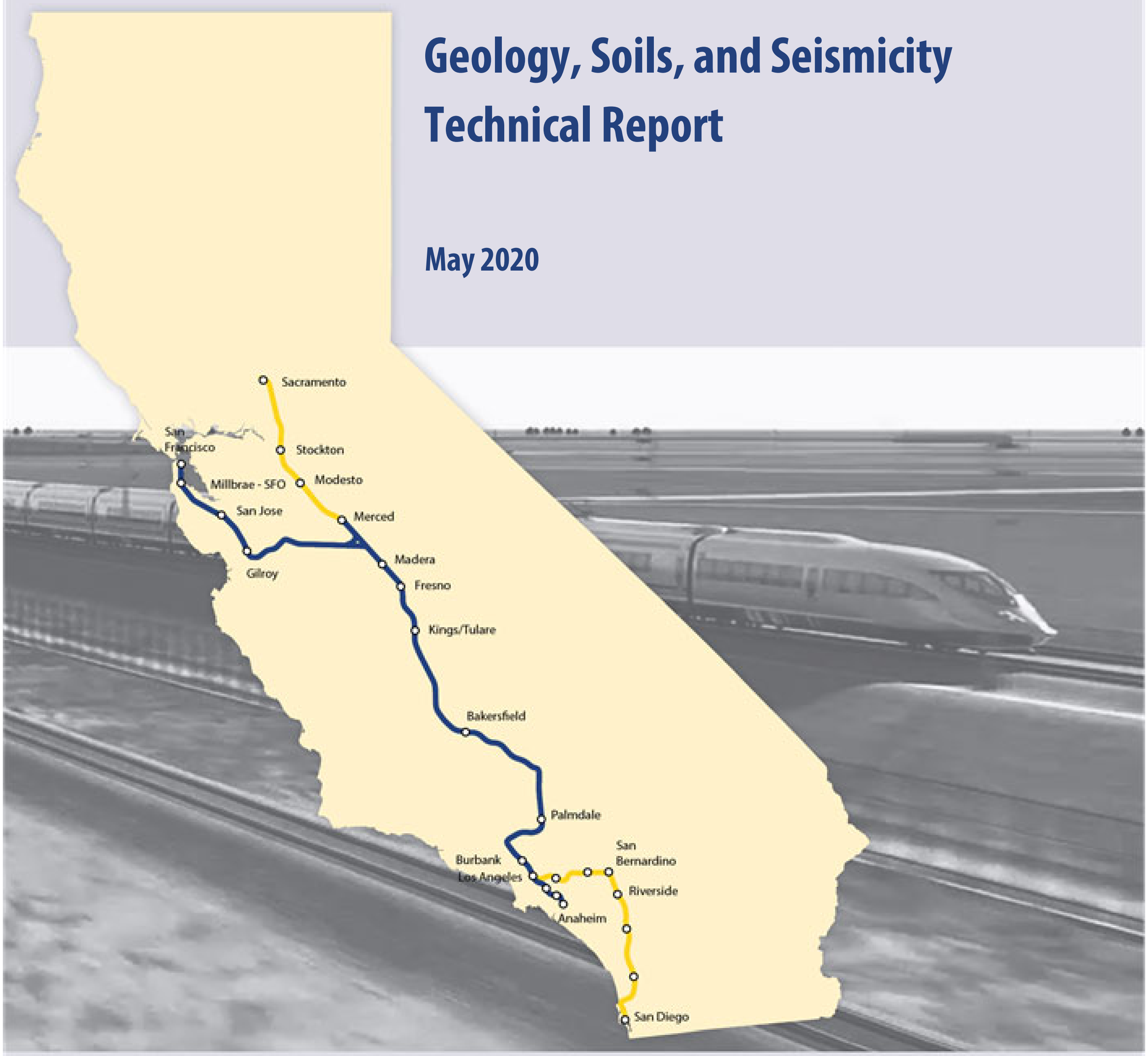
California High-Speed Rail Authority

Burbank to Los Angeles Project Section

Geology, Soils, and Seismicity Technical Report

May 2020



CALIFORNIA
High-Speed Rail Authority

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being or have been carried out by the State of California pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated July 23, 2019, and executed by the Federal Railroad Administration and the State of California.

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ACRONYMS AND ABBREVIATIONS

Amtrak	National Railroad Passenger Corporation
AP Act	Alquist-Priolo Earthquake Fault Zoning Act
AASHTO	American Association of State Highway and Transportation Officials
Authority	California High-Speed Rail Authority
BMP	best management practice
Caltrans	California Department of Transportation
CBC	California Building Standards Code
CEQA	California Environmental Quality Act
CGS	California Geological Survey
CMF	Metrolink Central Maintenance Facility
CMP	construction management plan
DOGGR	Division of Oil Gas and Geothermal Resources
DOC	California Department of Conservation
EIR	environmental impact report
EIS	environmental impact statement
FRA	Federal Railroad Administration
HMF	heavy maintenance facility
HSR	high-speed rail
I	Interstate
IAMF	Impact Avoidance and Minimization Feature
LAUS	Los Angeles Union Station
Link US	Link Union Station (Metro project)
LMF	Light maintenance facility
LOSSAN	Los Angeles-San Diego-San Luis Obispo (train corridor)
Metro	Los Angeles County Metropolitan Transportation Authority
MOIF	Maintenance of Infrastructure Facility
MOIS	Maintenance of Infrastructure Siding
MRZ	Mineral Resource Zone
MSL	mean sea level
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
OCS	overhead contact system
PGA	peak ground acceleration
PTC	positive train control
RSA	resource study area

