface will be related to access ramps, tunnel portals, and shuttle stations. Similar to Concept #4, the tunneling in Concept #6 will extend into the San Fernando Valley and Los Angeles Basins which will mean there will be greater geologic concerns related to ground settlement and water saturated alluvium in regards to the bored tunnel sections. Concept #6 will also have the same issue regarding fault rupture as Concept #4, and will need to be designed appropriately as discussed above.

Based on the geotechnical and geologic evaluation of the potential transportation concepts for the Sepulveda Pass Corridor study area, this study is deemed acceptable for a systems planning study.

8.0 LIMITATIONS

This Geotechnical Evaluation has been prepared for the exclusive use of Metro for specific application to the Sepulveda Pass Corridor Study, Los Angeles, California. The report has been prepared in accordance with generally accepted engineering practices. No other warranty, express or implied, is made.

The geotechnical and geological information contained in this report is based on the data obtained from the review of available sources of information, such as geological maps and documents, other consultant reports, and our existing data within or proximal to the project study area. The data used represents the information that was available during preparation of this report within the preparation time allowed.

The evaluation is based on the preliminary and conceptual design information. These concepts are subject to changes and revisions in the nature, design, and/or locations of the proposed improvements and thus the conclusions and recommendations of this report should not be considered valid unless such changes are reviewed, and conclusions of this report are modified or verified in writing by Earth Mechanics, Inc. Earth Mechanics, Inc. is not responsible for any claims, damages, or liability associated with the reinterpretation or reuse of the data in this report by others.

We appreciate the opportunity to provide geotechnical services for the advanced conceptual planning phase of this project. If you have any questions, please contact us at (714) 751-3826.

Sincerely,

EARTH MECHANICS, INC.

Michael Hoshiyama, PG 8864
Staff Geologist

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APPENDIX C – SUMMARY NOTES FROM CHARRETTES #1 AND #2

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Charrette #1 Recommendations

1. Easiest, least costly concept: at-grade Sepulveda Blvd BRT;
   Most complex and costly concept: an auto/shuttle tunnel
2. Connections to the north build on proposed East San Fernando Valley Transit Corridor improvements along Van Nuys Blvd.
3. Connections to the south could tie into the Crenshaw/LAX Transit Corridor at Century/Aviation where LAWA may build an intermodal transportation facility.
4. Constraints along Sepulveda Blvd limit opportunities for dedicated lanes.
5. For Managed Lanes concept: HOT 3+ minimum occupancy can be used where two HOT lanes in each direction are not feasible.

Charrette #1 Recommendations

6. The Highway Viaduct concept has fatal flaws (including visual impacts) and was screened out in the I-405 EIR/EIS; Viaduct concept should not be modeled.

7. Tolled Tunnel concept has two possible southern portals near Santa Monica Blvd. and Venice Blvd.

8. Tolled Tunnel concept should be tested as toll-only facility (all autos pay, only buses free), since HOV lanes on I-405 would still be available for free.

9. Fixed-Guideway Rail concept with interlining connections to Metro Rail network would be a pure public project, since it is not likely to be attractive to P3 investors.

10. Highway/Shuttle Tunnel concept could require private entity to apply toll revenue towards building/operating transit service per performance specs.

Sepulveda Pass Corridor Systems Planning Study

Charrette #2 Notes

Prepared for:

Metro

Prepared by:

Parsons Brinckerhoff
in collaboration with HNTB, IBI Group, Atwell Consulting, and The Robert Group

September 2012

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Sepulveda Pass Corridor Systems Planning Study Charrette #2: Meeting Notes for July 30, 2012

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Introductions
David Mieger (Metro) opened the charrette with an overview of the Study, its relation to Measure R, and the concept families. Roger Martin (Metro) led the group through introductions.

Project Overview
David Mieger (Metro) stated that the Sepulveda Pass is one of the last of the 12 transit corridors included in Measure R and is identified in Metro's adopted Long Range Transportation Plan (LRTP). The current I-405 Widening Project was conducted by Caltrans for highway improvements, but did not fully explore potential transit options. An issue for this and future studies of this corridor is what are the project options and how to fund them.

Metro is currently conducting a broad systems planning study of the corridor and potential concepts to improve mobility through the Sepulveda Pass, which is a major bottleneck that impedes north/south travel between the San Fernando Valley and the Westside regions. The Texas Transportation Institute ranks the two interchanges at either end of the Sepulveda Pass, I-405/US-101 and I-405/I-10, as the 2^{nd} and 3^{rd} most heavily congested interchanges in the nation. A separate study by Metro, the East San Fernando Valley (ESFV) Transit Corridor Alternatives Analysis Study, is currently examining transit options for the northern end of the Sepulveda Pass Study corridor, within the San Fernando Valley, while another study by the City of Los Angeles Department of Transportation (LADOT), the Westside Mobility Study, is examining various mobility improvements for the southern end of the corridor, from Westwood to LAX.

David briefly reviewed the six concept families being studied, which progress from a "low cost" at-grade bus improvements to several "higher cost" highway and transit capital improvements that could include highway and/or transit tunnels under the mountains, through the Sepulveda Pass and various configurations for connections to the north and south of the Pass itself.

David also noted that the purpose of this study is to provide comparative analyses of the different concepts. An Alternatives Analysis (AA) Study could potentially follow the current study. He indicated that the next steps are to continue working with the Public-Private Partnership (P3) group, the East San Fernando Valley Transit Corridor, and the Westside Mobility Study teams in evaluating the six systems planning concepts. The final planning concept report for the Study is anticipated to be completed in the Fall 2012.

Review of Representative Concepts from Charrette #1
Theresa Dau-Ngo (PB, Transportation Planning) presented an overview of each of the representative concepts from Charrette #1 in May (Table 1.1): Van Nuys/Sepulveda BRT; Managed Lanes; Highway Viaduct; Toll Tunnel; Fixed Guideway Rail Tunnel; and privatized Highway/Transit Shuttle Tunnels.

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Table 1.1 Concept Families from Charrette #1 (May 2012)

	Concept	1. Van Nuys/Sepulveda BRT	2. BRT in At-Grade Freeway Managed Lanes	3. Highway Aerial Managed Lanes	4. BRT with Tolled Highway Tunnel	5. Fixed Guideway LRT	6. Highway/Private Shuttle Tunnels
Profile		At-Grade	At-Grade	Elevated	Tunnel	At-Grade/Tunnel	Tunnel
P3 Potential		No	Maybe	Maybe	Yes	No	Yes
Transit	**Mode**	Rubber tire bus with signal priority, queue jumpers	Rubber tire bus with DARs	Rubber tire bus	Rubber tire bus	At-grade LRT with tunnel section under SM Mtn.	Privately operated rail shuttle in tunnel
	Approximate Route	Sylmar Metrolink to Century/Aviation	3 BRT Routes: Sylmar to LAX, Sylmar to Purple Line, Orange Line to LAX	Sylmar Metrolink to Expo Line	3 BRT Routes: Sylmar to LAX, Sylmar to Purple Line, Orange Line to LAX	Sylmar Metrolink to Century/Aviation (Green Line)	Van Nuys Metrolink to Century/Aviation (Green Line)
	Exclusive Lane or Guideway	Partial (shared with ESFV Transit Corr.)	Yes	Yes	Yes	Yes	Yes
	Metro Rail or Bus Guideway Connections	ESFV, Orange, Purple, Expo, Crenshaw, Green Lines	ESFV, Ventura Metrolink, Antelope Valley Metrolink, Orange, Purple, Expo, Crenshaw, Green Lines	ESFV, Orange, Purple, Expo Lines	ESFV, Ventura Metrolink, Antelope Valley Metrolink, Orange, Purple, Expo, Crenshaw, Green Lines	ESFV, Orange, Purple, Expo, Crenshaw, Green Lines	ESFV, Orange, Purple, Expo, Crenshaw, Green Lines
Freeway/ Tollway	**Approximate Route Length**	29.7 miles (4.5 miles on freeway shoulder)	29 miles	10 miles (aerial)	9.1 miles (tunnel)	N/A	21 miles
	Lane Configuration	Freeway shoulder over the Pass and Sepulveda Boulevard	5 GP + 2 HOT NBD, 4GP + 2 HOT SBD (US 101 - La Grange)	5 GP + 2 HOT (viaduct from Magnolia to I-10)	2 Toll Lanes each direction	N/A	2 Toll Lanes each direction
	Lane Policies	Dedicated bus on shoulder during peak	HOT 3+	HOT 3+	Tollway (excludes trucks)	N/A	Tollway (excludes trucks)
	Direct Access Ramps	None	Orange Line (bus only), 101, Santa Monica, H.Hughes	None	Orange Line via flyover, US 101 direct connector	N/A	N/A

Note: Lane configurations are in each direction, and illustrative only

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East San Fernando Valley Transit Corridor Connection Options

Walter Davis (Metro, Project Manager) presented an update of the East San Fernando Valley Transit Corridor Alternatives Analysis Study, a joint study with the City of LA and cooperating with the City of San Fernando, including feedback received from the public thus far. He noted that, based on public input, the study area has been expanded north to the Sylmar Metrolink Station and west, to include improvement options along portions of Sepulveda Blvd, in addition to Van Nuys Blvd.

- The East San Fernando Valley Transit Corridor AA Study is currently looking at the following options:
  - No Build
  - Transportation Systems Management (TSM)
  - Van Nuys BRT (Alternative 1B) - From Van Nuys to Sylmar/San Fernando Metrolink Station)
  - Van Nuys BRT (Alternative 2B) - Instead of connecting to Metrolink Station, continue north to I-210 to serve Lakeview Terrace)
  - Van Nuys/Sepulveda BRT (Alternative 3B) - Same as 2B but connects to Sylmar/San Fernando Metrolink Station);
  - Sepulveda BRT (Alternative 4B) – Runs along Van Nuys, then Parthenia, then Sepulveda. This places the route in a well-landscaped median, which the community is against.
  - Sepulveda/Van Nuys LRT (Alternative 4L)

- Measure R provides $68.5 million and LRTP reserves $170.1 million for a project within the corridor. This could potentially fund a BRT project within the corridor, but would require considerable additional funds for LRT.
- Ridership figures do not differ considerably between BRT and LRT due to similar operating speeds.
- San Fernando Valley residents have expressed a strong desire for any project in this corridor to connect directly with a potential Sepulveda Pass project.
- The majority of community support has come from residents in the central and northern segments of the corridor, where there are higher concentrations of transit dependent residents.
- Currently there are 24,800 average weekday boardings along Van Nuys Blvd., making it the 2nd most utilized transit route within the San Fernando Valley, after the Metro Orange Line. Sepulveda Blvd. has an average of 10,000 average weekday boardings.
- All alternatives include the use of two multi-purpose lanes in each direction with a bike lane or curbside parking
- Van Nuys and Sepulveda Boulevards both have large utility poles immediately adjacent to the curb, necessitating substantial costs if their sidewalks are impacted.
- With BRT, buses could be housed at existing maintenance facilities with minor modifications. LRT would require an entirely new yard near or along any potential alignment.

- Sylmar/San Fernando Metrolink Station Park and Ride Lot and layover zone will likely require reconfiguration under any option that terminates there.

- Bicyclists have been attending the public/community meetings and have expressed strong support for inclusion of bike improvements with any potential alternative. Bike lanes are currently being considered as part of the ESFV Transit Corridor study and the LA City Bike Plan calls for bike lanes on both Sepulveda and Van Nuys Boulevards. Bike lanes are being considered for all options. In response to whether this will require curbside parking, there may be a tradeoff on some alignments and segments to include either bike lanes or curbside parking. This will be looked at in more detail in the EIR.

- **Question:** Was asked about the origins and destinations of residents within the ESFV Study Area?

