Geotechnical Report

for the East San Fernando Valley Transit Corridor

August 2015

Metro

Prepared by the
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Acronyms and Abbreviations

2008 RCP	2008 Regional Comprehensive Plan
2012 RTP	2012–2035 Regional Transportation Plan/Sustainable Communities Strategy
AA	Alternatives Analysis
BRT	bus rapid transit
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CPA	Community Plan Area
DEIR	Draft Environmental Impact Report
DEIS	Draft Environmental Impact Statement
FTA	Federal Transit Administration
Growth Vision	2004 Compass Blueprint Growth Vision
HOV	high-occupancy vehicle
I	Interstate [I]
LADOT	Los Angeles Department of Transportation
LRT	light rail transit
LRTP	Long-Range Transportation Plan
Metro	Los Angeles County Metropolitan Transportation Authority
MPO	Metropolitan Planning Organization
MSF	maintenance and storage facility
NEPA	National Environmental Policy Act
RTP/SCS	Regional Transportation Plan/Sustainable Communities Strategy
SCAG	Southern California Association of Governments
SR	State Route
TSM	Transportation System Management
U.S.C.	United States Code

Chapter 1
Introduction

1.1 Study Background

What Is the East San Fernando Valley Transit Corridor?

The Federal Transit Administration (FTA) and Los Angeles County Metropolitan Transportation Authority (Metro) have initiated a Draft Environmental Impact Statement (DEIS)/Environmental Impact Report (DEIR) for the East San Fernando Valley Transit Corridor Project (project). The DEIS/DEIR is being prepared with the FTA as the Lead Agency under the National Environmental Policy Act (NEPA) and Metro as the Lead Agency under the California Environmental Quality Act (CEQA).

The DEIS/DEIR and related engineering are being undertaken by Metro, in close coordination with the Cities of Los Angeles and San Fernando. The DEIS/DEIR will be a combined document complying with the most recent state and federal environmental laws. The project's public/community outreach component is being undertaken as an integrated parallel effort to the DEIS/DEIR.

Prior to the initiation of the DEIS/DEIR, an Alternatives Analysis (AA) was received by the Metro Board in January 2013 to study the East San Fernando Valley Transit Corridor in order to define, screen, and recommend alternatives for future study.

This study enabled Metro, the City of Los Angeles, and the City of San Fernando to evaluate a range of new public transit service alternatives that can accommodate future population growth and transit demand, while being compatible with existing land uses and future development opportunities. The study considered the Sepulveda Pass Corridor, which is another Measure R project, and the proposed California High Speed Rail Project. Both of these projects may be directly served by a future transit project in the project study area. The Sepulveda Pass Corridor could eventually link the West Los Angeles area to the eastern San Fernando Valley and the California High Speed Rail Project via the project corridor. As part of the January 2013 Alternatives Analysis, most of Sepulveda Boulevard was eliminated as an alignment option, as well as the alignment extending to Lakeview Terrace. As a result of the Alternatives Analysis, modal recommendations were for bus rapid transit (BRT) and light rail transit (LRT).

As a result of the alternatives screening process and feedback received during the public scoping period, a curb-running BRT, median-running BRT, median-running low-floor LRT/tram, and a median-running LRT, were identified as the four build alternatives, along with the TSM and No-Build Alternatives to be carried forward for analysis in this DEIS/DEIR.

1.1.1 Study Area

Where Is the Study Area Located?

The East San Fernando Valley Transit Corridor Project study area is located in the San Fernando Valley in the County of Los Angeles. Generally, the project study area extends from the city of San Fernando and the Sylmar/San Fernando Metrolink Station in the north to the Van Nuys Metro

Orange Line Station within the city of Los Angeles in the south. However, the project study area used for the environmental issue described in this report could vary from this general project study area, depending on the needs of the analysis. For the purposes of the analysis contained in this report, the project study area coincides with the general project study area.

The eastern San Fernando Valley includes the two major north-south arterial roadways of Sepulveda and Van Nuys Boulevards, spanning approximately 10 to 12 miles and the major north/west arterial roadway of San Fernando Road.

Several freeways traverse or border the eastern San Fernando Valley. These include the Ventura Freeway US-101, the San Diego Freeway I-405, the Golden State Freeway I-5, the Ronald Reagan Freeway SR-118, and the Foothill Freeway I-210. The Hollywood Freeway SR-170 is located east of the project study area. In addition to Metro Local and Metro Rapid bus service, the Metro Orange Line (Orange Line) Bus Rapid Transit service, the Metrolink Ventura Line commuter rail service, Amtrak inter-city rail service, and the Metrolink Antelope Valley Line commuter rail service are the major transit corridors that provide interregional trips in the project study area.

Land uses in the project study area include neighborhood and regional commercial land uses, as well as government and residential land uses. Specifically, land uses in the project study area include government services at the Van Nuys Civic Center, retail shopping along the project corridor, and medium- to high-density residential uses throughout the project study area. Notable land uses in the eastern San Fernando Valley include: The Village at Sherman Oaks, Panorama Mall, Whiteman Airport, Van Nuys Airport, Mission Community Hospital, Kaiser Permanente Hospital, Van Nuys Auto Row, and several schools, youth centers, and recreational centers.

1.1.2 Alternatives Considered

What Alternatives Are under Consideration?

The following six alternatives, including four build alternatives, a TSM Alternative, and the No-Build Alternative, are being evaluated as part of this study:

- No-Build Alternative
- Transportation Systems Management (TSM) Alternative
- Build Alternative 1 – Curb-Running Bus Rapid Transit (BRT) Alternative
- Build Alternative 2 – Median-Running BRT Alternative
- Build Alternative 3 – Low-Floor LRT/Tram Alternative
- Build Alternative 4 – Light Rail Transit (LRT) Alternative

All build alternatives would operate over 9.2 miles, either in a dedicated bus lane or guideway (6.7 miles) and/or in mixed-flow traffic lanes (2.5 miles), from the Sylmar/San Fernando Metrolink station to the north to the Van Nuys Metro Orange Line station to the south, with the exception of Build Alternative 4 which includes a 2.5-mile segment within Metro-owned railroad right-of-way adjacent to San Fernando Road and Truman Street and a 2.5-mile underground segment beneath portions of Panorama City and Van Nuys.

1.1.2.1 No-Build Alternative

The No-Build Alternative represents projected conditions in 2040 without implementation of the project. No new transportation infrastructure would be built within the project study area, aside from projects that are currently under construction or funded for construction and operation by 2040.

These projects include highway and transit projects funded by Measure R and specified in the current constrained element of the Metro 2009 Long-Range Transportation Plan (LRTP) and the 2012 Southern California Association of Governments (SCAG) Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS). Existing infrastructure and future planned and funded projects assumed under the No-Build Alternative include:

- Existing Freeways – Interstate 5, and Interstate 105, State Route 118, and U.S. 101;
- Existing Transitway – Metro Orange Line;
- Existing Bus Service – Metro Rapid and Metro Local Shuttle;
- Los Angeles Department of Transportation Commuter Express, and DASH;
- Existing and Planned Bicycle Projects – Bicycle facilities on Van Nuys Boulevard and connecting east/west facilities; and
- Other Planned Projects – Various freeway and arterial roadway upgrades, expansions to the Metro Rapid Bus system, upgrades to the Metrolink system and the proposed California High Speed Rail project.

This alternative establishes a baseline for comparison to other alternatives in terms of potential environmental effects, including adverse and beneficial environmental effects.

1.1.2.2 TSM Alternative

The TSM Alternative enhances the No-Build Alternative and emphasizes transportation systems upgrades, which may include relatively low-cost transit service improvements. It represents efficient and feasible improvements to transit service, such as increased bus frequencies and minor modifications to the roadway network. Additional TSM Alternative transit improvements that may be considered include, but are not limited to, traffic signalization improvements, bus stop amenities/improvements, and bus schedule restructuring (Figure 1-1).

The TSM Alternative considers the existing bus network, enhanced operating hours, and increased bus frequencies for Rapid Line 761 and Local Line 233. Under this alternative, the Metro Rapid Line 761 and Metro Local Line 233 bus routes would retain existing stop locations. This alternative would add 20 additional buses to the existing Metro Local 233 and Metro Rapid 761 bus routes. These buses would be similar to existing Metro 60-foot articulated buses, and each bus would have the capacity to serve up to 75 passengers (57 seats x 1.30 passenger loading standard). Buses would be equipped with transit signal priority equipment to allow for improved operations and on-time performance.

The existing Metro Division 15 maintenance and storage facility (MSF) located in Sun Valley would be able to accommodate the 20 additional buses with the implementation of the TSM Alternative. Operational changes would include reduced headway (elapsed time between buses) times for Metro Rapid Line 761 and Metro Local Line 233, as follows:

- Metro Rapid Line 761 would operate with headways reduced from 10 minutes to 8 minutes during peak hours (7 a.m. to 9 a.m. and 4 p.m. to 7 p.m. on weekdays) and from 17.5 minutes to 12 minutes during off-peak hours.
- Metro Local Line 233 would operate with headways reduced from 12 minutes to 8 minutes during peak hours and from 20 minutes to 16 minutes during off-peak hours.

Figure 1-1: TSM Alternative

Source: STV, 2014.

1.1.2.3 Build Alternative 1 – Curb-Running BRT Alternative

Under the Curb-Running BRT Alternative, the BRT guideway would incorporate 6.7 miles of existing curb lanes (i.e., lanes closest to the curb) along Van Nuys Boulevard between San Fernando Road and the Metro Orange Line. This alternative would be similar to the Metro Wilshire BRT project and would operate similarly. The lanes would be curb-running bus lanes for Metro Rapid Line 761 and Metro Local Line 233, and for other transit lines that operate on short segments of Van Nuys Boulevard. In addition, this alternative would incorporate 2.5 miles of mixed-flow lanes, where buses would operate in the curb lane along San Fernando Road and Truman Street between Van Nuys Boulevard and Hubbard Avenue for Metro Line 761. Metro Line 233 would continue north on Van Nuys Boulevard to Lakeview Terrace. These improvements would result in an improved Metro Rapid Line 761 (hereafter referred to as 761X) and an improved Metro Local Line 233 (hereafter referred to as 233X). The route of the Curb-Running BRT Alternative is illustrated in Figure 1-2.

From the Sylmar/San Fernando Metrolink station:

- Metro Rapid Line 761X would operate within roadway travel lanes on Truman Street and San Fernando Road.
- At Van Nuys Boulevard, Metro Rapid Line 761X would turn southwest and travel south within a curb-running dedicated bus lane along Van Nuys Boulevard.
- The alternative would continue to be curb running along Van Nuys Boulevard until reaching the Metro Orange Line Van Nuys station where Metro Rapid Line 761X service would be integrated into mixed-flow traffic.
- Metro Line 761X would then continue south to Westwood as under existing conditions, though it should be noted that in December 2014 the Metro Rapid Line 761 will be re-routed to travel from Van Nuys Boulevard to Ventura Boulevard, and then to Reseda Boulevard, while a new Metro Rapid Line 788 would travel from Van Nuys Boulevard through the Sepulveda Pass to Westwood as part of a Metro demonstration project.

Metro Local Line 233X would operate similar to how it currently operates between the intersections of Van Nuys and Glenoaks Boulevards to the north and Van Nuys and Ventura Boulevards to the south. However, Metro Local Line 233X would operate with improvements over existing service because it would utilize the BRT guideway where its route overlaps with the guideway along Van Nuys Boulevard.