SAA	Supplemental Alternatives Analysis
SCRRA	Southern California Regional Rail Authority
SR	State Route
SWPPP	Stormwater Pollution Prevention Plan
TPSS	Traction Power Substation
UPRR	Union Pacific Railroad
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

EXECUTIVE SUMMARY

The California High-Speed Rail Authority (Authority) proposes to construct, operate, and maintain an electric-powered high-speed rail (HSR) system in California. When completed, it will run from San Francisco to Los Angeles in under three hours, at speeds in excess of 200 miles per hour. The system will eventually extend to Sacramento and San Diego, with 800 miles of track and up to 24 stations.

The Burbank to Los Angeles Project Section of the HSR system is approximately 14 miles long and would be located within the cities of Burbank, Glendale, and Los Angeles on an existing freight and passenger railroad corridor. The project would be located within a narrow and constrained urban environment, crossing major streets and highways, and portions would run adjacent to the Los Angeles River. The Burbank to Los Angeles Project Section would include HSR stations in the vicinity of Hollywood Burbank Airport (City of Burbank) and at Los Angeles Union Station. The HSR alignment would be entirely grade-separated, meaning that crossings for roads, railroads, and other transport facilities would be located at different heights (overcrossings or undercrossings) so the HSR Project would not interrupt nor interface with other modes of transport, including vehicle, bicycle, and pedestrian.

The Authority and the Federal Railroad Administration (FRA) have prepared program-wide, Tier 1 environmental documents for the HSR system under the California Environmental Quality Act and the National Environmental Policy Act. Specifically, the Authority and the FRA prepared the *Statewide Program Environmental Impact Report/Environmental Impact Statement (EIR/EIS*; Authority and FRA 2005) to evaluate the ability of the HSR system to meet existing and future demands on the capacity of California's intercity transportation system. The Authority is now undertaking Tier 2 project environmental evaluations for individual sections of the statewide system. This technical report evaluates project impacts to geologic, soil, and seismic hazards and resources for the Burbank to Los Angeles Project Section, and the information contained herein will be included in the Burbank to Los Angeles Project Section EIR/EIS.

Section 3 summarizes key federal, state, and local jurisdictional laws and regulations that pertain to geology, soils, and seismicity that are most relevant to the project section. Section 4 summarizes the resource study area (RSA) and the methodologies used for assessing the geology, soils, and seismicity. The geologic materials, faults, seismic characteristics, and other subsurface conditions of the RSA are summarized in Section 5. The effects analysis is summarized in Section 6 and includes evaluation for fault rupture, seismic ground shaking and secondary seismic effects, poor soil conditions, and mineral resources. Potential effects include the potential for fault rupture at the Hollywood-Raymond fault zone and seismically induced liquefaction potential and lateral spreading at several proposed grade crossings.

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1 INTRODUCTION

1.1 California High-Speed Rail System Background

The California High-Speed Rail Authority (Authority) is responsible for planning, designing, building, and operating the first high-speed passenger rail service in the nation. The California High-Speed Rail (HSR) System will connect the mega-regions of the state, contribute to economic development and a cleaner environment, create jobs, and preserve agricultural and protected lands. When it is completed, it will run from San Francisco to the Los Angeles basin in less than 3 hours at speeds capable of exceeding 200 miles per hour. The system will eventually extend to Sacramento and San Diego, totaling 800 miles with up to 24 stations, as shown on Figure 1-1.[1] In addition, the Authority is working with regional partners to implement a statewide rail modernization plan that will invest billions of dollars in local and regional rail lines to meet the state's 21st century transportation needs.

The California HSR System is planned to be implemented in two phases. Phase 1 would connect San Francisco to Los Angeles and Anaheim via the Pacheco Pass and the Central Valley.[2] Phase 2 would connect the Central Valley to Sacramento, and another extension is planned from Los Angeles to San Diego. The California HSR System would meet the requirements of Proposition 1A,[3] including the requirement for a maximum nonstop service travel time between San Francisco and Los Angeles of two hours and 40 minutes.

1.2 Burbank to Los Angeles Project Section Background

The Burbank to Los Angeles Project Section would be a critical link in Phase 1 of the California HSR System connecting the San Francisco Bay Area to the Los Angeles Basin. The Authority and the Federal Railroad Administration (FRA) selected the existing railroad right-of-way as the corridor for the preferred alternative between Sylmar and Los Angeles Union Station (LAUS) in the 2005 *Statewide Program Environmental Impact Report/Environmental Impact Statement* (EIR/EIS) (Authority and FRA 2005). The Sylmar to Los Angeles railroad corridor includes Burbank, which is southeast of Sylmar. Therefore, the Project EIR/EIS for the Burbank to Los Angeles Project Section focuses on alignment alternatives along the existing Sylmar to Los Angeles railroad corridor.