- **Response:** 80% of trips that originate within the Study Area have destinations within the San Fernando Valley. In addition, the ridership figures reveal a strong preference for riders along any potential ESFV project to transfer to the Metro Orange Line. This estimate comes from the Metro Travel Demand Model.

Westside Mobility Plan

Sarah Brandenberg (Fehr and Peers) and Tyler Bonstead (STV) presented an overview of the Plan, which is currently in progress.

- Six studies are being conducted over three years (TDF model, Mobility and Rail Connectivity, revision to two specific plans—Coastal Corridor and West Los Angeles Transportation Plans - Parking, and Livable Boulevards).

- Study area focuses on two specific plan areas (Coastal Corridor and West Los Angeles).

- Studying jobs/housing imbalance on the Westside, where 214,000 people travel into study area for jobs and other activities, but only 82,000 residents leave daily.

- The Westside lacks strong north/south transit connections. This study will explore ways to improve connections to forthcoming east-west improvements (Expo Line Phase 2, Westside Subway Extension).

- Considering four multi-modal mobility improvement packages:

    - Transit on Lincoln (LRT)

    - Transit on Sepulveda (LRT)

    - Low Capital Transit (BRT)

- High Capital Transit Improvements – will explore possibilities for high capital improvements

- These improvements consider transit, bicycle, pedestrian, transit demand management, and congestion pricing

- The Plan is expected to be completed in Summer/Fall 2013.
- Ridership figures do not differ considerably between BRT and LRT due to similar operating speeds and service frequency.

- For packages 1 and 2 - LRT improvements would be mainly at-grade because of land use constraints adjacent to Sepulveda and Lincoln Blvds.

- **Question**: Is an EIR being prepared for this project?

- **Response:** An EIR is not part of current study. They are prioritizing options that can be potentially analyzed under future environmental clearances.

- **Comment**: There is higher ridership on Sepulveda versus Lincoln Blvd., partly due to higher densities along Sepulveda.

- **Question**: Is the project looking at funding sources?

- **Response:** The Project Team is preparing cost estimates, but not identifying funding sources at this time.

Airport Metro Connector AA Study

Cory Zelmer (Metro PM) presented an update of the Study.

- Recommending four alternatives to carry forward into EIR/EIS:
  - Direct LRT Branch (Extends Metro Green Line to LAX terminals from planned Aviation/Century Station);

  - Modified LRT Trunk (through LAX, single station in LAX terminal area);

  - Circulator Automated People Mover (APM) would circulate around LAX terminal area with two or three stations stops and then extend east to planned Aviation/Century station – requires a transfer to/from the Metro Rail system; and

  - Circulator Bus Rapid Transit.

- Approximately $200 million allocated to project from Measure R.

- Planned LRT maintenance facility at Arbor Vitae, shared by Crenshaw/LAX Transit Corridor, Green Line, and Airport Metro Connector.

- Next question for project is timing of environmental phase.

- Additional studies: Los Angeles World Airports released the Specific Plan Amendment Study (SPAS) DEIR on July 27, looking at BRT and APM to connect to Metro Rail at planned Aviation/Century Station; SPAS is a program-level study that will require a subsequent project-level EIS/EIR.

- No Airport Metro Connector alternative precludes a future northwest extension of the Coastal Corridor along Lincoln or Sepulveda Blvds.

Overview of Travel Demand and Revenue Forecast Results

Steve Greene (AECOM) presented an overview of travel demand and revenue forecast results for the six concepts being studied.

Mr. Greene reviewed results for: average weekday transit boardings; average weekday traffic "over the pass"; average weekday person throughput "over the pass"; average weekday auto travel times "over the pass"; and average weekday transit travel times. "Over the pass" generally refers to travel (transit boardings, traffic, and person throughput) between the US-101 and I-10 freeways.

- Across alternatives, transit demand seems to be 50,000 persons/day through Sepulveda Pass.

- Current total person throughput over the pass per weekday is about 507,000; the concepts increase throughput to between 560,000 to 650,000 people

- Tunnel Concepts provide the highest vehicle throughput because they provide the most lanes.

- **Question:** Question regarding the potential for heavy rail to attract more riders and/or better meet the high transit demand in the corridor.

  Response: Heavy rail would allow for slightly higher speeds and potentially higher ridership, but at a higher cost versus light rail.

- Heavy rail may attract more transit riders because of higher speeds and grade separation.

- Additional grade separation would increase capital costs.

- Concept 6 has $42 Billion price tag.

- **Question**: Is ridership high enough to justify heavy rail over LRT?

  Response: LRT could likely handle the peak loads, but the team will review.

- **Question**: How many miles of tunnel in Concept 5?

  Response: 6 miles.

- **Question**: Would Concept 5 also include the implementation of tolling on the I-405 Freeway HOV lanes?

  Response: No, however this could be done.

- **Question**: Would the toll rate be high enough to maintain free flow traffic in tunnels?

  Response: Model speeds generally reflect Metro policy of maintaining 45 mph in tunnel, but no equilibration has been done.

- If implementing as P3, this may require a higher toll. More study is needed.

Initial Conclusions from Forecasts:

- Concept 5 (Fixed Guideway LRT) has highest transit ridership
- Concept 4 (BRT with toll highway tunnel) has highest person throughput "over the Pass"
- Concept 6 (Highway/private shuttle tunnel) carries the most vehicles "over the Pass"
- Transit person throughput "over the Pass" is similar for Concepts 2, 4, and 6. Concept 2 person throughput is slightly less than Concepts 4 and 6 overall but is expected to have much lower capital costs. Concept 5 overall person throughput is less than Concept 2.
- **Question**: Was heavy rail considered, including whether the ridership would be higher, and how it would affect costs?

  Response: It would need to be entirely grade separated and therefore would have higher capital costs. The LRT assumes a tunnel under the Sepulveda Pass and a rolling profile similar to other Metro LRT projects.

Revenue Forecast Results:

- Revenue forecasts were modeled based on the current Metro fare policy adopted for the I- 110/I-10 ExpressLanes pilot program.
- Demand and willingness to pay may be higher in Sepulveda corridor than in the Express Lanes corridors and therefore there may be an opportunity to charge higher tolls, but more detailed study is required.
- **Question**: Were toll costs for "toll road bypasses" used in the forecast?

  Response: Current Metro policy was used in the forecasts and examples of toll bypasses were presented (ICC in suburban Washington, DC) with similar toll structures.

Top Performance Findings

Eugene Kim (PB) presented the results of the screening analysis for a comparison of the performance findings among the concepts.

The six systems concepts were evaluated on a variety of measures, including: capital costs; cost effectiveness; person throughput; ridership; hours of travel time saved (user benefit); and revenue.

Initial conclusions from performance analyses:

- Concept 1 - has the lowest capital cost, but also the lowest boardings and throughput.
- Concept 2 - has ridership performance about equal to Concepts 4 and 6, at a significantly lower capital cost (approx. $1 billion vs. $13 and $42 billion). Concept 2 provides the second highest amount of revenue.
- Concept 4 - has the highest person throughput, but also has high capital costs and good revenue potential.
- Concept 5 - has the highest transit boardings, but also higher incremental costs per boarding than under Concepts 2 and 4.
- Concept 6 - has high person throughput, but transit boardings are only marginally higher than other lower cost concepts (4 and 6); Concept 6 also has the highest revenue potential but capital costs are extremely high ($42 billion).
- **Question**: What has been done to ensure that the buses in Concept 2 could get over the grade of the Pass? Also was a new fleet factored into the cost or possibly consider larger capacity buses.

  Response: new fleet was not considered at this time, but preliminary discussions for acquiring higher speed/power buses have been held with Metro Vehicle Technology and Support Department.
- **Question**: Can vehicles exit tunnel to provide service more directly to Westwood/UCLA, and before Santa Monica Boulevard? Response: There are considerable physical restraints north of La Grange/Santa Monica Blvd., including federal land surrounding the Wilshire Blvd/I-405 interchange.
- **Comment**: Concept 2 is good if it can be implemented with the concerns of the surrounding community after the I-405 widening project (i.e., fitting the additional lanes within the existing roadway pavement or, at least, the existing Caltrans Right of Way.
- **Comment**: Metro should consider combining Concepts 2 and 5 so that there is a toll facility at grade (revenue potential), and also to include a transit component in tunnel.
- **Comment**: Concept 1 is similar to Line 761. Concept 2 runs on the shoulder through the Pass. It is a low cost improvement to get buses through the Pass.

- **Question**: asked if Caltrans was consulted about the concept of reducing lane width for Concept 2 (from current project reinstitution of 12' lanes back into 11' lanes). Comment was also made that Federal Highway Administration may have issue with investment made to put 12 foot lanes back in. Response: Caltrans has not been consulted at this stage of study about this issue. Concept 2 is only possible with 11 foot lanes, without widening freeway.

Review of Systems Concepts

Mr. Kim then led a discussion of each of the systems concepts, as they had been refined and evaluated since Charrette #1. The main purpose was to ensure concurrence of the concepts' definition and/or identify additional refinements needed for each concept. Nathan Burgess and Kelly Dunlap highlighted engineering and environmental issues, respectively, for each concept.

Concept #1: Van Nuys/Sepulveda BRT

- Concept includes: 30 miles in length from Sylmar Metrolink to Century Aviation; freeway shoulder during peak; priority treatments.
- Minimal comments on refined concept.
- Concept is similar to a TSM alternative (that would be a required alternative under FTA rules).
- May have issues using the medians on Van Nuys Boulevard for buses only, as a certain portion of Van Nuys, south of the Orange Line, is currently being used for car dealerships as a loading zone, and those areas of Van Nuys Blvd. that have landscaped medians.
- **Question**: Will you consider a stop at Ventura?
- **Comment:** Interchange upgrades required if considering a stop on Ventura Blvd.
- **Question**: How will people get from Sepulveda/I-405 to Purple Line? A: Riders would walk about one and a half blocks east on Wilshire to the Lot 36 Purple Line entrance.
- **Comments**:
  - Concept will not capture discretionary riders if there are no stops in the San Fernando Valley south of Burbank Blvd.
  - Unique opportunity to utilize park and ride lot near Skirball Center.
  - Design for queue jumping lanes in the center median appears interesting. A sample of this can be seen at Figueroa and 8th Street.
  - Can have phased project and use this as transitional concept.

Concept #2: Managed Lanes

- Concept includes: 29 miles; 5 general purpose/2 HOT lanes each direction through Pass; single HOT north of Pass/south of I-10; includes BRT routes; direct access ramps.

- Modified carpool policy to HOT+3, otherwise lanes would be over capacity.
- Between the US-101 and La Grange Ave. - 5 GP lanes + 2 HOT lanes.
- Transit plan same as Concept 4.
- Flyover ramp from US-101 will have visual concerns.
- Widening on both sides near Sherman Oaks Galleria at US-101/I405 interchange; efforts should be made to minimize, and if possible, avoid widening into properties along the southbound side of I-405.
- More analysis needed to understand impacts to air quality; trade-offs exist between improved traffic flow and increased traffic volumes.
- Potential for noise concerns due to increased capacity and moving closer to receptors.
- Direct Access Ramp (DAR) at La Grange- environmental issues.
    - One way road connections (local traffic circulation): ROW acquisition ; possible localized noise and air quality effects.
- If there is spot widening outside the existing pavement, it may impact sensitive biological resources near Getty Center.
- Review pedestrian bridges or underpasses for wildlife access across the I-405.
- Right of Way acquisitions will be extremely difficult to accomplish due to community concerns.
- Find places for DAR that do not require ROW acquisition or place them where impacts to residential neighborhoods due to heavy through traffic are minimized.
- **Question**: How is the traffic flow from 2 lanes to 1 affected? Will there be bottlenecks? A: almost half of the current automobile traffic over the pass is destined for areas north of I-10 (the Westside) so much lower traffic volumes are expected south of the transition to one lane (at La Grange).
- **Question**: Are buses running in one lane north and south of pass?
    - Caltrans' old policy is to have two lanes in each direction.
- **Comment**: If 5 general purpose lanes and 2 HOV lanes are implemented south of Santa Monica Blvd., then widening of the freeway would be needed. Metro wants to implement 5/2 lanes where freeway does not need to be widened; therefore, this cannot happen south of Santa Monica

- **Comment**: Goal is to look for portal areas where residential and commercial acquisition would not be required

- **Question**: Asked about stations within the freeways.