Transit service would not be confined to only the dedicated curb lanes. Buses would still have the option to operate within the remaining mixed-flow lanes to bypass right-turning vehicles, a bicyclist, or another bus at a bus stop.

The Curb-Running BRT Alternative would operate in dedicated bus lanes, sharing the lanes with bicycles and right turning vehicles. However, on San Fernando Road and Truman Street, no dedicated bus lanes would be provided. The Curb-Running BRT Alternative would include 18 bus stops.

Figure 1-2: Build Alternative 1 – Curb-Running BRT Alternative

Metro

Source: KOA and ICF International, 2014.

1.1.2.4 Build Alternative 2 – Median-Running BRT Alternative

The Median-Running BRT Alternative consists of approximately 6.7 miles of dedicated median-running bus lanes between San Fernando Road and the Metro Orange Line, and would have operational standards similar to the Metro Orange Line. The remaining 2.5 miles would operate in mixed-flow traffic between the Sylmar/San Fernando Metrolink Station and San Fernando Road/Van Nuys Boulevard. The Median-Running BRT Alternative is illustrated in Figure 1-3.

Similar to the Curb-Running BRT Alternative, the Median-Running BRT (Metro Rapid Line 761X) would operate as follows from the Sylmar/San Fernando Metrolink station:

- Metro Rapid Line 761X would operate within mixed-flow lanes on Truman Street and San Fernando Road.
- At Van Nuys Boulevard, the route would turn southwest and travel south within the median of Van Nuys Boulevard in a new dedicated guideway.
- Upon reaching the Van Nuys Metro Orange Line Station, the dedicated guideway would end and the Rapid Line 761X service would then be integrated into mixed-flow traffic.
- The route would then continue south to Westwood, similar to the existing route. Similar to Build Alternative 1, it should be noted that in December 2014 the Metro Rapid Line 761 will be re-routed to travel from Van Nuys Boulevard to Ventura Boulevard, and then to Reseda Boulevard, while a new Metro Rapid Line 788 would travel from Van Nuys Boulevard through the Sepulveda Pass to Westwood as part of a Metro demonstration project.

Metro Local Line 233 would operate similar to existing conditions between the intersections of Van Nuys and Glenoaks Boulevards to the north and Van Nuys and Ventura Boulevards to the south. Rapid Bus stops that currently serve the 794 and 734 lines on the northern part of the alignment along Truman Street and San Fernando Road would be upgraded and have design enhancements that would be Americans with Disabilities Act (ADA) compliant. These stops would also serve the redirected 761X line:

1. Sylmar/San Fernando Metrolink Station
2. Hubbard Station
3. Maclay Station
4. Paxton Station
5. Van Nuys/San Fernando Station

Along the Van Nuys Boulevard segment, bus stop platforms would be constructed in the median. Seventeen new median bus stops would be included.

Figure 1-3: Build Alternative 2 – Median-Running BRT Alternative

Source: KOA and ICF International, 2014.

1.1.2.5 Build Alternative 3 – Low-Floor LRT/Tram Alternative

The Low-Floor LRT/Tram Alternative would operate along a 9.2-mile route from the Sylmar/San Fernando Metrolink station to the north, to the Van Nuys Metro Orange Line station to the south. The Low-Floor LRT/Tram Alternative would operate in a median dedicated guideway for approximately 6.7 miles along Van Nuys Boulevard between San Fernando Road and the Van Nuys Metro Orange Line station. The low-floor LRT/tram alternative would operate in mixed-flow traffic lanes on San Fernando Road between the intersection of San Fernando Road/Van Nuys Boulevard and just north of Wolfskill Street. Between Wolfskill Street and the Sylmar/San Fernando Metrolink station, the low-floor LRT/tram would operate in a median dedicated guideway. It would include 28 stations. The route of the Low-Floor LRT/Tram Alternative is illustrated in Figure 1-4.

The Low-Floor LRT/Tram Alternative would operate along the following route:

- From the Sylmar/San Fernando Metrolink station, the low-floor LRT/tram would operate within a median dedicated guideway on San Fernando Road.
- At Wolfskill Street, the low-floor LRT/tram would operate within mixed-flow travel lanes on San Fernando Road to Van Nuys Boulevard.
- At Van Nuys Boulevard, the low-floor LRT/tram would turn southwest and travel south within the median of Van Nuys Boulevard in a new dedicated guideway.
- The low-floor LRT/tram would continue to operate in the median along Van Nuys Boulevard until reaching its terminus at the Van Nuys Metro Orange Line Station.

Based on Metro's *Operations Plan for the East San Fernando Valley Transit Corridor Project,* the Low-Floor LRT/Tram Alternative would assume a similar travel speed as the Median-Running BRT Alternative, with speed improvements of 18 percent during peak hours/peak direction and 15 percent during off-peak hours.

The Low-Floor LRT/Tram Alternative would operate using low-floor articulated vehicles that would be electrically powered by overhead wires. This alternative would include supporting facilities, such as an overhead contact system (OCS), traction power substations (TPSS), signaling, and a maintenance and storage facility (MSF).

Because the Low-Floor LRT/Tram Alternative would fulfill the current functions of the existing Metro Rapid Line 761 and Metro Local Line 233, these bus routes would be modified to maintain service only to areas outside of the project corridor.

Stations for the Low-Floor LRT/Tram Alternative would be constructed at various intervals along the entire route. There are portions of the route where stations are closer together and other portions where they are located further apart. Twenty-eight stations are proposed with the Low-Floor LRT/Tram Alternative. The 28 proposed low-floor LRT/tram stations would be ADA compliant.

Figure 1-4: Build Alternative 3 – Low-Floor LRT/Tram Alternative

Metro

Source: KOA and ICF International, 2014.

1.1.2.6 Build Alternative 4 – LRT Alternative

Similar to the Low-Floor LRT/Tram Alternative, the LRT would be powered by overhead electrical wires (Figure 1-5). Under Build Alternative 4, the LRT would travel in a dedicated guideway from the Sylmar/San Fernando Metrolink station along San Fernando Road south to Van Nuys Boulevard, from San Fernando Road to the Van Nuys Metro Orange Line Station, over a distance of approximately 9.2 miles. The LRT Alternative includes a segment in exclusive right-of-way through the Antelope Valley Metrolink railroad corridor, a segment with semi-exclusive right-of-way in the middle of Van Nuys Boulevard, and an underground segment beneath Van Nuys Boulevard from just north of Parthenia Street to Hart Street.

The LRT Alternative would be similar to other street-running LRT lines that currently operate in the Los Angeles area, such as the Metro Blue Line, Metro Gold Line, and Metro Exposition Line. The LRT would travel along the median for most of the route, with a subway of approximately 2.5 miles in length between Vanowen Street and Nordhoff Street. On the surface-running segment, the LRT Alternative would operate at prevailing traffic speeds and would be controlled by standard traffic signals.

Stations would be constructed at approximately 1-mile intervals along the entire route. There would be 14 stations, three of which would be underground near Sherman Way, the Van Nuys Metrolink station, and Roscoe Boulevard. Entry to the three underground stations would be provided from an entry plaza and portal. The entry portals would provide access to stairs, escalators, and elevators leading to an underground LRT station mezzanine level, which, in turn, would be connected via additional stairs, escalators, and elevators to the underground LRT station platforms

Similar to the Low-Floor LRT/Tram Alternative, the LRT Alternative would require a number of additional elements to support vehicle operations, including an OCS, TPSS, communications and signaling buildings, and an MSF.

Figure 1-5: Build Alternative 4 – LRT Alternative

Metro

Source: KOA and ICF International, 2014.

Chapter 2
Regulatory Framework/Methodology

2.1 Regulatory Framework

2.1.1 Federal Regulations

The National Flood Insurance Program (NFIP) was established by U.S. Congress in 1968 and is administered by Federal Emergency Management Agency's (FEMA). NFIP prepares maps that identify the flooding potential throughout the United States for 100-year and 500-year flood events.

2.1.2 State Regulations

The Alquist-Priolo Geologic Hazards Zone (APEFZ) Act[1] was passed in 1972 by the State of California to mitigate the hazard of surface faulting to structures for human occupancy. The act has been amended 10 times and was renamed the APEFZ Act on January 1, 1994. The APEFZ Act's main purpose is to prevent the construction of structures used for human occupancy on the surface trace of active faults as documented in Special Publication 42 by California Geological Survey (CGS). The APEFZ Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards.

The Seismic Hazards Mapping Act of 1990 was enacted, in part, to address seismic hazards not included in the APEFZ Act, including strong ground shaking, landslides, and liquefaction. Under this Act, the State Geologist is assigned the responsibility of identifying and mapping seismic hazards. CGS Special Publication 117A,[2] adopted in 2008 by the State Mining and Geology Board, constitutes guidelines for evaluating seismic hazards other than surface faulting, and for recommending mitigation measures as required by Public Resources Code Section 2695 (a). The CGS seismic hazard zone maps use a ground-shaking event that corresponds to 10 percent probability of exceedance in 50 years.

2.1.3 Local Regulations

Metro Design Criteria (Metro, 2012) requires that special earthquake protection criteria be followed for important structures such as the grade separation bridges. "The philosophy for earthquake design for these criteria is to provide a high level of assurance that the overall system will continue to operate during and after an Operating Design Earthquake (ODE)." Operating procedures assume safe shutdown and inspection before returning to operation. "Further, the system design will provide a high level of assurance that public safety will be maintained during and after a Maximum Design Earthquake (MDE)." The ODE and MDE are defined as earthquake events with return periods of 150 and 2,500 years, respectively. The probabilities of exceedance of the ODE and MDE events are 50 and 4 percent or less, respectively, during the 100-year facility design life.

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[1] Bryant, W. A. and E.W. Hart, 2007, Fault Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zone Maps, California Division of Mines and Geology Special Publication 42, Interim Revision 2007.

[2] California Geological Survey, 2008, Special Publication 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California, September 2008.

2.2 Methodology

Impacts associated with the geotechnical considerations have been identified from a review of available published and unpublished literature that includes, but is not limited to, the Safety Element of the Los Angeles City General Plan; official APEFZ maps; official seismic hazard zone maps; and geologic and topographic maps and other publications of CGS, U.S. Geological Survey (USGS), and the California Division of Oil and Gas.

2.3 Significance Thresholds

Significance thresholds are used to determine whether a project may have a significant environmental effect. The significance thresholds, as defined by federal and state regulations and guidelines, are discussed below.

2.3.1 Federal

NEPA does not include specific significance thresholds. According to the Council on Environmental Quality (CEQ) Regulations for Implementing NEPA, the determination of significance under NEPA is based on context and intensity. The CEQA thresholds (described below) encompass the factors taken into account under NEPA to determine the significance of an action in terms of its context and the intensity of its impacts. Therefore, the CEQA thresholds listed below also apply to NEPA for the project and its alternatives.

2.3.2 State

CEQA does not describe specific significance thresholds. According to the Governor's Office of Planning and Research (OPR), significance thresholds for a given environmental effect are the discretion of the Lead Agency and are the levels at which the Lead Agency finds the effects of the project to be significant.

2.3.2.1 State CEQA Guidelines

The CEQA guidelines define a significant effect on the environment as: "a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance" (CEQA Guidelines, Section 15382).[3]

The CEQA Guidelines do not describe specific significance thresholds. However, Appendix G of the CEQA Guidelines lists a variety of potentially significant effects.

As outlined in Appendix G, a project would normally have a significant impact with respect to geology and soils if it would:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death, involving:
  - Rupture of a known earthquake fault, as delineated on the most recent APEFZ Map for the area or based on other substantial evidence of a known fault,

[3] Governor's Office of Planning and Research, CEQA Statutes and Guidelines, 2014.

  - Strong seismic ground shaking,
  - Seismic-related ground failure, including liquefaction, or
  - Landslides;
- Result in substantial soil erosion or the loss of topsoil;
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;
- Be located on expansive soil creating substantial risks to life or property; or
- Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems in areas where sewers are not available for the disposal of wastewater.

2.3.3 L.A. CEQA Thresholds Guide

According to the *L.A. CEQA Thresholds Guide* (City of Los Angeles, 2006), a project would normally have a significant impact on geology and soils if it would:

- Cause or accelerate geologic hazards that would result in substantial damage to structures or infrastructure or expose people to substantial risk of injury;
- Constitute a geologic hazard to other properties by causing or accelerating instability from erosion;
- Accelerate natural processes of wind and water erosion and sedimentation, resulting in sediment runoff or deposition that would not be contained or controlled on-site; or
- One or more distinct and prominent geologic or topographic features would be destroyed, permanently covered or materially and adversely modified. Such features may include, but are not limited to, hilltops, ridges, hill slopes, canyons, ravines, rock outcrops, water bodies, streambeds, and wetlands.[4]

[4] City of Los Angeles. 2006. *LA CEQA Thresholds Guide, G. Water Resources*. Available: http://www.ci.la.ca.us/ead/programs/Thresholds/G-Water Resources.pdf. Accessed February 21, 2013.

Chapter 3
Affected Environment/Existing Conditions

Geology, soils, and seismicity are factors that often determine design criteria for the development of transit improvements, particularly when grade separation structures are involved. This report summarizes the geologic materials, faults, seismic characteristics, and other subsurface conditions of the project area.

Subsurface data was reviewed from Caltrans logs of test borings (LOTB), borings published by the California Geological Survey (CGS), and previous Diaz-Yourman & Associates (DYA) investigations. A map identifying the approximate previous boring locations is shown on Figure 3-1.

3.1 Geology, Surface/Subsurface Condition, and Groundwater Level

3.1.1 Geologic Units and Structure in the Eastern San Fernando Valley

The project area along Van Nuys Boulevard is located in the eastern portion of the San Fernando Valley, north of the Santa Monica Mountains, south of the San Gabriel Mountains, southeast of the foothills of the Santa Susana Mountains, and west of the Verdugo Hills. This portion of the San Fernando Valley ranges in elevation from approximately 1,100 feet above mean sea level (MSL) at the northeast end to 640 feet MSL at the Los Angeles River, a drop of 460 feet in the approximately 11-mile length (USGS, 1991 and 1995).[5,6] Ground surface generally slopes to the south and southwest because of a merger of alluvial fan surfaces, except at the far southern end, where slopes adjacent to the Santa Monica Mountains are to the north and northeast.

The San Fernando Valley is a geologic area underlain by a thick (several thousand feet) sequence of Tertiary age sedimentary bedrock overlain by younger alluvial deposits. From oldest to youngest, these bedrock formations include the Saugus, Pico, Towsely, Modelo, and Topanga Formations, and these formations are underlain by crystalline basement (Yerkes and Campbell, 2005).[7] Each formation is composed of rock layers alternating between sandstone, conglomerate, and siltstone. The project area alignment is completely founded on alluvial fan materials overlying these bedrock formations. The nearest surface exposures of Tertiary sedimentary bedrock are in the low hills west of Hansen Dam near (Topanga and crystalline basement) and adjacent to the north edge of the Santa Monica Mountains as shown on Figure 3-2. It is possible, although unlikely, that shallow bedrock exists in some portions of the project area.

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5 United States Geological Survey, 1991, Van Nuys 7.5-minute topographic quadrangle map, scale 1:24,000.

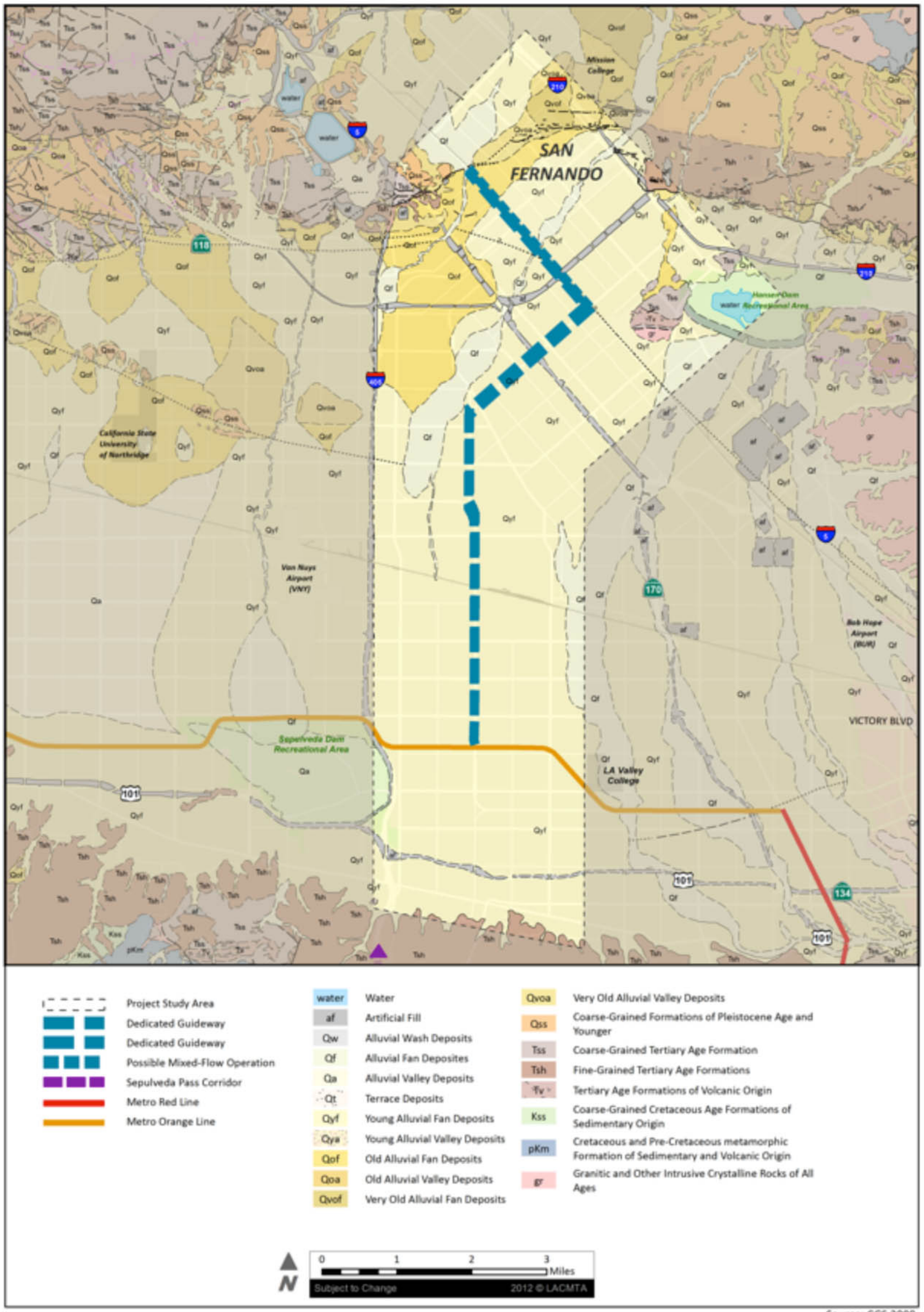
6 United States Geological Survey, 1995, San Fernando 7.5-minute topographic quadrangle map, scale 1:24,000.

7 Yerkes, R. F. and Campbell, R. H., 2005, Preliminary Geologic Map of the Los Angeles 30' x 60' Quadrangle, Southern California U.S. Department of the Interior U.S. Geological Survey Open File Report 2005-1019, Scale 1:100000.

Figure 3-1: Previous Borings or Available Subsurface Data

Source: Caltrans 1959, 1971, 2001; CGS 1997, 1998.

Figure 3-2: Geologic Map



Source: CGS 2008.

Older and younger Quaternary (Holocene through early Pleistocene) alluvial fan deposits (Figure 3-2; Yerkes and Campbell, 2005; CGS, 1997 and 1998)[6,8,9] consist predominantly of sand, silt, and gravel/boulders, along with smaller amounts of clay-rich materials. Descriptions of materials encountered in most borings drilled into these deposits for unrelated previous projects at various locations along the project area consist of loose to moderately dense sand. These deposits have been historically saturated to within 10 feet below the ground surface (bgs) near the south end of the project area to approximately 35 feet bgs at the northeast end and deeper within approximately 220 feet in the area of San Fernando Road and Van Nuys Boulevard (CGS; 1997, 1998).[8,9] Deposits along the alignment south of approximately Vanowen Street are considered susceptible to liquefaction, as are deposits at/near the intersection of San Fernando Road and Hubbard Street at the northeast end of the project area (see Section 3.5).

Most soils within the project area have been modified and disturbed by grading and earthmoving associated with development, which includes the placement of artificial fill. Therefore, it is unlikely that significant areas of undisturbed native soils are present along the surface of the proposed alignment. Three geologic maps cover the project area, one from the USGS (Yerkes and Campbell, 2005) and three from the CGS (1997, 1998, and Bedrossian and others, 2012). Bedrossian and others (2012) is used for Figure 3-2 and consolidates mapping from the other previous work within the project area. Map units contacts and symbols vary among these maps, and the 2012 contacts and map symbols are referred to herein. Alluvial material in the project area is predominantly sand and silty sand with some gravel (CGS, 1997).[8] Smaller amounts of clay are also known to occur, along with cobbles and boulders. Abbreviated unit descriptions are as follows:

Af – Artificial Fill: Figure 3-2 shows artificial fill along the Freeways (US-101, I-210, SR-118, and I-5) and at Hanson Dam; this is noted by the CGS (1997, 1998). Other fill materials likely exist in areas scattered across the San Fernando Valley and, therefore, even though not shown on published maps, potentially exist to some extent in the project area. These fills may be engineered and compacted to modern standards or may be undocumented with unknown properties. In general, it can be expected that the engineered fill materials will be predominantly sand, silt, and fine gravel due to the ease of compaction. Locally present undocumented fills may contain larger materials (cobble, boulders) and trash (e.g., organic matter, metal, concrete, wood).

Qf – Alluvial Fan Deposits (Holocene): The Qf deposits extend into the San Fernando Valley from the larger canyons to the north and east of the project area (e.g., Pacoima, and Tujunga Canyons, respectively). The map view of these deposits is typically an irregular linear ribbon, some of which passes beneath portions of the proposed alignment. Qf deposits generally consist of unconsolidated gravelly, sandy, or silty alluvial deposits with cobbles and boulders on active and recently active alluvial fans.