  Response: Transit riders do not like freeway stations.

Concept #3: Highway Viaduct

- Concept includes: 10 miles; elevated above I-405 from I-101 to I-10; BRT 21 miles from Sylmar to Expo Sepulveda Station; 2 HOT each direction; frees up existing HOV; screened out by CT due to seismic/safety.

- Studied initially because Caltrans had previously studied this concept

- Concept was not modeled in this study, but was included for comparative purposes. This concept may have significant environmental concerns.

Concept #4: BRT with a Toll Tunnel

- Concept includes: 9.1 miles; 4 toll lanes, 2 per direction; portals at I-101 and Santa Monica Blvd; direct connectors from Eastbound I-101 and Southbound I-405; carpools pay regular toll; P3 potential; same BRT service plan as in Concept 2.

- All users pay based on occupancy; transit vehicles ride free.

- No ability for intermediate access.

- Add in HOT lane connectors within freeway interchanges.

- Street segments are currently congested through canyon roads.

- Flyover connector would have visual concerns; potential noise concerns with flyover closer to receptors.

- Potential 4(f) issue if the improvements cannot be kept within existing Caltrans ROW at US-101/I-405 interchange.

- Candidate for P3.

- Need to keep portals within Caltrans ROW.

- **Question:** Did you look at connector to I-10E?

  Response: Models show that there is very low demand for that market (Valley to I-10 East) as most residents destined for eastern portions of the LA Basin (including Downtown Los Angeles) utilize the US-101 corridor instead (shorter distance).

- Will need mitigations for trucks; stock pile dirt near freeway and travel at night.

- Potential displacement of Los Angeles Fire Department (LAFD) training center.

- Ventilation for tunnel; potential for Section 4(f) use if ventilation is within the Santa Monica Mountains open space area.

- **Comment**: Need to accommodate all movements at the US-101. Response: focus was on movements that had most traffic (i.e., from the north and west).

- **Question**: Will stations be located within the freeways? Comment in response: transit riders do not like freeway-adjacent stations.

- **Comment**: Explore transit stop near UCLA/Westwood; need to get people there and Century City; perhaps opportunity to have buses pull to the side and unload passengers.

Concept #5: Fixed Guideway Light Rail Transit Tunnel

- Concept includes: 28 miles; LRT from Sylmar Metrolink to Century/Aviation; at-grade, dedicated, median running, grade-separated major intersections; LRT in transit-only 6-mile tunnel; 15 stations; portals at Ventura/Van Nuys and Santa Monica; connectivity to Metro Rail; no P3 potential.

- At 90,000 projected daily boardings, questions arise over whether LRT handle those boardings or would HRT be required.

- Will need ROW acquisitions for northern portal.

- Transit ridership potential heaviest along Van Nuys Blvd. through the San Fernando Valley, but heavy rail may not be justified in this segment of the corridor.

- **Comments**:

  - Might be beneficial to couple Concept 5 with at-grade toll facility over pass (Concept 2).

  - LRT cannot command premium fare under this Concept, as it would be run by Metro.

    P3 might be premium option (with higher fares), but would serve different market.

  - If Concept 5 moves forward, it needs to be coupled with tolling to offset high capital costs.

  - Need to create description of Concept 5 that is more mode neutral; range of costs and range of boardings.

  - Consider making Concept 5 mode neutral to not preclude HRT.

Concept #6: Highway/Private Shuttle Tunnel

- Concept includes: 21-mile highway tunnel with portals at Roscoe/Century Blvds; direct connectors Eastbound I-101/Southbound I-405; 3 intermediate access points; 21-mile private shuttle between Van Nuys Metrolink and Century/Aviation; P3 potential.

- **Comments:**
  - To be self-sustaining (i.e., fares cover costs), capital costs would need to be in the $12 to $15 Billion range.
  - Intermediate access difficult because of the considerable below-grade infrastructure needed to connect to at-grade roadways on both sides of the Pass.
  - Difficult to finance grade-separated rail even with premium toll ability and higher revenues.
  - Managed lanes and at-grade alternatives may encounter strong community resistance.
  - Environmental justice issues near Roscoe/I-405.
  - Design this concept to accommodate bus traffic and restrict truck traffic.
  - Interest in rail in San Fernando Valley for equity purposes.
  - Need a variation of Concept 6 that would have lower cost.
- **Question**: Is environmental justice a consideration if no federal money involved?

  Response: Yes – CEQA and Metro policy would still necessitate a full environmental justice analysis.

Conclusions/Next Steps

Mr. Kim then led a discussion to summarize the conclusions and next steps.

- Need to consider a transit station on Ventura Boulevard for Concept 1.
- Need good, solid access on Westside, particularly Westwood/UCLA.
- LRT may not provide the capacity needed to meet future demand (similar to Blue Line which has similar boarding numbers and is at capacity). This requires further study to see if heavy rail is required.
- Concept 5 – needs to be mode neutral while considering fully grade-separated heavy rail and rolling profile LRT; benefit to show range (LRT street running versus entirely grade separated) and what happens to cost, market penetration, and ridership.
- Concept 6 – modify due to cost within $12-$15 Billion; modify length, consider phasing (Minimally Operable Segments).
- Consider coupling options so that toll is a part of any option.
- Beneficial to have discussion regarding the “conservative” tolling policy and cost estimating.
- US-101 to I-10 – most critical segment (heavy traffic volumes and heavily constrained ROW).

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APPENDIX D – JUNE 20, 2012 STAFF REPORT

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PLANNING AND PROGRAMMING COMMITTEE
JUNE 20, 2012

SUBJECT: SEPULVEDA PASS CORRIDOR SYSTEMS PLANNING STUDY

ACTION: RECEIVE AND FILE

RECOMMENDATION

Receive and file this interim report on the Sepulveda Pass Corridor Systems Planning Study.

ISSUE

The Sepulveda Pass Corridor (I-405 Connector) is the last of the twelve transit corridors included in the Measure R expenditure plan and is identified in our adopted Long Range Transportation Plan (LRTP) with a 2039 delivery date. As the project is undefined in terms of mode and length, we initiated a Systems Planning Study to evaluate the range of possible concepts that could be implemented. This report presents the interim findings.

DISCUSSION

The Sepulveda Pass provides a crucial transportation link across the Santa Monica Mountains between the heavy concentration of households in the San Fernando Valley and major employment and activity centers in Los Angeles County's Westside region. The I-405 Freeway is ranked as one of the most traveled urban highways in the nation by the Federal Highway Administration (FHWA) with Average Annual Daily Traffic of 374,000 in 2010. A 13-mile stretch of the Freeway, from Getty Center Drive to the I-105 (Century Freeway), was recently ranked as the third most congested freeway segment in the United States. In addition, the US-101 and I-10 interchanges with the I-405, to the north and south respectively, consistently rank among the five most congested freeway interchanges in the country. The I-405 Sepulveda Pass Improvements Project which is currently under construction will address some of these congestion issues when it is completed in about a year. However, demand is still expected to exceed capacity as growth in travel demand expands in this corridor and no special provisions have been included in the current construction project for transit.

The I-405 varies between four to six general purpose lanes in each direction and includes a continuous HOV lane in the southbound direction from the I-5/I-405 split in the northern San Fernando Valley to the Orange County line. The I-405 Sepulveda Pass Improvements Project, currently underway, will add a 10-mile HOV lane in the northbound direction of the I-405 between the I-10 and the US-101 freeways. This will complete the I-405 HOV lanes in both directions between the I-5 and the Orange County line.

Systems Planning

The current Systems Planning Study is the earliest phase of project development and precedes the traditional Alternatives Analysis Study or Environmental Impact Studies. Travel demand modeling is being conducted as well as initial rough order of magnitude (ROM) costing for a range of highway, transit and multi-modal improvements.

The Study Area being evaluated extends approximately 30 miles from the Sylmar/San Fernando Metrolink Station in the northern San Fernando Valley to the Los Angeles International Airport (LAX) (Attachment A). Transit modes being considered include heavy rail (HRT), light rail (LRT) and bus rapid transit (BRT). In addition, highway improvements that could incorporate congestion pricing strategies such as high occupancy toll (HOT) lanes in both surface and below grade configurations are being explored. We are also evaluating whether the full length of the study area is the most cost effective transportation investment area or whether a shorter segment is more cost effective.

The Measure R expenditure plan identified $1 billion for this project, which is based on the recommendations from the I-405 Sepulveda Pass Improvements Project Environmental Study conducted jointly by Caltrans and FHWA, which envisioned a BRT project that would utilize three to four direct access ramps located on both the north and south sides of the Sepulveda Pass. We are working collaboratively with our Public Private Partnership (PPP) staff in developing feasible transit and highway concepts that could be implemented with the $1 billion available through Measure R and reserved through the adopted LRTP as well as concepts that go beyond the funding presently available for the project. We are also coordinating with the staff assessing alternatives for the East San Fernando Valley North/South Transit Corridor Van Nuys and/or Sepulveda Boulevards to ensure compatibly between projects in the San Fernando Valley and with the Airport Metro Connector and Crenshaw/LAX LRT Projects to insure compatibility on the Westside and South Bay.

Concepts Being Considered

Attachment B shows the six system concepts that were developed to represent a range of different systems planning concepts. These progress from lower cost at-grade bus improvements to higher cost highway and transit options that utilize tunnels under the mountains and various configurations of highway and transit connections north and south of the Sepulveda Pass.

- Concept #1: Van Nuys/Sepulveda BRT

  This concept utilizes BRT technology that could serve as a southern extension of the East San Fernando Valley North/South transit corridor, if BRT is selected as the appropriate transit mode for that corridor. The southern extension would extend for six miles through the Sepulveda Pass and another 12 miles to connect to the LAX/Transit Gateway Center.

  Although a dedicated arterial bus lane would be preferred, this is challenging in many areas due to right-of-way and traffic constraints. This BRT line would therefore primarily follow arterial streets (configuration to be determined), except for a segment in the Sepulveda Pass where the BRT is envisioned to operate during peak periods on the shoulder of the I-405 Freeway.

  This would be the lowest cost concept with approximately six miles of freeway running, 12 miles in the San Fernando Valley and 12 miles on the Westside following Sepulveda Boulevard to LAX. The cost of this concept would range from $72-$82 million for the freeway improvements with bus priority treatment north and south of the Pass. The East San Fernando Valley North/South Transit Corridor project is currently exploring transit options on Van Nuys and/or Sepulveda Boulevard with $170.1 million reserved through the adopted LRTP. The total cost of the 30-mile long corridor would potentially reach $252 million.

- Concept #2: BRT in At-Grade Freeway Managed Lanes

  This concept utilizes BRT technology, but combines the transit improvement with the implementation of managed lanes on the I-405 Freeway for 29 miles between the I-5 split in the north San Fernando Valley to the I-105 Freeway near LAX. One additional lane would be added in the Sepulveda Pass and paired with the HOV lanes that currently exist and are in construction to create two managed HOT lanes in each direction that would also serve 3+ HOV service without tolls. It appears, at this time, that one additional lane in each direction could be accomplished mostly through restriping (narrow the shoulders, 11' General Purpose lanes, 12' HOT lanes) and some spot-widening within the existing Caltrans right-of-way in the southbound direction. North and south of the Sepulveda Pass the one existing HOV lane would be converted to a HOT lane with 3+ HOV service.