Qyf – Young Alluvial Fan Deposits (Holocene-Late Pleistocene): Young alluvial fans cover a slightly greater percentage of the proposed alignment area than the alluvial fan deposits. As described by Yerkes and Campbell (2005),[7] Qyf consists of unconsolidated gravel, sand, and silt, coarser-grained closer to the mountains deposited from flooding streams and debris flows. The alluvial fan surfaces can show slight to moderate pedogenic soil development including clay development and cementation.

[8] California Geological Survey, 1997 (Revised 2001), Seismic Hazard Zone Report 008, Seismic Hazard Zone Report for the Van Nuys 7.5-Minute Quadrangle, Los Angeles County, California, 1997 (Revised 2001).

[9] California Geological Survey, 1998, Open File Report 98-06, Seismic Hazard Evaluation for the San Fernando 7.5-Minute Quadrangle, Los Angeles County, California.

Qof – Old Alluvial Fan Deposits (Late-Middle Pleistocene): Qof is the undifferentiated older alluvial fan deposits (Yerkes and Campbell, 2005). Qof is found along San Fernando Road as it approaches Hubbard Street from the southeast. Qof consists of slightly to moderately consolidated silt, sand, and gravel deposits on incised alluvial fans; surfaces can show moderately to well-developed pedogenic soils.

3.1.2 Groundwater

Groundwater levels are shallow at the southern end of the project area near the Los Angeles River and become deeper at the northern end of the project area near the foothills. Based on the review of the Caltrans LOTBs and CGS data, groundwater was detected in the previous borings near elevation approximately 635 feet MSL, approximately 25 bgs at the southern end. Borings at the northern end did not encounter groundwater. Historically, groundwater has been as high as the ground surface at the southern end of the project area near the Los Angeles River (CGS, 1997).[8] The historically high groundwater levels specified by the CGS are shown on Figure 3-3.

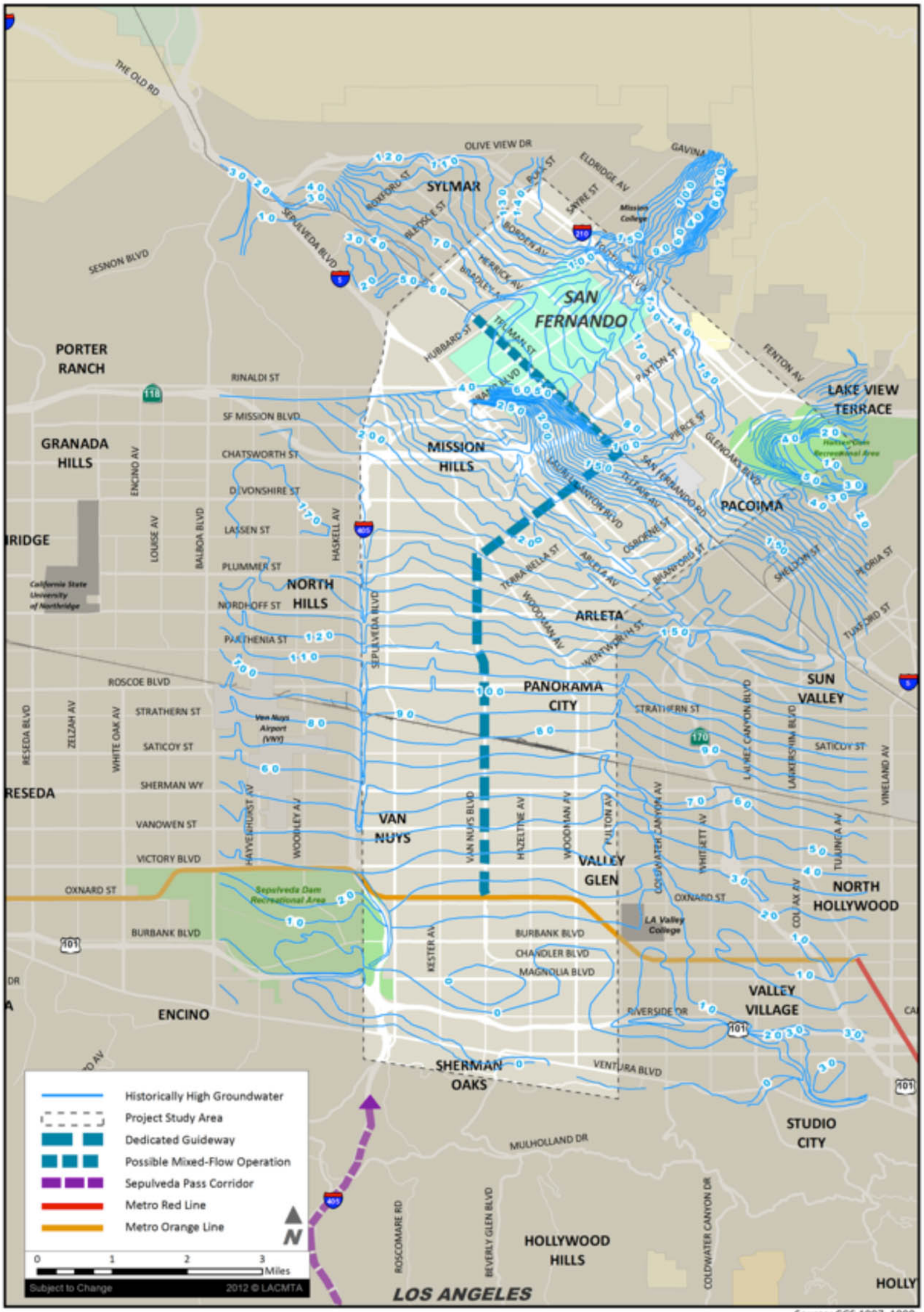
3.2 Faulting and Earthquake Potential

Plate tectonics and the forces that affect the earth's crust affect all of Southern California geology and seismicity. Faults are formed at the plate boundaries and other stress points within tectonic plates. Faults adjacent to, within, and beneath the city of Los Angeles and San Fernando Valley areas may be classified as inactive, potentially active, or active. Figure 3-4 identifies known faults in the region (CGS, 2010).[10] Regional faults of concern are strike slip faults (e.g., San Andreas, San Jacinto, Elsinore, Newport-Inglewood), normal, reverse, and thrust faults (e.g., Santa Monica-Hollywood, Sierra Madre-San Fernando, Palos Verdes, Raymond, and Verdugo), and buried (blind) thrust faults (e.g., Puente Hills, Northridge, and Elysian Park). This seismotectonic setting has been a part of the evolution of the Los Angeles County landscape for the past 5 million years.

The surface faults of most concern for the project area with respect to strong ground shaking are the Verdugo, San Fernando, Santa Monica-Hollywood, Oak Ridge, Newport-Inglewood, and San Andreas faults, shown on Figure 3-4. Other smaller faults, such as the Mission Hills and Northridge Hills north and west of the project area, and the possible North Hollywood fault south and east of the project area, are of lesser concern due to their lower likelihood of independently generating moderate to large earthquakes. There remains uncertainty with regard to the earthquake characteristics of blind thrust faults (e.g., Elysian Park, Puente Hills, and Northridge) because they are buried; the Northridge blind thrust (source of the 1994 Northridge earthquake) underlies the northeastern San Fernando Valley at a depth of several thousand feet. Additional descriptions of the San Fernando, Verdugo and Northridge Hills, and possible North Hollywood faults are included below because each fault crosses or projects toward the project area, and each could produce ground rupture or ground deformation in a significant earthquake centered in this portion of the San Fernando Valley.

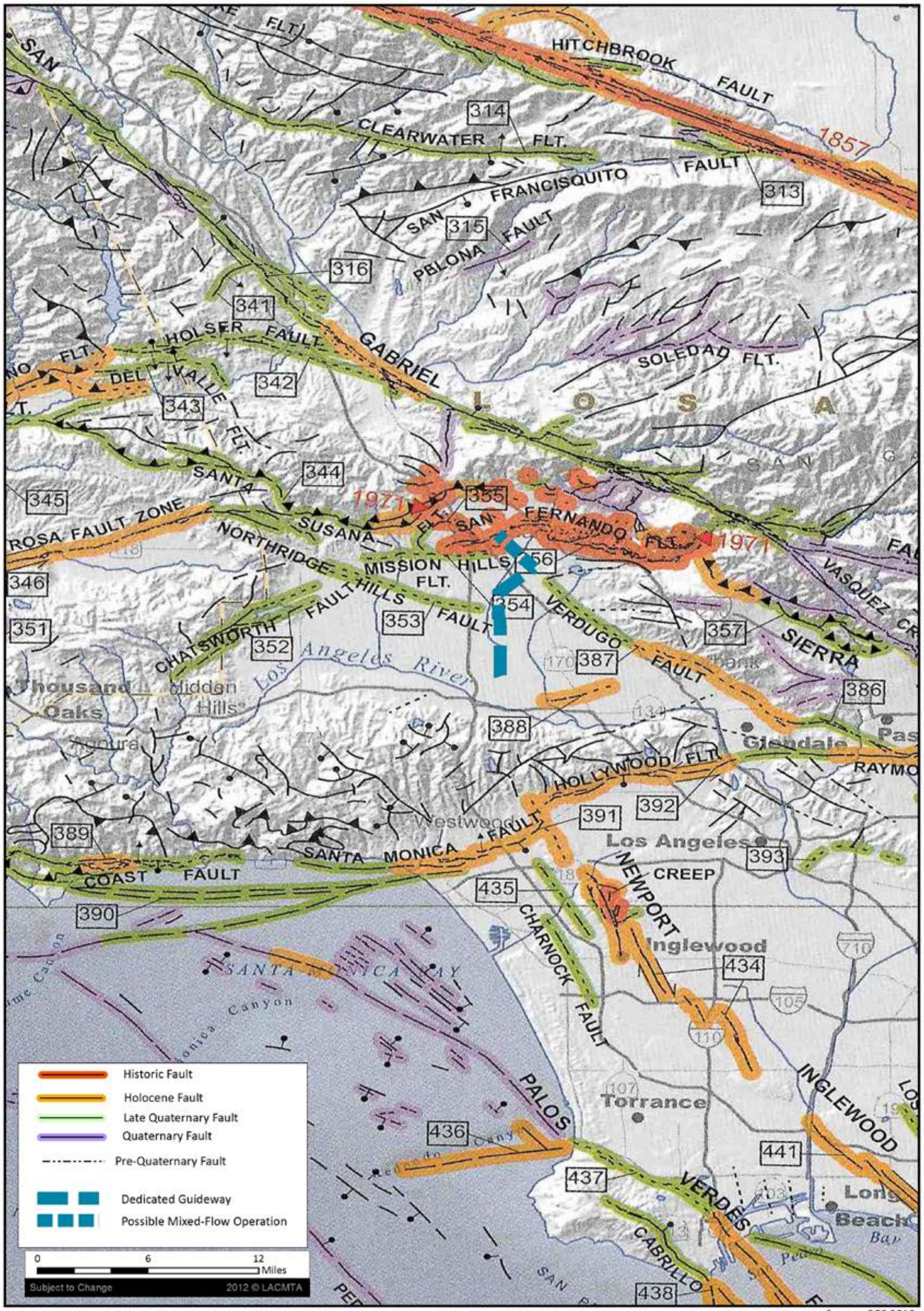
[10] California Geological Survey, 2010, Fault Activity Map of California, Geologic Data Map No. 6, Compilation and Interpretation by Charles W. Jennings and William A. Bryant.