  Various types of bus service could utilize the managed lanes with access and egress at interim points to serve various levels of transit service including Metro Rapid, LAX Flyaway and Commuter Express Lines. Due to the steep grades over the Sepulveda Pass and the need to maintain HOT lane speeds, buses using these lanes would need to maintain posted speeds using larger engines.

Standard buses would need to use general purpose lanes in the steeper climbing segments of the Sepulveda Pass.

It is anticipated that this alternative could be completed within the $1 billion reserved in the LRTP. In addition, the tolling component could potentially help to subsidize further improvements such as direct access ramps at selected locations and connections to the intersecting transit lines.

- Concept #3: BRT with Aerial/Viaduct Managed Lanes
  This concept is being carried to reflect the current Caltrans' Corridor Concept Plan which calls for the future construction of an aerial viaduct above the I-405 in the Sepulveda Pass between the US-101 and I-10. Although this is the Caltrans adopted plan for future upgrades of the I-405 Freeway, Caltrans and FHWA project did not select this option for the current widening project, but rather chose in favor of at-grade freeway improvements. Similar to Concept #2, two HOT lanes in each direction would be built on an elevated structure through the Sepulveda Pass, freeing the existing at-grade HOV lanes to be used as a dedicated busway.

  Various types of bus service could utilize the bus lanes with access and egress at interim points to serve various levels of transit service including Metro Rapid, LAX Flyaway and Commuter Express Lines. It is anticipated that this alternative would carry several fundamental drawbacks and seismic safety concerns which have been previously documented in the I-405 HOV Viaduct Feasibility Study Memo included in the I-405 Sepulveda Pass Improvements Project Environmental Study. As a result, this concept will be documented in the final report for this study, but is not expected to be carried forward into future phases of analysis for further performance, feasibility and cost evaluations.

- Concept #4: BRT with Tolled Highway Tunnel
  This concept consists of a tunnel beneath the Sepulveda Pass with four toll lanes (two per direction) that would extend for approximately 11 miles with a northern portal at US-101 and a southern portal near Venice or Santa Monica Boulevard. The northern portal would have connectors to the west side of US-101 as well as from further north on the I-405.

  Metro's Tolling Policy, adopted in July 2009 for the I-10 and I-110 ExpressLanes project, have been set with the minimum and maximum toll rates at $0.25 and $1.40 per mile, respectively (scheduled to open in October 2012 and February 2013, respectively). Tolls will vary based on traffic levels (demand) in the corridors to ensure free flowing (45 mph or greater) conditions, even during peak periods. A parallel freeway-oriented BRT similar to the one for Concept #2 could be operated either in the tunnel or on the surface HOV lane.

  Costs for this tunnel would be comparable to a similar tunnel project that is under construction in Seattle. The Alaska Highway Tunnel is 1.8 miles in length and is being constructed as a 58' diameter large bore tunnel with two travel lanes in each direction at a cost of approximately $1.0 billion per mile. Comparable costs per mile could be expected for an 11 mile tunnel in the Sepulveda Pass.

- Concept #5: Fixed-Guideway LRT
  This concept utilizes LRT technology that could serve as a southern extension of the East San Fernando Valley North/South Transit Corridor, if LRT is selected as the appropriate transit mode. The route could extend in a tunnel beneath the mountains from either Van Nuys or Sepulveda Boulevards in the Valley for at least six miles to a portal on the Westside that could be located near Sunset Boulevard at the UCLA Campus, or farther south in a tunnel to the Metro Purple Line or Expo Line. Ultimately, the full LRT project could extend for up to 29 miles, if it were to extend from near the Sylmar/San Fernando Station in the north San Fernando Valley to the Century/Aviation Station near LAX where it could potentially interline with the Crenshaw/LAX or Metro Green Line.

  Costs for a LRT tunnel could be compared to the Eastside Gold Line Extension tunnel segment, the Westside Subway Extension or the Regional Connector LRT Project. Based on these projects, two 20-foot diameter tunnels could range between $300-$400 million per mile. LRT segments above ground could be compared to the Crenshaw/LAX LRT or Expo LRT which range from $75-$200 million per mile.

- Concept #6: Integrated 58-Foot Tunnel Concept (Hybrid)
  This concept borrows from concepts currently being developed by the PPP Team for a large bore tunnel approximately 60-feet in diameter that would be operated as a PPP by a toll concessionaire who would be charged with the responsibility to finance, build, operate and maintain the project in return for revenues generated by the toll facility and any additional public subsidy that might be required. The project could operate solely as a highway tunnel with transit buses or as a highway tunnel with a rail transit component. There would be intermediate access points at Santa Monica Boulevard and Howard Hughes Parkway. In order to maximize profitability, the rail component is envisioned by the PPP team to operate as a private shuttle that would begin near the Van Nuys Metrolink Station and continue south into the tunnel and continue through the Westside to LAX.

Attachment C is a matrix comparing the six concepts above in terms of their profile, PPP potential, ROM costs in 2012 dollars (excluding access ramps and rolling stock), transit and freeway/tollway characteristics.

NEXT STEPS

We will continue working with the PPP and the East San Fernando Valley Transit Corridor planning staffs in evaluating the systems planning concepts. The final concept report is anticipated to be completed in Fall 2012. A Livability grant application has been submitted to FTA for the Alternatives Analysis Study.

ATTACHMENTS

A. Map of the Sepulveda Pass Systems Planning Study Area
B. Maps of the Systems Planning Study Concepts
C. Comparative Table

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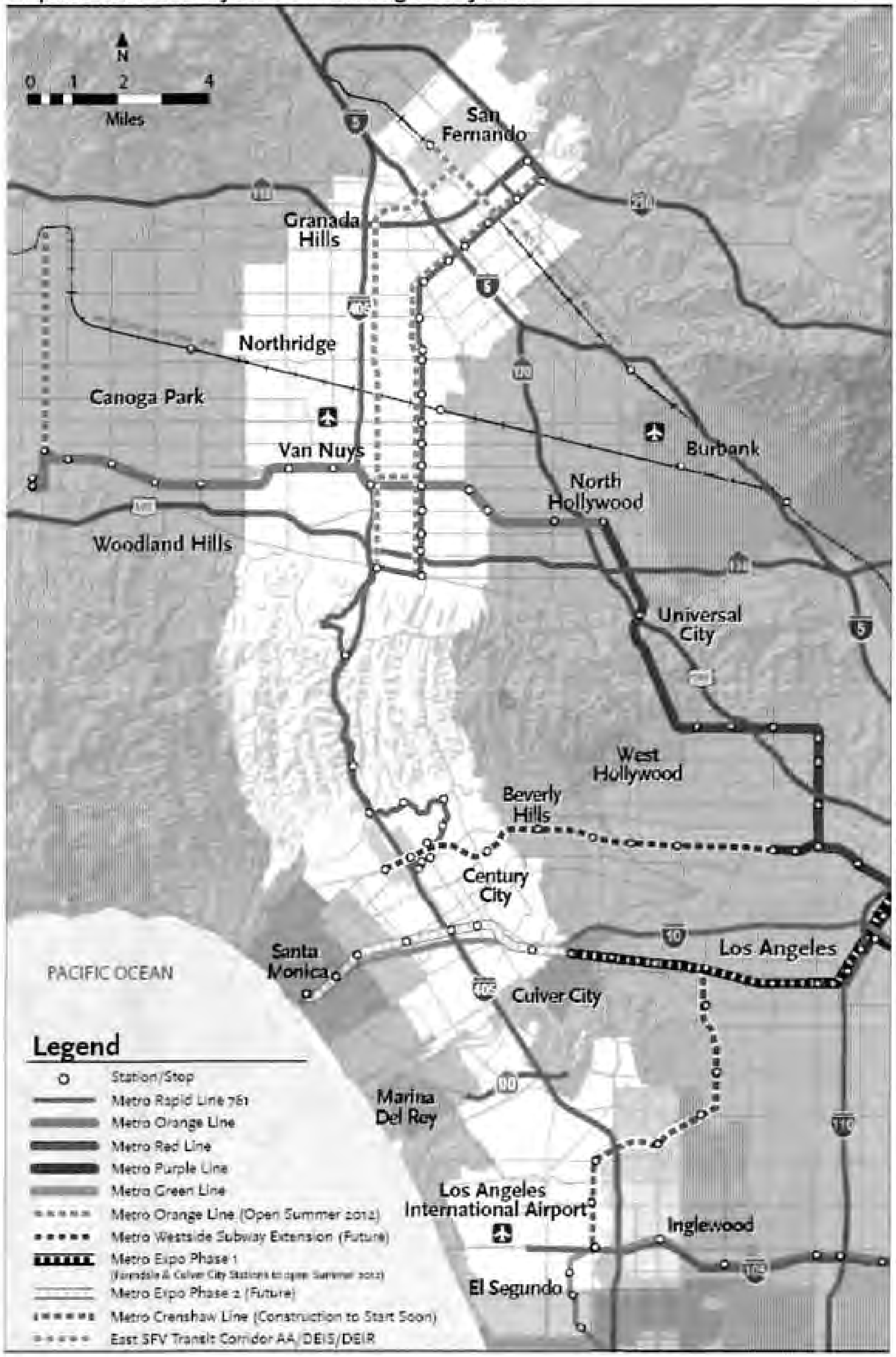
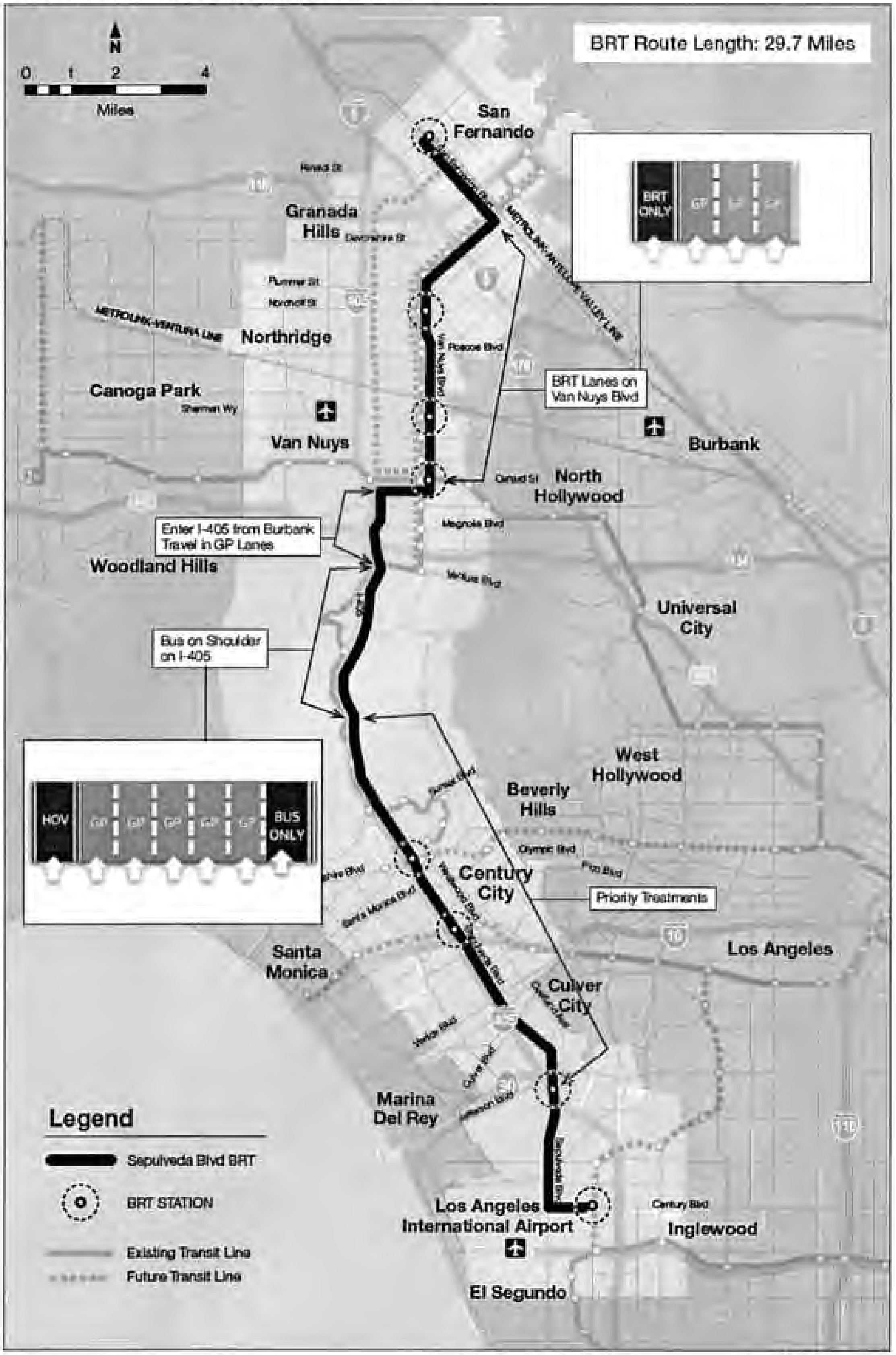
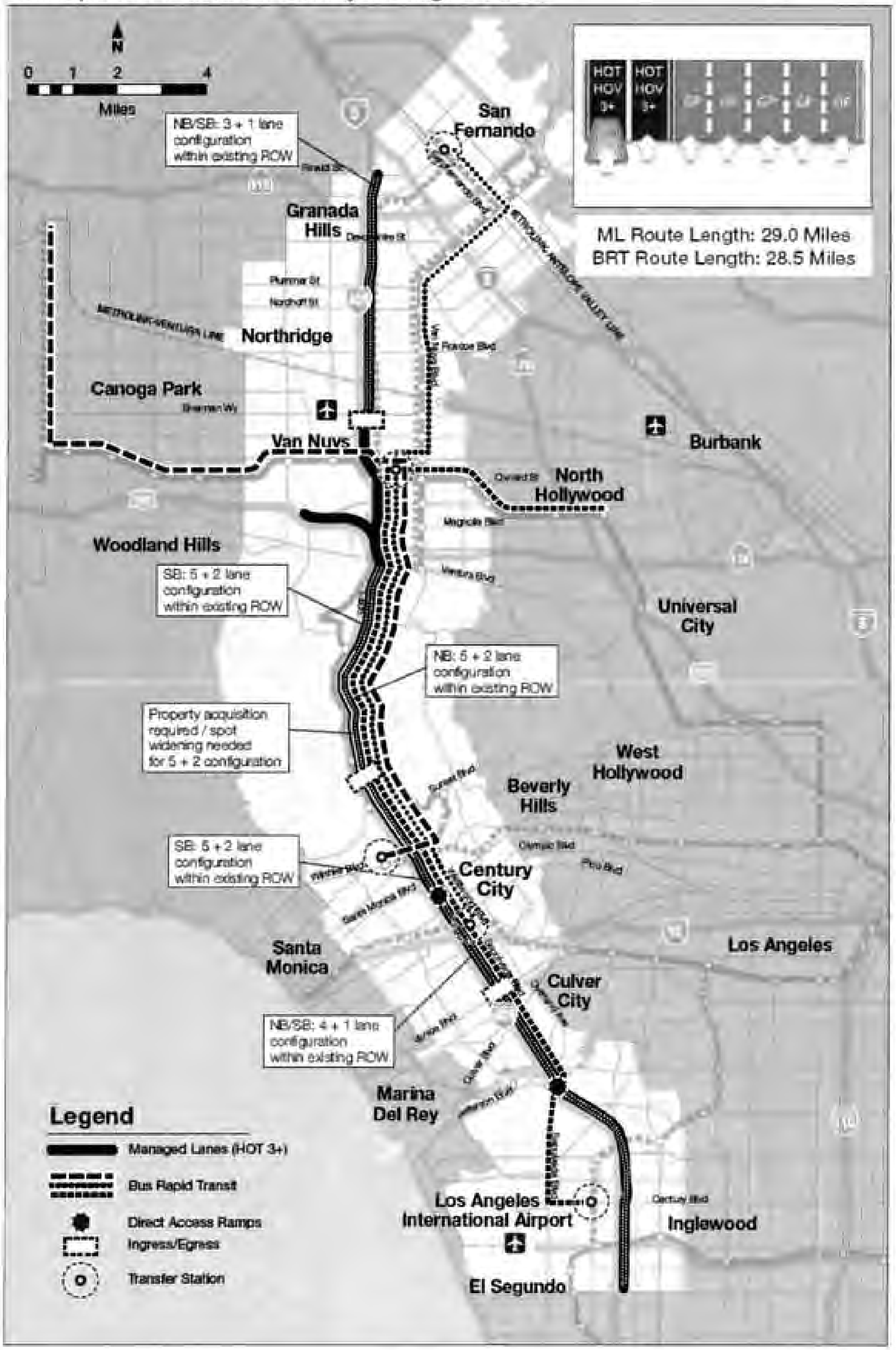
Sepulveda Pass Systems Planning Study Area