Figure 3-3: Groundwater



Source: CGS 1997, 1998.

Figure 3-4: Fault Map



Source: CGS 2010.

San Fernando Fault: The active Sierra Madre fault zone marks the southern margin of uplift of the western San Gabriel Mountains; the fault within the zone affecting the project area is the north-dipping San Fernando (Figures 3-2 and 3-4). Mapped San Fernando faults are within the APEFZ and the City Fault Rupture Study Area (FRSA) at the intersection of San Fernando Road and Hubbard Street. The San Fernando fault (also divided by some into the San Fernando, Mission Wells, and Reservoir fault segments) ruptured most significantly in the 1971 San Fernando earthquake (see reddish orange areas on Figure 3-4.) Ground rupture occurred approximately 1,000 feet northeast of the above-named intersection. Offsets measure approximately 3 inches of left lateral and 10 inches of vertical displacement. The overall ratio of horizontal to vertical movement across the San Fernando fault zone in the 1971 earthquake (USGS, 1971) was 1.9:1.39 (horizontal:vertical), and the maximum oblique displacement was 7.9 feet. Based on the USGS 1971 report, vertical movement within limited areas appears to have been greater in magnitude for bedrock sites 3.3 feet, less for older alluvium sites (1.6 feet), and substantially less for younger alluvium sites (2+ inches).

Verdugo Fault: The northwest-southeast trending Verdugo fault is the major bounding structure of the eastern San Fernando Valley and is considered active, although not within an APEFZ. Weber et al. (1980)[11] reported possible fault scarps 6 to 10 feet high in Qyf/Qf-age deposits in the Burbank area. Nearer the project area in Sun Valley, Weber et al. (1980) report minor fault offset 130 feet deep in sand and gravel pit deposits.

Yerkes and Campbell (2005)[7] show the buried Verdugo fault trending through the project area at San Fernando Road. The Verdugo fault may turn to the west and merge with the Mission Hills fault (CGS, 2010).[10]

Two cities south of the project area, Burbank and Glendale, address the Verdugo fault in more detail from a planning perspective. The City of Glendale (2003),[12] in their 2003 Safety Element, states "most investigators agree that the Verdugo fault is active and therefore has the potential to generate future surface-rupturing earthquakes," and "geological studies should be conducted for sites within the Verdugo fault hazard management zone if new development or significant redevelopment is proposed." The City of Burbank (1997)[13] indicates that "the fault should be considered active for planning and development purposes, until geologic studies can resolve the issue," and the "proximity of the Verdugo fault to the city of Burbank makes the earthquake scenario on this fault particularly useful for long-range urban planning and worst-case disaster response planning, even though the actual likelihood of an earthquake on this fault is low." Within the project area, the Verdugo fault is less well studied, but at a minimum, data from these two neighboring cities indicate the fault would be considered potentially active.

Northridge Hills Fault: The 2010 State Fault Map (CGS, 2010)[10] shows the eastern end of the Northridge Hills fault stopping just west of the proposed alignment; this fault is not shown by Yerkes and Campbell (2005).[7] Baldwin et al. (2000)[14] performed a paleoseismic evaluation of the Northridge Hills fault nearer the center of the fault's trend in the community of Northridge. They describe the Northridge Hills fault as fault-propagation fold above an underlying blind thrust fault dipping

[11] Weber, F.H., Jr., Bennett, J.H., Chapman, R.H., Chase, G.W., and Saul, R.B., 1980, Earthquake hazards associated with the Verdugo-Eagle Rock and Benedict Canyon fault zones, Los Angeles County, California: Calif. Div. Mines and Geology Open File Report 80-10LA, 18 p.

[12] City of Glendale, 2003, Glendale General Plan Safety Element.

[13] City of Burbank, 1997, Burbank General Plan Safety Element, adopted July 1, 1997.

[14] Baldwin, J. N., K. I. Kelson, and C. E. Randolph, 2000, Late Quaternary Fold Deformation along the Northridge Hills Fault, Northridge, California: Deformation Coincident with Past Northridge Blind-Thrust Earthquakes and Other Nearby Structures?, Bulletin of the Seismological Society of America, 90, 3, pp. 629–642, June 2000.

northward at about 45 degrees based on previous work; the fault is considered potentially active. This means that the fault has not yet broken the ground to the surface, but could cause local uplift, tilting, and ground deformation.

Possible Fault in North Hollywood (Unnamed Fault L 66a): The CSG (2010) shows this fault (labeled 388 on Figure 3-4) projecting from approximately 1/4 mile on the east toward the southern portion of the project area south of US 101. The fullest description of this fault (called unnamed fault L66a by Weber and others, 1980) indicates it is defined on the 1901 and 1928 USGS topographic maps as an elevation change across a possible low, south-facing break in slope in younger Holocene alluvial deposits. This feature is also associated with an area of subsidence north of the Benedict Canyon fault and is suggestive of down-on-the-south movement affecting Holocene deposits. The fault lies outside any city of Los Angeles FRSA.

3.3 Surface Faulting / Ground Rupture Hazard

The anticipated (average) amount of surface fault rupture on any given fault trace for the maximum earthquake can be inferred from measurements of offsets caused by past earthquakes. In general, these estimates range from zero to about 1 foot for magnitudes under M6.0, and from 1 foot to 10 feet or more for magnitudes between M6.0 and 7.5. Many variables affect the amount of surface rupture, including the depth of the earthquake hypocenter where the strain energy is released. Site-specific study is typically conducted to refine such estimates for a fault segment at a given project site.

A portion of the project area on San Fernando Road near the existing Metrolink Sylmar station is within an APEFZ for the San Fernando fault as shown on Figure 3-4. In addition, the Verdugo fault is located within the project area and is considered to have potential ground rupture and differential uplift. The potential for earthquake activity and ground rupture is known for the San Fernando fault and not well understood for the Verdugo fault. The faults discussed in Section 3.2 and shown on Figure 3-4 are considered in the City of Los Angeles Safety Element (1996).[15] The City of Los Angeles Safety Element identifies an FRSA similar to an APEFZ where fault rupture potential is less well known and is less than that required for the APEFZ designation. An FRSA is located along the San Fernando and Verdugo faults that encompass portions of the project area. A fault evaluation is required prior to locating structures in an FRSA. An estimate of the potential range of displacements for the San Fernando and Verdugo faults could be made based on existing information and site-specific analysis. In addition, smaller disruptions from co-seismic uplift, ground tilting, and ground disturbance are possible in the project area, particularly as associated with the projection of the Northridge Hills fault and to a lesser degree of the possible North Hollywood fault into the project area.

3.4 Seismic Ground Motion

The site is located within a seismically active region. The characteristics of nearby known faults are summarized in Table 3-1.

[15] City of Los Angeles, 1996, Safety Element of the Los Angeles City General Plan, Department of City Planning, Los Angeles, California, City Plan Case No. 95-0371, Adopted November 26, 1996.

Table 3-1: Major Fault Characterization in the Project Vicinity

FAULT	APPROXIMATE DISTANCE[1] (miles)	TYPE OF FAULT	MAXIMUM EARTHQUAKE MAGNITUDE[2] (Mw)
Verdugo	3.1	Reverse	6.9
Sierra Madre (San Fernando)	5.0	Reverse	6.7
Sierra Madre Connected	5.0	Reverse	7.3
Northridge	7.2	Thrust	6.9
Santa Susana, alt 1	7.2	Reverse	6.9
Hollywood	9.5	Strike Slip	6.7
Sierra Madre	9.7	Reverse	7.2
San Gabriel	10	Strike Slip	7.3
Santa Monica Connected, alt 1	11	Strike Slip	7.3
Santa Monica, alt 1	11	Strike Slip	6.6
Santa Monica Connected, alt 2	11	Strike Slip	7.4
Elysian Park (Upper)	11	Reverse	6.7
Newport-Inglewood, alt 1	13	Strike Slip	7.2
Newport-Inglewood Connected, alt 1	13	Strike Slip	7.5
Newport-Inglewood Connected, alt 2	13	Strike Slip	7.5

Notes:
1. Distances measured from intersection of Roscoe Boulevard and Van Nuys Boulevard.
2. The maximum earthquake magnitude values are based on the Ellsworth relation.
Source: USGS National Seismic Hazard Maps 2008.

3.5 Liquefaction Potential and Seismic Settlement

Liquefaction occurs when saturated, low relative density, low plastic materials are transformed from a solid to a near-liquid state. This phenomenon occurs when moderate to severe ground shaking causes pore-water pressure to increase. Site susceptibility to liquefaction is a function of the depth, density, soil type, and water content of granular sediments, along with the magnitude and frequency of earthquakes in the surrounding region. Saturated sands, silty sands, and unconsolidated silts within 50 feet of the ground surface are most susceptible to liquefaction. Liquefaction-related phenomena include lateral spreading, ground oscillation, flow failures, loss of bearing strength, subsidence, and buoyancy effects.

The expected level of ground shaking in the project area is high. However, for liquefaction to take place, groundwater must be present. According to CGS historical high groundwater maps, there is shallow groundwater (less than 50 feet bgs) at the southern end of the project alignment from approximately Vanowen Street to the southern limit of the project area and near the northeast end of the project area along Hubbard Street. These portions of the project area are potentially susceptible to liquefaction. A seismic hazard zone map, based on data produced by the CGS, is presented on Figure 3-5.

3.6 Landslide and Slope Instability

The project site is not located within a landslide potential zone designated on a CGS seismic hazard map or areas designated by the City of Los Angeles Hillside Ordinance (City of Los Angeles, 2004). Based on the level topography of the site, the landslide potential at the site is judged to be low.

3.7 Scour Potential

Scour is not a design concern at this time because the drainage channels within the project site are concrete-lined.

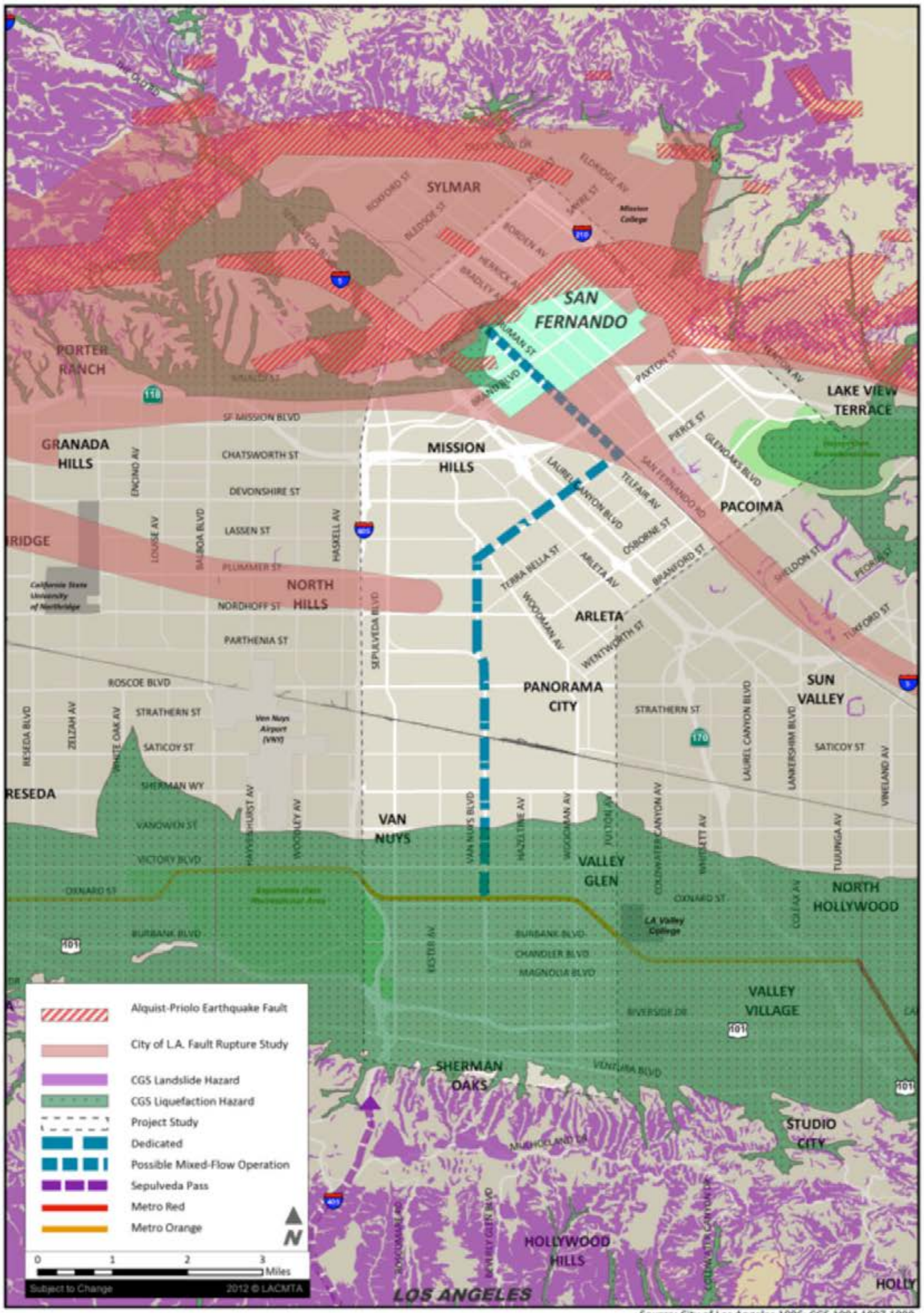
3.8 Corrosion Potential

No corrosion test results from subsurface soils were available for the project site. Sands, silty sands, and silts are expected at the site. Generally, sands and silty sands do not present a corrosive environment. Soil samples should be collected and tested during the design stages to check the potential for corrosion.

3.9 Flooding and Inundation

FEMA's NFIP maps the flooding potential of Los Angeles County and associated areas. Figure 3-6 depicts those flood zones as presented by the City of Los Angeles Safety Element (1996).[15] The project area crosses a 100-year floodplain at the Los Angeles River and a 500-year floodplain at the Pacoima Wash and Pacoima Diversion Channel. The City of Los Angeles Safety Element (1996) also summarizes inundation potential from dam failures and water storage facility failures. These areas are shown on Figure 3-7. The project area is located within a potential inundation zone.

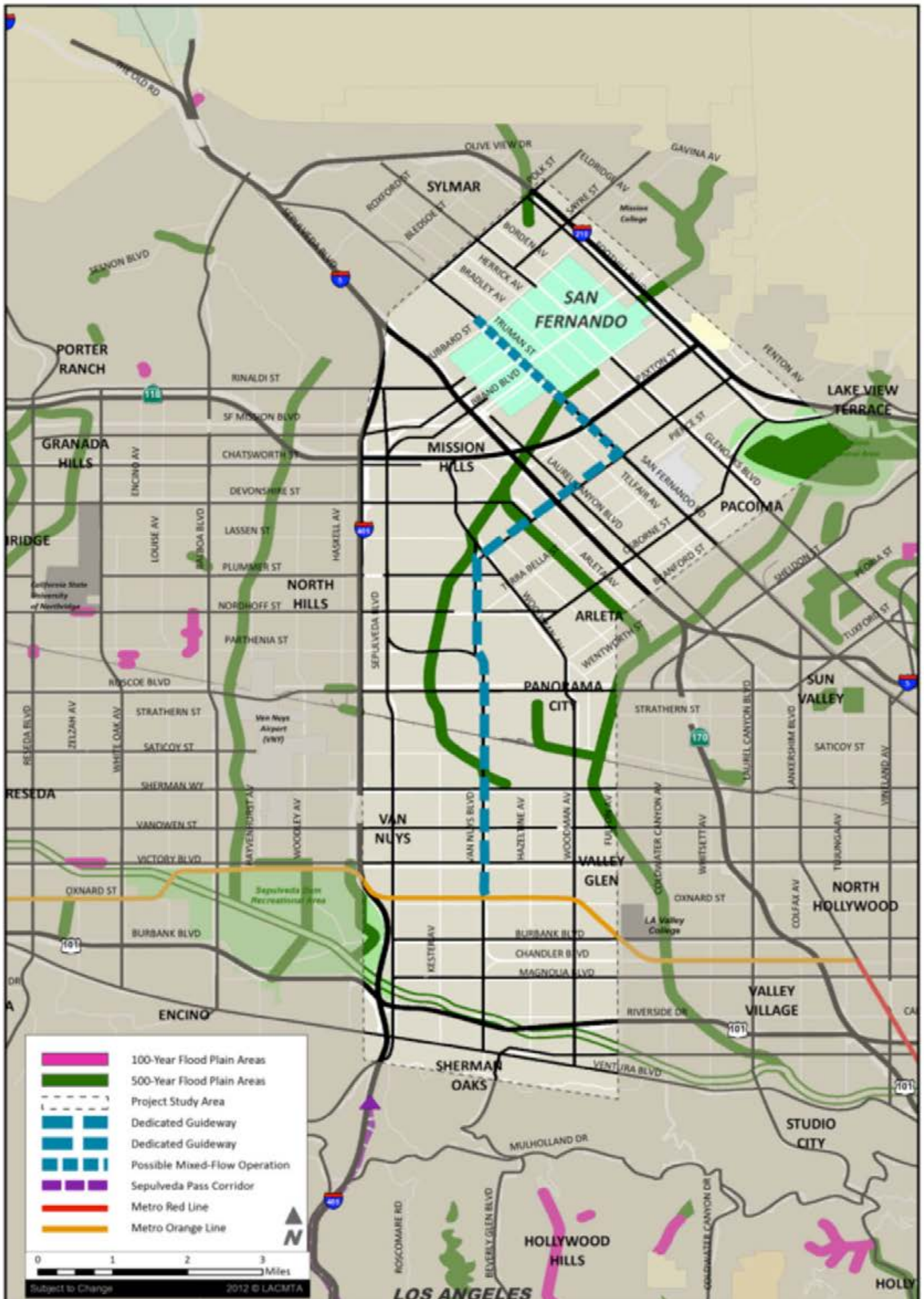
Figure 3-5: Seismic Hazard Zones



Source: City of Los Angeles 1996; CGS 1994,1997,1998.

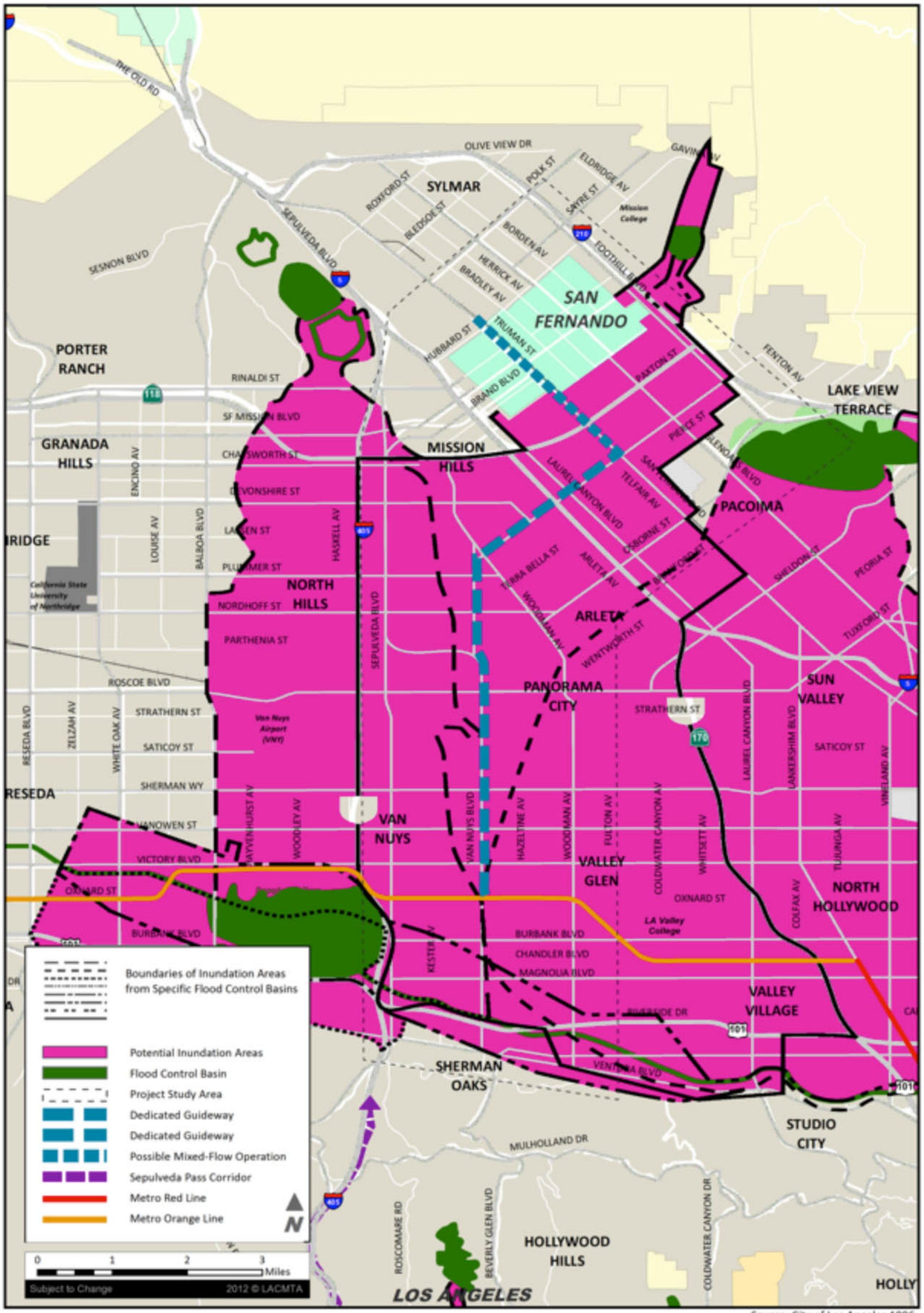
Metro

Figure 3-6: Flood Plain Areas



Source: City of Los Angeles 1996.

Figure 3-7: Inundation Areas



Source: City of Los Angeles 1996.

3.10 Methane

In 2004, the City identified methane gas intrusion into buildings as a potential hazard in some areas of the city and incorporated construction standards to mitigate the potential hazard into the Los Angeles Municipal Code (LAMC). All new buildings and paved areas located in a methane zone or methane buffer zone shall comply with the requirements of the Methane Mitigation Standards established by the Superintendent of Buildings.