Concept #1: Van Nuys/Sepulveda BRT



Concept #2: At-Grade Freeway Managed Lanes



Concept #3: Highway Aerial Managed Lane

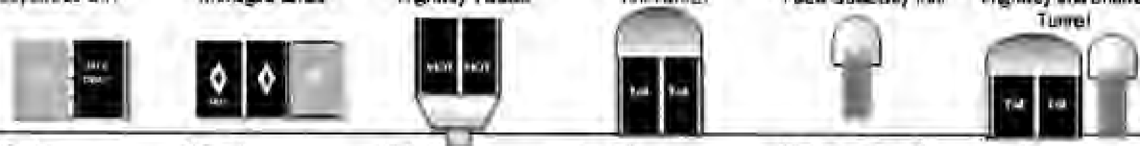
Concept #4: Tolled Highway Tunnel

Concept #5: Fixed-Guideway Light Rail Tunnel

Concept #6: Integrated 58-Foot Tunnel Concept (Hybrid)

Comparative Analysis

Concept Families



	Concept (Lane configurations in each direction)	1 Sepulveda BRT	2 Managed Lanes	3 Highway Viaduct	4 Toll Tunnel	5 Fixed Guideway Rail	6 Highway and Shuttle Tunnel
Profile		At Grade	At-Grade	Viaduct	Tunnel	At-Grade / Tunnel	Tunnel
P3 Potential		No	Maybe	Maybe	Yes	No	Yes
ROM Costs (excl. access ramps and rolling stock) (2012 $)		$72 – 82.5 M	$440 - 506 M	N/A	$10.9 – 12.6 B (one single bore tunnel segment)	$4.8 – 5.5 B (at-grade plus single bore tunnel segments)	Up to $16 – 18 B (two single bore tunnels)
Transit	Mode	Rubber tire bus with signal priority, queue jumpers	Rubber tire bus with DARs *	Rubber tire bus	Rubber tire bus with DARs	At-grade Light Rail Transit with tunnel section under Santa Monica Mtn.	Privately operated rail shuttle in tunnel
	Approximate Route	Sylmar Metrolink to Century/Aviation	Sylmar Metrolink to Century/Aviation	Sylmar Metrolink to Expo Line	Ventura Blvd to Santa Monica Blvd or Venice Blvd	Sylmar Metrolink to Century/Aviation	Van Nuys Metrolink to Century/Aviation
	Exclusive Lane or Guideway	Partial	Yes	Yes	Yes	Yes	Yes
	Metro Rail or Bus Guideway Connections	ESFV, Orange, Purple, Expo, Crenshaw/LAX, GreenLine	ESFV, Orange, Purple, Expo, Crenshaw/LAX, GreenLine	ESFV, Orange, Purple, Expo	None	ESFV, Orange, Purple, Expo, Crenshaw/LAX, GreenLine	ESFV, Orange, Purple, Expo, Crenshaw/LAX, GreenLine
Freeway/Tollway	Approximate Route Length	6 miles (freeway shoulder)	30 miles	10 miles (aerial)	10 miles (tunnel)	25 miles (5.6 miles tunnel)	16 miles (twin tunnels)
	Lane Configuration	Use of freeway shoulder over the Pass and Sepulveda	5 GP + 2 HOT (Sherman Way – I 10) 5 GP + 1 HOT elsewhere	5 GP + 2 HOT (viaduct from Magnolia to I-10)	2 Toll Lanes/each direction	N/A	2 Toll Lanes each direction
	Lane Policies	Peak period only use of freeway shoulders	HOT 3+	HOT 3+	Tollway (excludes trucks)	N/A	Tollway (excludes trucks)
	Direct Access Ramps	None	Orange Line (bus only), US 101, Santa Monica, Howard Hughes	None	Orange Line via flyover, US 101 direct connector	N/A	N/A

* DAR = Direct Access Ramp

Los Angeles County Metropolitan Transportation Authority

Sepulveda Pass Corridor Systems Planning Study Update

June 20, 2012

Metro

Measure R Transit Corridors

- One of 12 Measure R Transit Corridors approved by Voters in 2008
- Systems Planning Study is first step in corridor planning
- LRTP includes $2.468 billion (escalated) in third decade

Metro

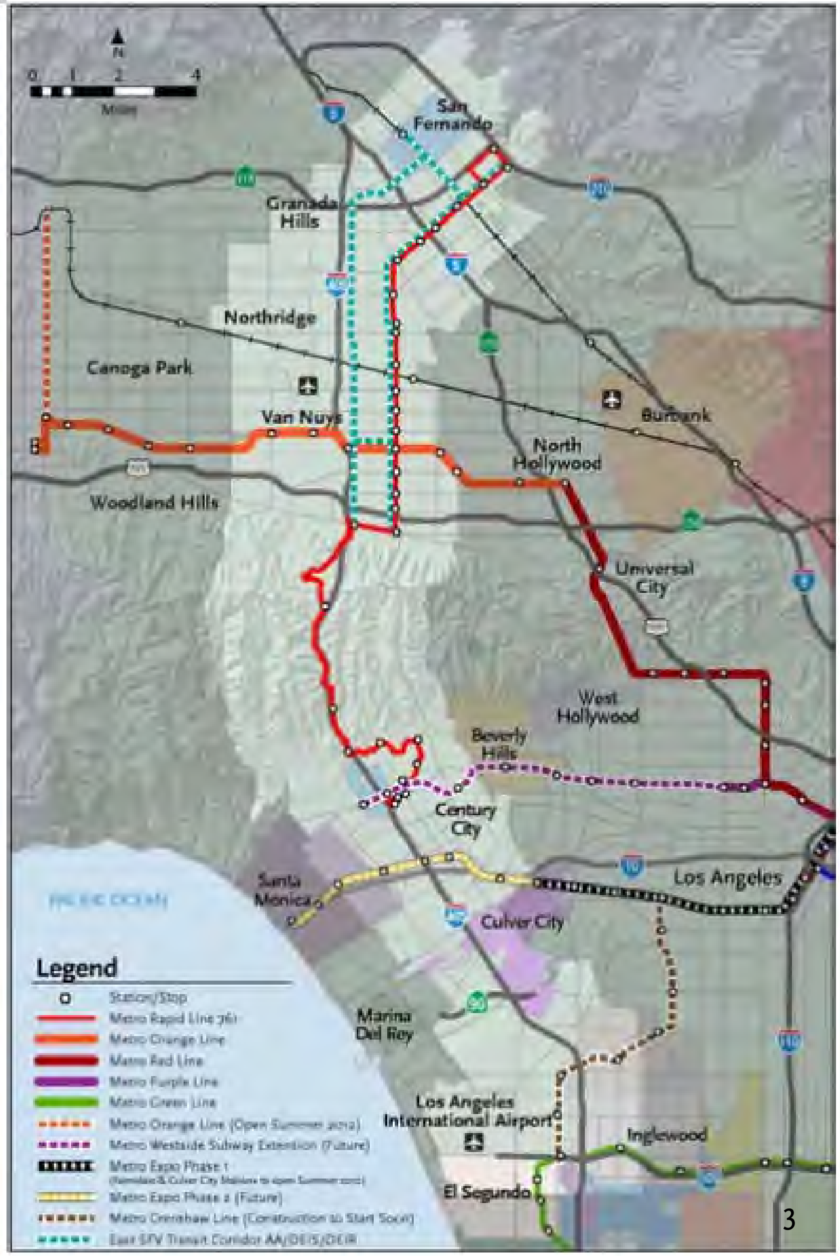
Sepulveda Pass Study Corridor

- Extends for 30 miles
  - San Fernando Valley - 12 miles
  - Sepulveda Pass – 8 miles
  - Westside to LAX – 10 miles

- Potential Transit Connections:
  - Metrolink Antelope Valley Line
  - Metrolink Ventura Line
  - East San Fernando Valley North/South Corridor
  - Metro Orange Line
  - Westside Subway Extension
  - Expo Line Phase 2
  - Crenshaw/LAX LRT Project
  - Airport Metro Connector
  - Metro Green Line

- Current I-405 Improvement Project
  - Adding NB HOV Lane
  - Existing SB HOV lane operates over capacity at peak periods (2+ carpool)

Metro



Corridor Travel Challenges

- 3rd Most Congested Highway Segment in the U.S.*
  - 295,000 vehicles per day (2010)
  - 430,000 vehicles per day (2030)
- Severe Transit Limitations
  - Metro Rapid 761 scheduled run time between Van Nuys and Westwood:
    - AM Southbound – 65 minutes to go 12 miles (11 mph)
    - PM Northbound – 74 minutes to go 12 miles (9.7 mph)
- Peak Demand Between US 101 and I-10
  - 45% of trips enter and exit in this 12 miles segment

*Source: Texas Transportation Institute (2011)

Sepulveda Pass Corridor Concepts

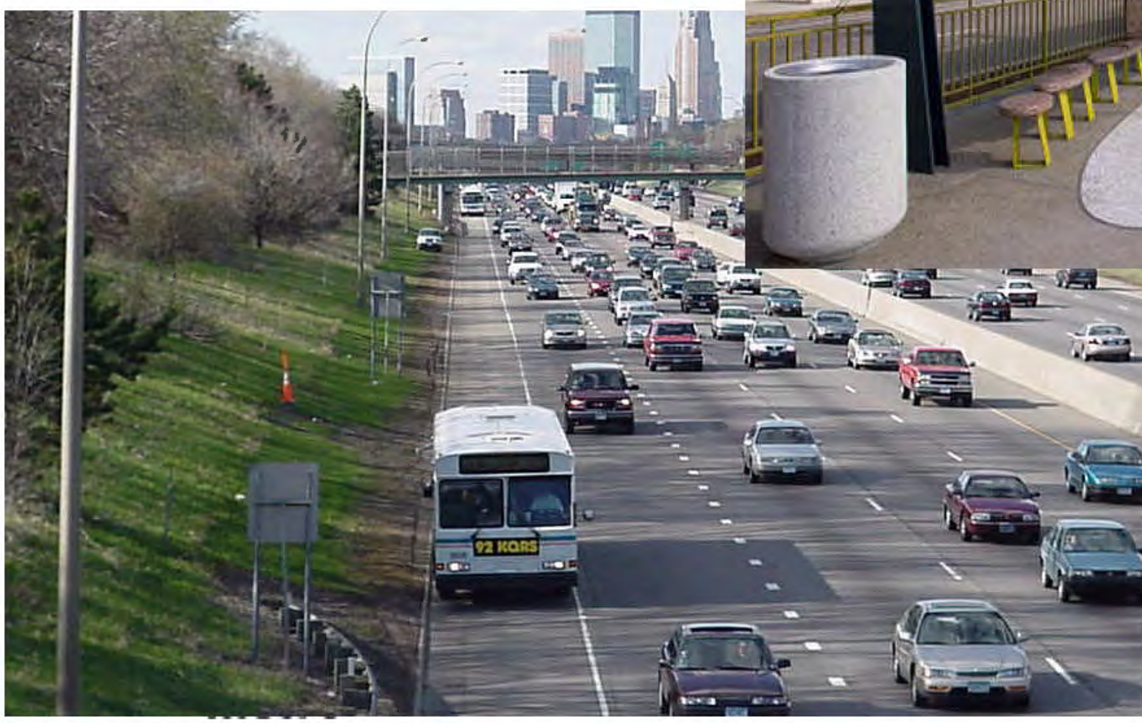
- Lower Cost (within Measure R Budget)
  - Concept 1: At-Grade BRT
  - Concept 2: Managed Lanes with BRT

- Higher Cost (requires supplemental funding, long-term phasing or other delivery strategies)
  - Concept 3: Caltrans Project Report Aerial Viaduct
  - Concept 4: Toll Tunnel (Highway and BRT)
  - Concept 5: Fixed Guideway Rail Tunnel
  - Concept 6: Toll Tunnel and Rail Tunnel

Metro

Concept 1: Sepulveda/Van Nuys BRT

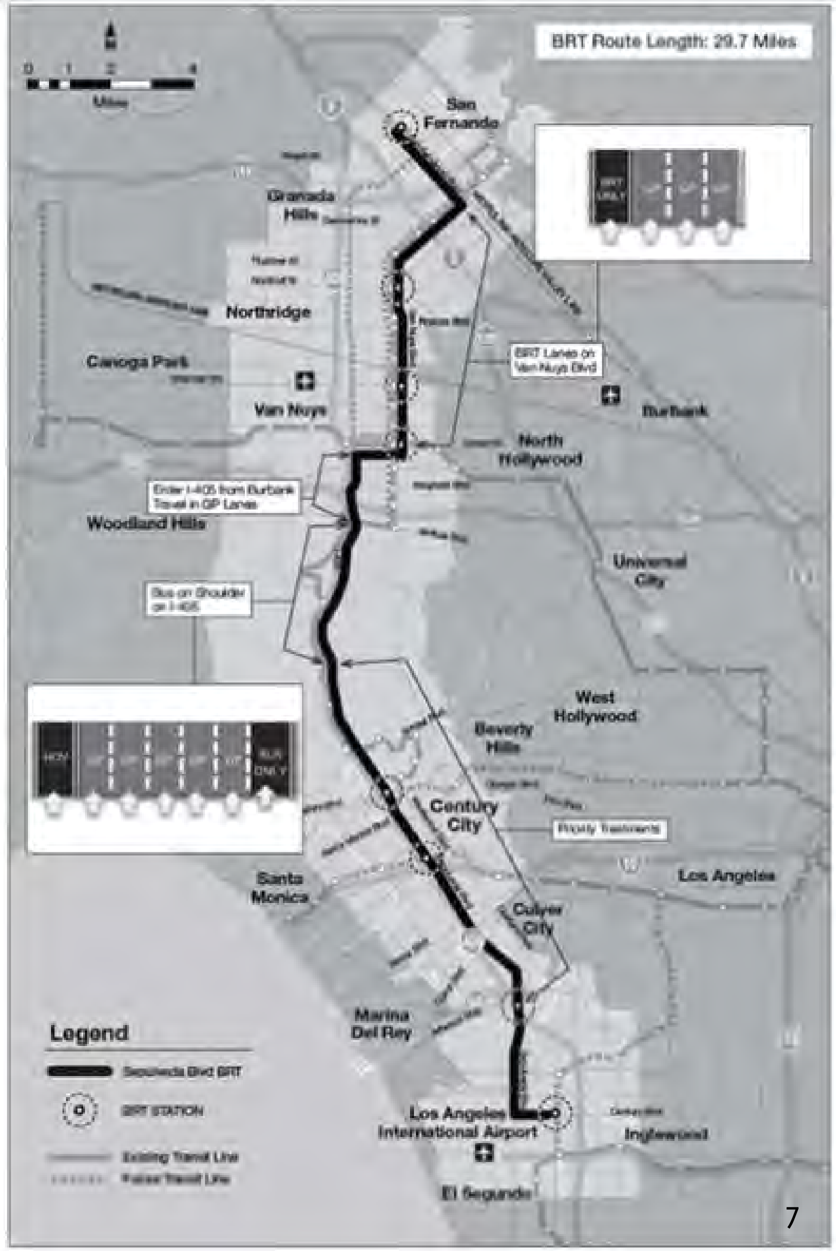
Metro Orange Line BRT



Freeway with Shoulder Running BRT - Minneapolis

Concept 1: Sepulveda/Van Nuys BRT

- Sylmar to LAX- 30 miles with partial priority lanes
- Use of Sepulveda Pass freeway shoulders during peak
- Potential Connection to ESFV Transit Corridor
- Priority treatment on Sepulveda Blvd through and south of the Pass



Concept 2: Managed Lanes with BRT

I-15 Managed Lanes San Diego County

Metro Express Lanes Project I-10 and I-110 Freeways

Route 91 Toll Lanes- Riverside/Orange Counties

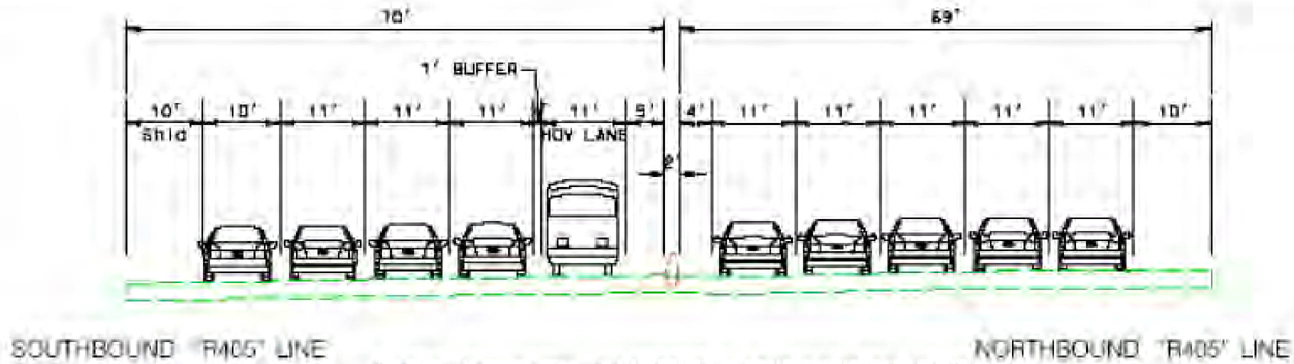
Metro

Concept 2: Managed Lanes with BRT

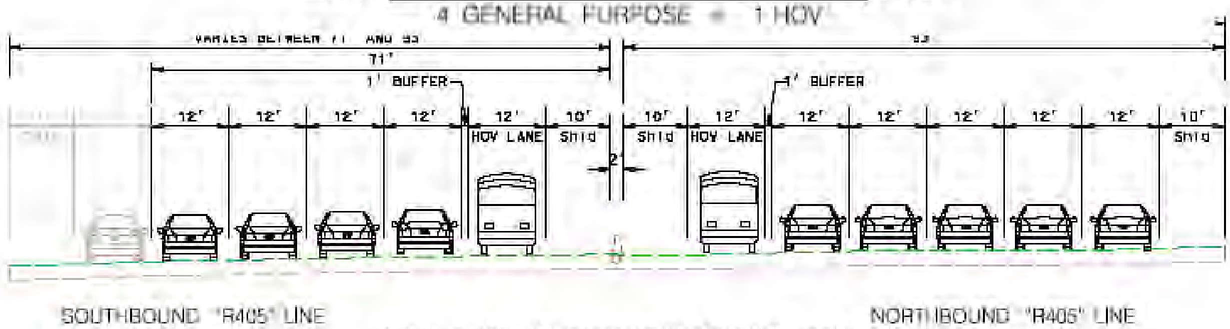
- Sylmar to LAX - 29 miles with Potential Connection to ESFV Transit Corridor
- High Occupancy Toll Lanes
  - 2 HOT lanes in Sepulveda Pass (each direction)
  - 1 HOT lane (3+ min. occupancy) north of Sepulveda Pass and south of I-10
- Potential Connection to ESFV Transit Corridor
- Public Private Partnership Potential