The City of Los Angeles Department of Building and Safety (LADBS) has defined the following areas as a Methane Hazard Site because a portion of the parcel is located within a Methane Zone/Methane Buffer Zone.

- Van Nuys Boulevard between Saticoy Street and Sherman Way.
- Van Nuys Boulevard between approximately 500 feet north of Plummer Street to San Fernando Road.
- San Fernando Road between Van Nuys Boulevard and the city of San Fernando eastern city limits.

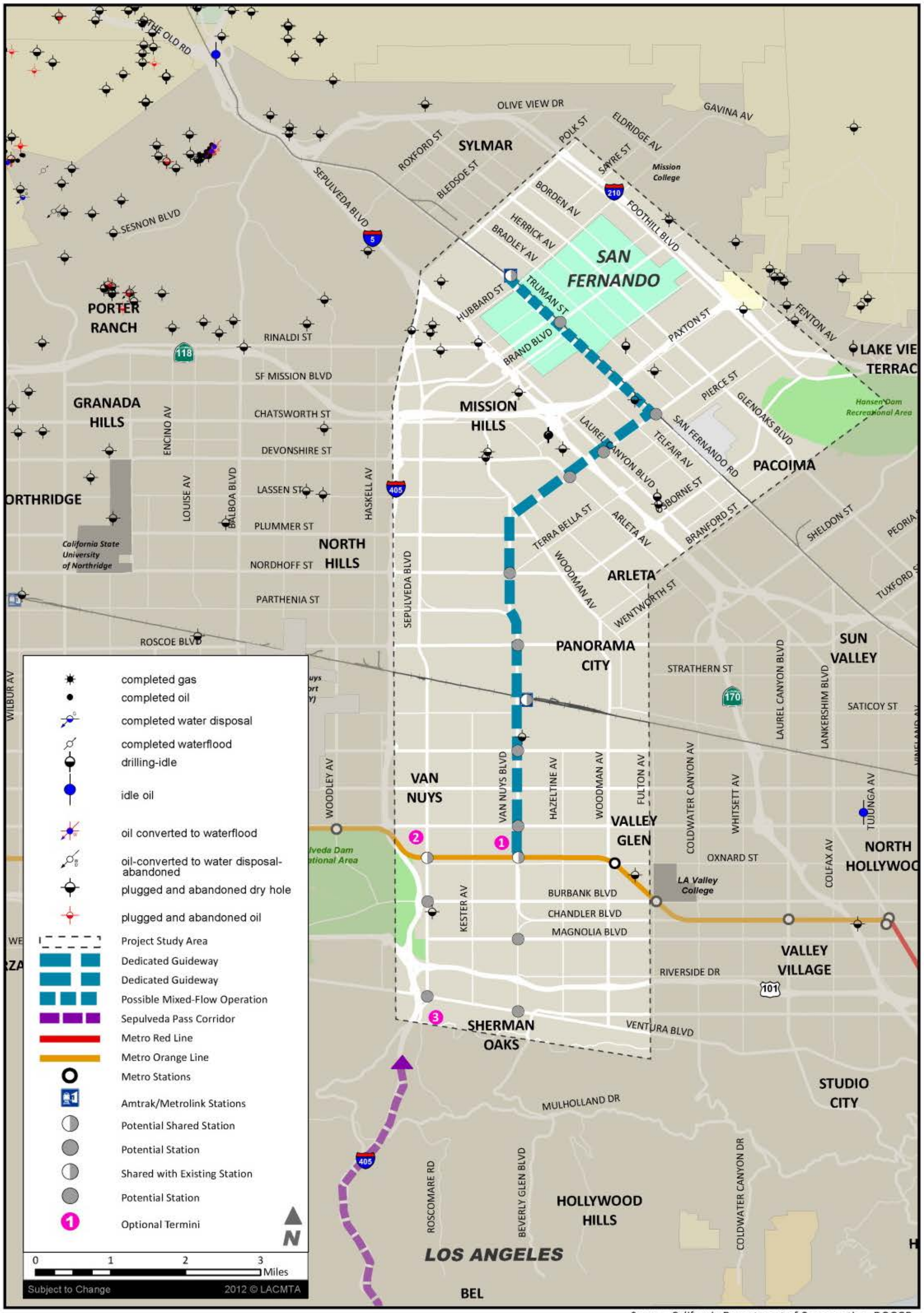
According to the LADBS, " ... if any portion of a parcel fell within the methane impact area or its buffer zone, the entire parcel was subject to investigation." Because the tunnel crosses the Methane zone it is considered a Methane Hazard Site, the LADBS requires a methane subsurface investigation prior to construction.

3.11 Mineral Resources

Although limited oil and gas exploration and pumping from proven reserves have occurred in the areas surrounding the project site, the proposed alignment passes through the Pacoima Oil field (Hesson, 1993). According to the Wildcat Maps and the California Department of Conservation Division of Gas and Geothermal Resources digital wells database, the wells within the project study area and vicinity are idle or abandoned dry wells. The locations of these wells are shown on Figure 3-8.

Abandoned wells and dry holes can represent potential hazards for nearby buildings and occupants. These holes represent potential vertical migration pathways for crude oil, methane, H_2S, and other compounds. The California Department of Conservation/Division of Oil, Gas, and Geothermal Resources (DOGGR) regulates drilling and abandonment of wells and dry holes. DOGGR regulations evolved over time to address problems and hazards identified in older wells. As a result, there are fewer problems associated with recently plugged wells and dry holes. Nevertheless, even when a well is plugged in accordance with DOGGR regulations, leaks can occur later.

Figure 3-8: DOGGR Wells



Source: California Department of Conservation, DOGGR .

Chapter 4
Environmental Consequences/Environmental Impacts

Based on review of available data noted in Section 3, the hazards posed by existing geologic conditions in the project study area were evaluated to determine the proposed alternatives' operational, construction, and cumulative geological hazards impacts.

4.1 Operational Impacts

This impact analysis evaluates the geological conditions and hazards that could affect or be affected by operation of the proposed project alternatives.

4.1.1 No-Build Alternative

Under this alternative, no new project facilities would be constructed; therefore, the No-Build Alternative would not result in any new operational impacts.

4.1.2 TSM Alternative

The TSM Alternative proposes minor improvements to transit service such as increased bus frequencies and bus schedule restructuring and could include minor physical improvements to the roadway network (e.g., signalization improvements) and bus facilities (bus stop amenities/improvements).

The East San Fernando Valley Transit Corridor, like other sites in Southern California, would be subjected to strong ground shaking during a seismic event. Although new structures would be small in scale and limited to bus stop amenities such as new canopies or signage, those improvements could experience strong seismic ground shaking and pose a hazard to bus patrons and passers-by. However, given the small size of the bus stop structures and the fact they would be constructed in accordance with current building codes, the potential risks would be minimal. Operation of this alternative would also not cause or accelerate geologic hazards or increase soil instability because the physical improvements would be minor and constructed on flat terrain in a developed urban area. Potential geological impacts and effects would be less than significant under CEQA and minor adverse under NEPA.

4.1.3 Build Alternative 1 – Curb-Running BRT Alternative

As discussed above and described in further detail in Chapter 3, the East San Fernando Valley Transit Corridor would be subjected to strong ground shaking during a seismic event. As a consequence, structures constructed under the Curb-Running BRT Alternative, which would include new traffic and pedestrian signs and bus stop canopies, could experience strong seismic ground shaking and pose a hazard to riders and passers-by.

On the north end of the alternative alignment, the Sylmar/San Fernando Station is located with an APEFZ as discussed in Section 3.3 and as shown on Figure 3-4. The Curb-Running BRT Alternative would include the following project components subject to faulting on the northern end of the alignment: new paving and rehabilitation or resurfacing of existing pavement along San Fernando Road and new traffic and pedestrian signs.

The portion of the alternative alignment south of Vanowen Street is located in a liquefaction zone, as shown on Figure 3-5 and discussed in Section 3.5. The proposed traffic and pedestrian signs, and bus stop canopies south of Vanowen Street would be subject to liquefaction.

The project site is located outside a landslide hazard zone. No steep slopes were observed within the project area and no significant fill slopes are proposed.

Since, the project would be designed and constructed in compliance with regulatory requirements and current building codes, as discussed in Chapter 1, the operational geological impacts and effects of the Curb-Running BRT Alternative would be less than significant under CEQA and minor adverse under NEPA.

The Curb-Running BRT alignment is not located within a designated 100-year floodplain. The BRT alignment would, however, cross 500-year flood plain areas at three locations as shown on Figure 3-6. The BRT alignment is also located in a dam failure inundation zone as shown on Figure 3-7. Although flooding could cause damage to proposed BRT facilities, the risk of substantial flooding would be low and the proposed project would not cause or exacerbate existing flooding risks. Therefore, the impacts would be less than significant under CEQA and the effects would be minor adverse under NEPA.

4.1.4 Build Alternative 2 – Median-Running BRT Alternative

The Median-Running BRT Alternative would result in operational impacts very similar to those described above for the Curb-Running BRT Alternative. Consequently, the operational geological impacts of this alternative would be less than significant under CEQA and the effects under NEPA would be minor adverse.

4.1.5 Build Alternative 3 – Low-Floor LRT/Tram Alternative

On the north end of the alignment for Low-Floor LRT/Tram Alternative, the proposed pedestrian bridge for the Sylmar/San Fernando Station is located with an APEFZ (see Figure 3-4). In addition, the Pacoima Wash Bridge on San Fernando Road is located in the City of Los Angeles FRSA (see Figure 3-4). If further studies indicate that there is a potential for fault rupture at the proposed Sylmar/San Fernando Station pedestrian crossing and/or the Pacoima Wash Bridge on San Fernando Road, the fault rupture hazards to these project facilities could be significant.

Other project structures along the alignment including the Pacoima Channel Bridge, traffic and pedestrian signs, and train stop canopies would be subject to strong seismic ground shaking and could pose a hazard to riders and passers-by. In addition, the proposed catenary wires, traffic and pedestrian signs, and train stop canopies south of Vanowen Street would be subject to potential liquefaction hazards. The catenary wires will move during a seismic event and the system, like other light rail systems currently operated by Metro, will need to be inspected prior to continuing service.

Since the project would be designed in compliance with current building codes and regulatory requirements as discussed in Chapter 1 to minimize potential geological hazards, the impacts/effects during operation of the Low-Floor LRT/Tram alternative would be less than significant under CEQA and minor adverse under NEPA.

The flooding risks that could affect or be affected by the Low-Floor LRT/Tram Alternative would be similar to those described above for the BRT alternatives.

4.1.6 Build Alternative 4 – LRT Alternative

The operational impacts of the LRT Alternative would be similar to the Low-Floor LRT/Tram Alternative. However, unlike the Low-Floor Tram/LRT Alternative, this alternative would include a tunnel. Because of the presence of alluvial soils, the tunnel segment of the alignment could be susceptible to seismic-induced settlement and ground loss, a potentially significant hazard. Experience in California and worldwide shows that tunnels perform well during earthquake ground shaking, exhibiting no significant damage or collapse.. Since they are embedded in the ground, they move with the ground, and thus, their motion is not magnified by the pendulum effect that occurs when an aboveground structure is shaken by an earthquake. As an example, during the Northridge Earthquake in 1994, Metro's Segment 1 Red Line tunnels received ground motions at the level of the Operating Design Earthquake without damage. Inspection was performed and the system was reopened for service the following day, with greatly increased ridership because highways were closed due to earthquake damage to bridges. Another example is the 1989 Loma Prieta earthquake that shook San Francisco, collapsing key elevated highways but leaving the Bay Area Rapid Transit tunnel system unaffected. Following an inspection of the tunnels, the system was quickly reopened.

The structural elements of Alternative 4 would be designed and constructed to resist or accommodate the appropriate site-specific estimates of ground loads and distortions imposed by the design earthquakes and conform to Metro's Design Standards for the Operating and Maximum Design Earthquakes. The concrete structures would be designed according to the Building Code Requirements for Structural Concrete by the American Concrete Institute (ACI 318).

Metro will implement Standard Operating Procedures in seismic areas to detect earthquakes and will provide back-up power, lighting, and ventilation systems to increase safety during tunnel or station evacuations in the event of loss of power due to an earthquake. For example, seismographs are located in 11 of the existing Metro Red/Purple Line stations to detect ground motions and trigger Standard Operating Procedures (SOP #8 – Earthquakes) by the train operators and controllers. Operating procedures are dependent on the level of earthquake and include stopping or holding trains, gas monitoring, informing passengers, communications with Metro's Central Control, and inspecting for damage. With the incorporation of these techniques and mitigation Measures MM-GEO-3 through MM-GEO-5, ground shaking does not present a significant impact to this alternative, including all stations and station entrances.

Portions of the alternative alignment are located adjacent to a City of Los Angeles Methane Zone. The proposed tunnel could be affected by hazardous subsurface gases in the area adjacent to the city of Los Angeles Methane Zone along Van Nuys Boulevard between Saticoy Street and Sherman Way. Tunnels and stations would be designed to provide a redundant protection system against gas intrusion hazard, such as those described in the City of Los Angeles Municipal Code, Chapter IX, Building Regulations, Article 1, Division 71, Methane Seepage Regulations. In compliance with these regulations, specific requirements are determined according to the actual methane levels and pressures detected on a site, and the identified specific requirements would be incorporated into the design and construction. Therefore, hazardous subsurface gas (methane) impacts would be minimized. The flooding risks that could affect or be affected by the LRT Alternative would be similar to those described above for the other build alternatives. Additionally, portions of the LRT Alternative would be below grade and could be a conduit for the flow of water if precautions are not taken, a potentially significant hazard. However, the portals for stations would be designed to ensure their protection from floodwaters. By complying with Metro's Design Standards, the impacts would be minor adverse under NEPA and less than significant under CEQA.

Because the LRT Alternative would be designed in compliance with current building codes and regulatory requirements, the risks posed by the geological hazards identified above would be reduced and therefore, the resulting impacts would be less than significant under CEQA and minor adverse under NEPA.

4.2 Construction Impacts

4.2.1 No-Build Alternative

The No-Build Alternative would not result in any project-related construction activities along the project alignment. Therefore, there would be no geological construction impacts as a result of the No-Build Alternative.

4.2.2 Transportation Systems Management Alternative

The TSM Alternative would consist of cost efficient service improvements and could include minor physical improvements to the roadway network and to bus stops. Given the very limited amount of construction that could occur under this alternative, geological and flooding hazards in the project area are not likely to affect or be affected by construction activities. Therefore, no or very minor impacts/effects would occur during construction.

4.2.3 Build Alternative 1 – Curb-Running BRT Alternative

The construction of the improvements and potential impacts would be similar to a typical construction project and would include avoiding damage to existing utilities and taking measures to prevent undermining of existing structures and reducing hazards to construction workers. Compliance with best construction practices and adherence to regulatory requirements would reduce potential risks to existing structures, the public, and construction workers. Therefore, the construction impacts/effects under this alternative would be less than significant under CEQA and minor adverse under NEPA.

4.2.4 Build Alternative 2 – Median-Running BRT Alternative

The Median-Running BRT Alternative would result in similar impacts to the Curb-Running BRT Alternative.

4.2.5 Build Alternative 3 – Low-Floor LRT/Tram Alternative

The Low-Floor LRT/Tram alternative would result in similar geological construction impacts to the BRT alternatives.

4.2.6 Build Alternative 4 – LRT Alternative

The LRT Alternative would result in construction impacts similar to the Low-Floor LRT/Tram Alternative and the BRT alternatives. However, under this alternative, the tunneling and deep excavations during construction could cause vertical and lateral movement of the existing soils adjacent to the improvements. Therefore, construction of the LRT Alternative could result in the following potentially significant adverse impacts/effects due to tunneling: ground settlement and differential settlement immediately above the alignment and on adjacent buildings and structures.

The LRT Alternative could also be affected by groundwater hazards during construction. Groundwater levels are shallow at the southern end of the LRT Alternative alignment near the Los Angeles River and become deeper at the northern end of the project area. The historically high groundwater levels are shown on Figure 3-3. The southern end of the proposed tunnel structure would potentially be located below historical high groundwater levels, and groundwater may be encountered during construction of the tunnel, a potentially significant hazard.

The LRT Alternative would be designed and constructed in compliance with current building codes and regulatory requirements, as discussed in Section Chapter 1, which would reduce the potential risks posed by the hazards above. Additionally, the potential for settlement during construction of the LRT tunnel, which could be a significant hazard, would be further reduced as a result of implementation of the design measures described in Chapter 5.

4.2.7 Cumulative Impacts

In general, geologic hazards are site specific and consequently, it’s unlikely that related and proposed projects would contribute to cumulative geological hazards impacts. One exception would be when subsurface excavations result in ground and differential settlement that could affect adjacent properties. If other nearby projects would also include excavation activities that could result in the potential settlement of soils, then the proposed and nearby projects could result in adverse cumulative settlement impacts on nearby properties. Since the LRT Alternative is the only build alternative that could result in substantial settlement impacts, the study area for cumulative geological hazards due to the LRT Alternative is limited to those properties adjacent to the tunnel portion of the LRT alignment. Although the project and cumulative impacts could be significant, compliance with the design and mitigation measures described in Chapter 5 above would reduce the project and cumulative impacts to a less-than-significant level.

Chapter 5
Mitigation Measures

5.1 Compliance Requirements and Design Features

There are no substantial geologic hazard impacts that could not be fully addressed by design requirements.

A geotechnical investigation would be performed during design for above-grade or below-grade transit structures, stations, and the maintenance yard for the preferred alternative. The geotechnical investigation will provide site specific data for design of the proposed improvement and for evaluating the threshold of movement allowed for existing structures within the influence zone of the project improvements during construction or operations.

Design features to address identified geotechnical hazards will be confirmed as the project progresses into advanced design. Some of these design features may be applicable to each build alternative. Provided below is a summary of the design features to reduce impacts for the selected alternative.

5.1.1 BRT Alternatives

For lightly loaded structures such as bus stops, canopies, and walls, geotechnical and/or structural methods to mitigate the effects of liquefaction on the foundations during final design would be implemented. The geotechnical mitigation methods may range from recompacting the upper material to providing a mechanically stabilized earth (MSE) foundation system. The design features may range from planning for repairs/maintenance after a seismic event to supporting the improvements on a mat foundation or interconnected beam foundations to tolerate the anticipated seismic settlement.

Fill soils will be overexcavated and replaced with engineered fill. Deeper foundations could be designed for station platforms and canopies located in areas of fill or areas mapped as liquefaction areas, as needed.

5.1.2 Low-Floor LRT/Tram Alternative

A geological study would be performed during the final design of any proposed grade separation structures located within the fault study area shown on Figure 3-5. If a fault is present, the potential horizontal and vertical movement of the fault would be developed so the foundation and the structure can be designed appropriately. The results of the geological studies will be incorporated in the final design of the proposed grade separation structures.

5.1.3 Light Rail Transit Alternative

The type of tunneling equipment will take into account the alluvial conditions and have systems in place to reduce the potential for settlement. Earth Pressure Balance or Slurry Tunnel Boring machines may be required to minimize ground loss. Grouting along the alignment would be performed where potential excess settlement could occur during construction of the tunnel and when beneath or adjacent to settlement-sensitive structures.

The southern end of the proposed tunnel structure would potentially be located below historically high groundwater levels. The tunnel would be designed and constructed with waterproofing and to resist uplift in case the groundwater increases to historical levels in the future.

5.2 Mitigation Measures

The following measures are proposed to further reduce and minimize potential geologic hazards and impacts during project operation of the rail alternatives (Build Alternatives 3 and 4).

MM-GEO-1: The rail alternatives shall be designed to incorporate systems that can control or shut down operations in response to an earthquake to reduce seismic hazards to transit patrons and workers.

MM-GEO-2: Emergency measures shall be developed and in place prior to project operations to protect people and reduce the potential of damage to the rail system in the event of a 500-year event or inundation from a dam failure. In addition to the design features described above, the following measures are proposed to further reduce potential geologic hazards during construction of the rail alternatives.

GEO-3: Prior to construction, a detailed survey of existing structures adjacent to the tunnel alignment (Build Alternative 4) shall be performed to document existing conditions (baseline survey). In addition, geotechnical instruments for measuring vertical, lateral, and angular movement should be installed before construction and a plan developed for frequency of measurements and appropriate measures to be taken if the measurements are outside acceptable thresholds.

GEO-4: Preventative measures to protect existing structures shall be taken prior to construction, including underpinning of existing structures and ground improvement, if needed.

GEO-5: Grouting or other types of ground improvement shall be performed to fill voids and replace soils displaced because of settlement during tunnel excavation.

Chapter 6
Impacts Remaining After Mitigation

The impacts after implementation of the design features and mitigation measures described in Chapter 5 would be mitigated or reduced to a less-than-significant level.

Chapter 7
CEQA Determination

The thresholds for determining the significance of impacts related to geotechnical, subsurface, and seismic hazards and associated with hazardous materials are identified in Section 3.2. There are not specific thresholds for these subject areas identified under NEPA.

7.1 No-Build Alternative

The No Build Alternative would result in no impacts.

7.2 TSM Alternative

The TSM Alternative would result in less-than-significant geologic impacts.

7.3 BRT Alternatives

The BRT alternatives will be designed in compliance with regulatory requirements, as discussed in Chapter 1. Consequently, the geologic impacts would be less than significant.

7.4 Low-Floor LRT/Tram Alternative

The proposed Low-Floor LRT/Tram Alternative would traverse an APEFZ and a City of Los Angeles FRSA, as well as a potential liquefaction zone. Throughout all of Southern California, there are risks associated with the activity of regional faults. The Low-Floor LRT/Tram Alternative will be designed in compliance with regulatory requirements, as discussed in Chapter 1, and consequently the impacts would be less than significant.

7.5 LRT Alternative

The LRT Alternative would result in operational impacts similar to the Low-Floor LRT/Tram Alternative. In addition, measures to mitigation the potential geologic hazards that could affect construction of the tunnel portion of the LRT Alternative will be required as needed to limit ground loss during construction to avoid exceeding the threshold limit for adjacent structures.

The LRT Alternative will be designed in compliance with regulatory requirements, as discussed in Chapter 1. Settlement during construction of the LRT Alternative tunnel could be a significant hazard, but would be reduced to less than significant with compliance with the requirements and design features described in Chapter 5.

Chapter 8
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