Metro

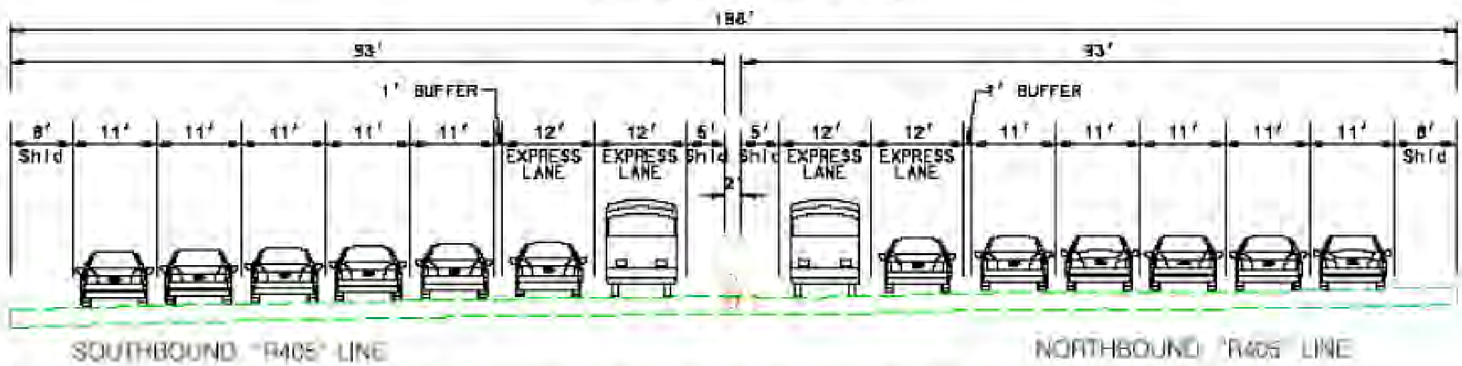
Concept 2: Managed Lanes and BRT



I-405 BEFORE CURRENT WIDENING PROJECT
4 GENERAL PURPOSE + 1 HOV



I-405 WITH CURRENT WIDENING PROJECT
5 GENERAL PURPOSE + 1 HOV



POSSIBLE FUTURE I-405 WITH ADDITION OF MANAGED LANES
5 GENERAL PURPOSE + 2 HOV (MODIFIED)

Metro

Concept 3: Highway Viaduct

I-5 Highway Viaduct – Santa Ana

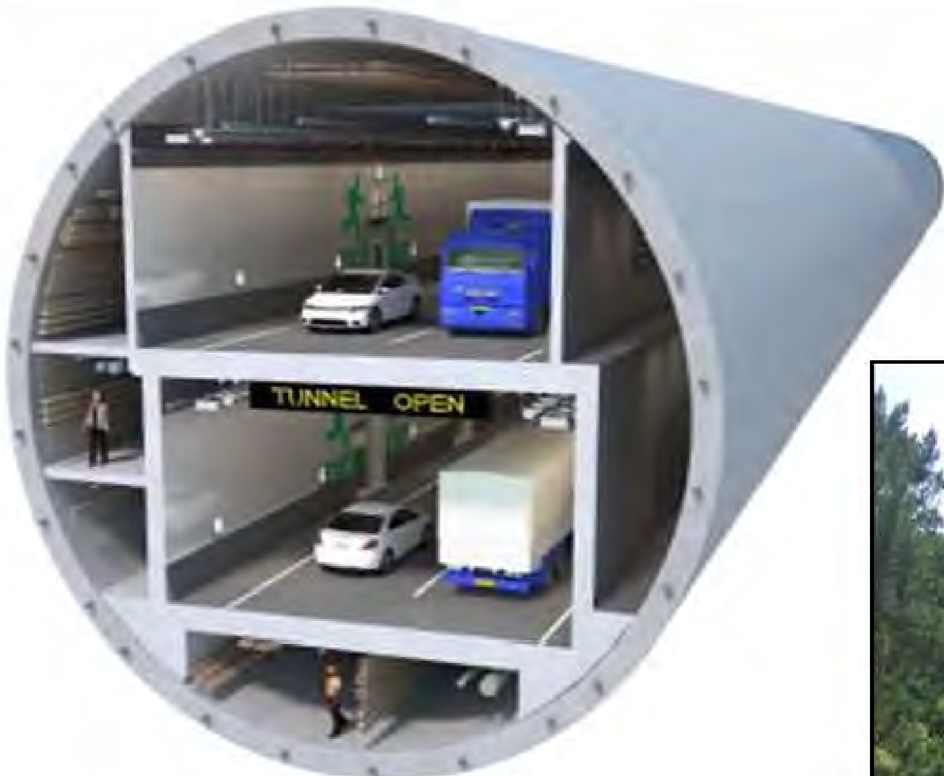
Metro

Concept 3: Highway Viaduct with BRT

- US 101 to I-10 Aerial Viaduct above Freeway – 10 miles
  - 2 HOT lanes in each direction on an elevated structure, freeing existing HOV lanes for dedicated busway beneath viaduct
- Potential Connection to ESFV Transit Corridor
- Conforms to Caltrans Route Study Report, but was eliminated as an alternative in current I-405 Improvement Project
  - May not be feasible due to environmental and engineering constraints

Metro

Concept 4: Highway Toll Tunnel with BRT



Concept Envisions one large bore tunnel similar to above left
Alaska Highway Viaduct Tunnel (Under Construction) – Seattle
Subway entrance portals would be similar to above Sepulveda Pass Tunnel
on Sepulveda Boulevard near Mulholland Drive

Metro

Concept 4: Highway Toll Tunnel with BRT

- Tunnel with four toll lanes (two per direction) under Sepulveda Pass- Minimum length of 10.5 miles
- BRT in Tunnel with potential connection to ESFV Transit Corridor
- Potential Direct Freeway Connections at
  - US 101 and I-405 (SFV)
  - Santa Monica Boulevard and Venice Boulevard (Westside)
- Public-Private-Partnership potential

Concept 5: Rail Transit Tunnel

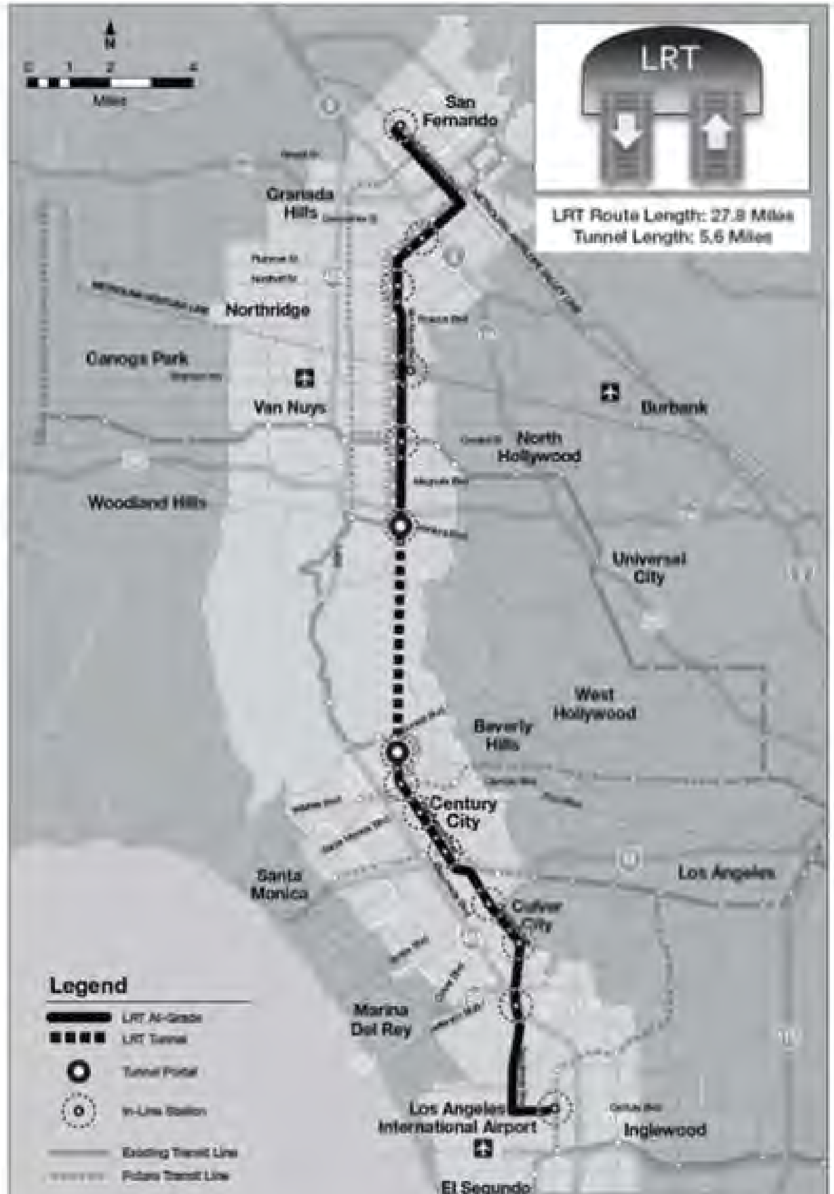
Metro Gold Line – Pasadena Tunnel near Colorado Boulevard

Metro

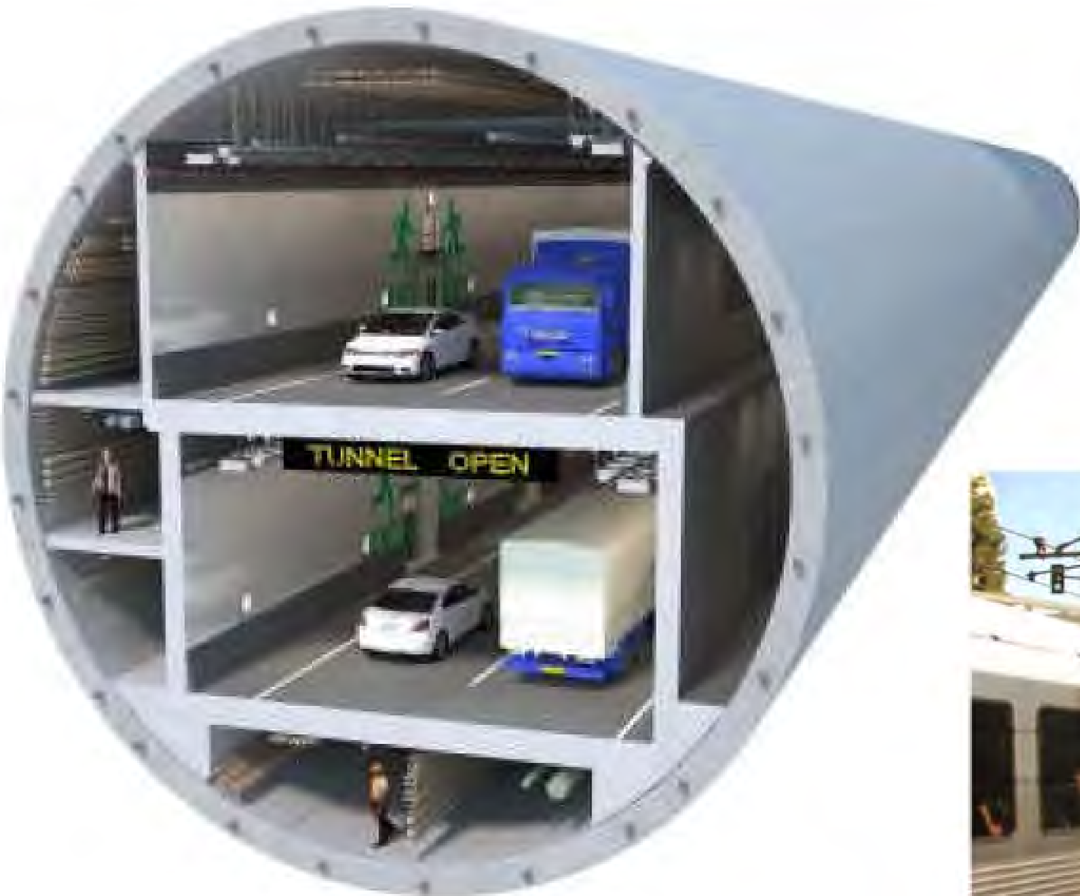
Concept 5: Rail Transit Tunnel

- Tunnel for Light Rail Transit (LRT) with surface operations north and south of Sepulveda Pass from Sylmar to LAX - 28 miles
- LRT travels underground in transit-only tunnel in the Sepulveda Pass (Minimum tunnel length- 6 miles)
- Potential Connection to ESFV Transit Corridor
- Connectivity to Metro Rail system; low public private partnership potential

Metro



Concept 6: Highway/Transit Tunnel



Concept Envisions one large bore tunnel similar to above left Alaska Highway Viaduct Tunnel (Under Construction) – Seattle and two 20' diameter rail tunnels similar to Metro Gold Line (shown above)

Metro

Concept 6: Highway/Transit Tunnel

Combines Concepts 4 and 5

Potential Highway and Private Rail Shuttle Tunnels from mid San Fernando Valley to LAX

Highway Tunnel:

- Tolled highway with tunnel segment- length up to 21 miles
    - Potential direct connectors from eastbound US 101 and southbound I-405 freeways with Intermediate Access Points at Ventura, Venice and Howard Hughes Parkway

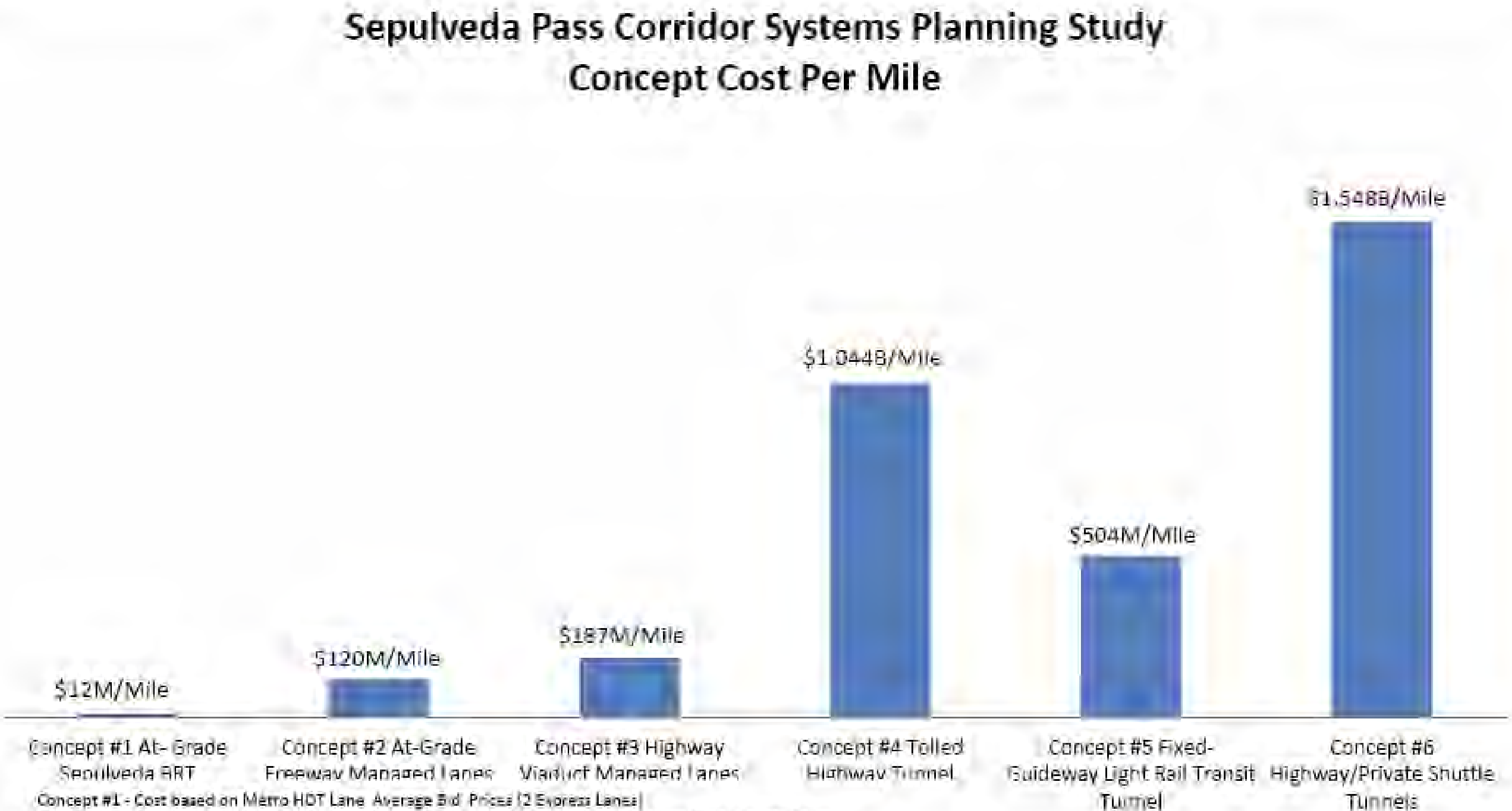
Private Shuttle Tunnel

- Shuttle length: up to 20 miles
    - Private shuttle with rail tunnel between Van Nuys Metrolink Station and Century/Aviation

Public-Private Partnership potential

Metro

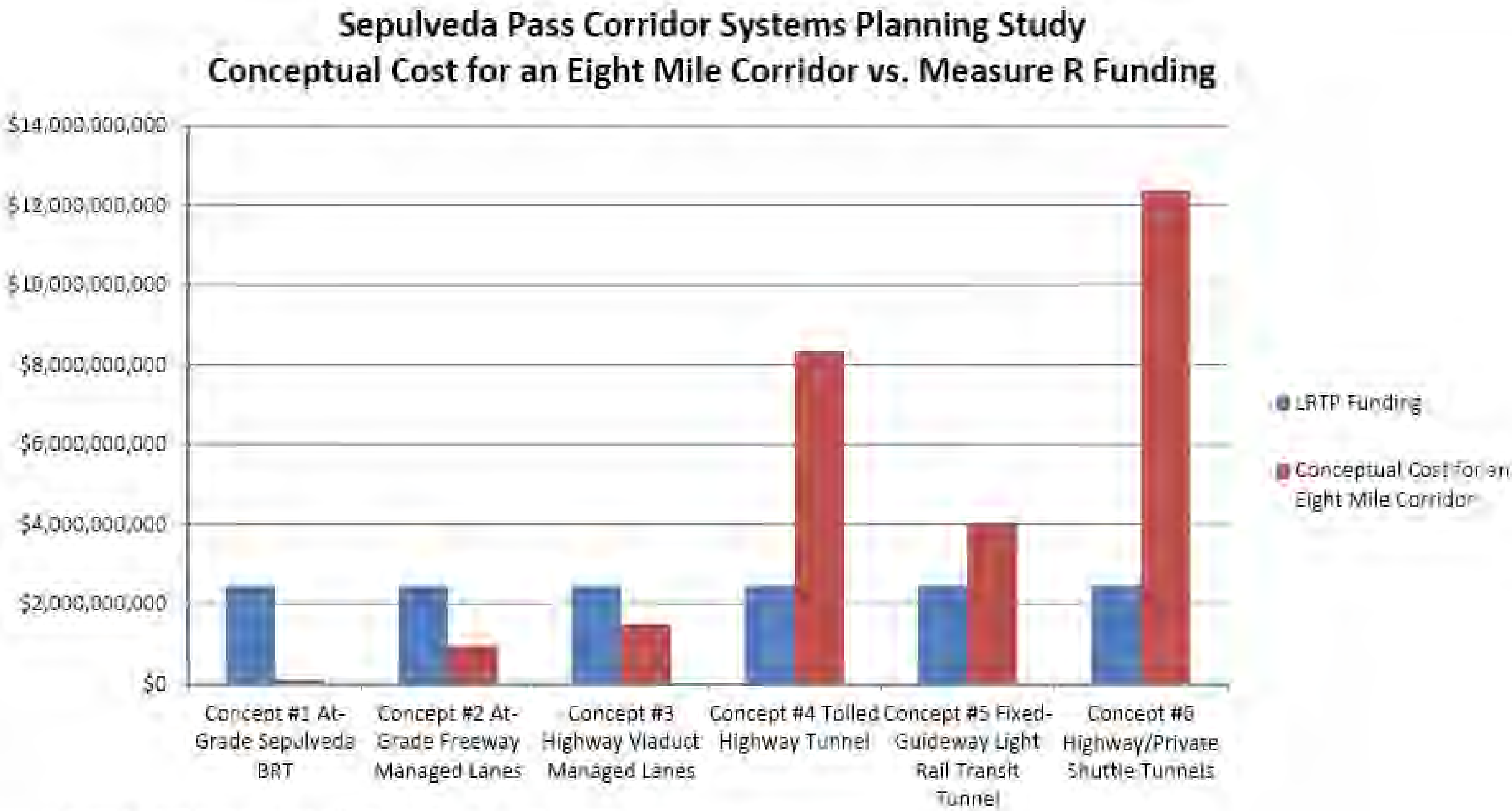
Comparisons – Cost per mile



Concept #1 - Cost based on Metro HOT Lane Average Bid Prices (2 Express Lanes)
Concept #2 - Cost based on Metro HOT Lane Average Bid Prices (4 Express Lanes) & two Direct Access Ramps
Concept #3 - Cost based on Alaskan Way Viaduct Option
Concept #4 - Cost based on Alaskan Way Tunnel (One 58' tunnel)
Concept #5 - Cost based on Metro Westside Subway Extension (Two 20' tunnels)
Concept #6 - Cost based on Concept #4 + Concept #5(One 58' tunnel and Two 20' tunnels)

Metro

Comparisons - Capital Cost



Concept #1 - Cost based on Metro HOT Lane Average Bid Prices (2 Express Lanes)
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Concept #5 - Cost based on Metro Westside Subway Extension (Two 20' tunnels)
Concept #6 - Cost based on Concept #4 + Concept #5(One 58' tunnel and Two 20' tunnels)

Metro

Next Steps

- Fall 2012
  - Complete Systems Planning Study
  - FTA Livability Grant Notification
    (Provides funding for Alternatives Analysis Study)

Metro