The Burbank to Los Angeles Project Section was initially considered as part of the Palmdale to Los Angeles Project Section. The Authority and the FRA announced their intention to prepare a joint EIR/EIS for the Palmdale to Los Angeles Project Section in March 2007. On March 12, 2007, the Authority released a Notice of Preparation, and the FRA published a Notice of Intent on March 15, 2007. Over the next several years, the Authority and FRA conducted scoping and prepared alternatives analysis documents for that section. The 2010 Palmdale to Los Angeles Preliminary Alternatives Analysis (Authority 2010a) recommended alignment alternatives and station options for the Palmdale to Los Angeles Project Section based on the program-level corridor selected in 2005. The 2011 Palmdale to Los Angeles Supplemental Alternatives Analysis (SAA) (Authority 2011a) focused specifically on the subsections from the community of Sylmar to LAUS and reevaluated the alternatives and station options. In June 2014, the Authority published a Palmdale to Los Angeles SAA Report, which introduced the concept of splitting the Palmdale to Los Angeles Project Section into two sections (Authority 2014). On July 24, 2014, the Authority released a Notice of Preparation and the FRA published a Notice of Intent to prepare EIR/EIS documents for the Palmdale to Burbank and Burbank to Los Angeles project sections.

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[1] The alignments on Figure 1-1 are based on Authority/FRA decisions made in the 2005, 2008, and 2012 Programmatic EIR/EIS documents.

[2] Phase 1 may be constructed in smaller operational segments, depending on available funds.

[3] http://www.catc.ca.gov/programs/hsptbp.htm.

Source: California High-Speed Rail Authority and Federal Railroad Administration, 2017

Figure 1-1 California High-Speed Rail System

One of the main reasons for the project section split was the Initial Operating Section[4] concept and its interim terminus in the San Fernando Valley, which was discussed in the Authority's 2012 and 2014 Business Plans. Additionally, the Authority and FRA determined that separate environmental documents would be more beneficial to address environmental impacts and conduct stakeholder outreach. The key environmental resources likely to be impacted were different between the two sections, and separate environmental documents better supported project phasing and sequencing.

In April 2016, the Authority released the Burbank to Los Angeles SAA, which refined the previously studied alignments. Additionally, the Authority released the 2016 Palmdale to Burbank SAA, which refined the concepts at the Burbank Airport Station and the alignments from south of the Burbank Airport Station to Alameda Avenue in the city of Burbank. The 2016 Burbank to Los Angeles SAA Report (Authority 2016a) proposed to evaluate one build alternative south of Alameda Avenue to LAUS. The subsection between the Burbank Airport Station and Alameda Avenue was studied in the 2016 Palmdale to Burbank SAA (Authority 2016b), which proposed two station options and two alignment options. Table 1-1 summarizes the conclusions of the two SAA reports.

Table 1-1 2016 Supplemental Alternatives Analysis Recommendations for the Burbank to Los Angeles Project Section

Alternative	Alignment/ Station	Area/Station	Alignment/Station Type
No Project Alternative			
HSR Build Alternative	Alignments	Burbank Airport Station to Alameda Avenue	Alignment Option A (Surface) Alignment Option B (Below-Grade and Surface)
		Alameda Avenue to LAUS	Surface Alignment
	Stations	Burbank Airport Station	Station Option A (Surface) Station Option B (Below-Grade)
		LAUS	Surface Station Option

Sources: California High-Speed Rail Authority 2016a, 2016b
HSR = high-speed rail
LAUS = Los Angeles Union Station

Since the release of the two SAA documents in 2016, the design has undergone further refinements. The surface options from Burbank Airport to Alameda Avenue (Alignment Option A and Station Option A) have been eliminated from consideration. The below-grade options (Alignment Option B and Station Option B) have been refined in order to minimize potential environmental effects and reduce cost. Therefore, this environmental document evaluates one build alternative for the project section.

FRA requires logical termini for project level analysis. The Authority has determined that logical termini are defined by stations, with Burbank Airport Station as the northern terminus and LAUS as the southern terminus for the Burbank to Los Angeles Project Section. These two stations are also termini for the Palmdale to Burbank and Los Angeles to Anaheim Project Sections. The analysis for the Burbank Airport Station is consistent with what is included in the Palmdale to Burbank EIR/EIS. Similarly, the analysis for LAUS is consistent with what is included in the Los Angeles to Anaheim EIR/EIS.

[4] The Initial Operating Section was the first segment planned for construction and operations, as outlined in the 2014 Business Plan. The segment permitted operation of HSR service from Merced to the San Fernando Valley. The 2016 Business Plan revised the initial segment termini to the Central Valley and Silicon Valley.

1.3 Project Description Purpose

This project description describes the project for use during environmental impact analyses to complete technical reports to inform the Burbank to Los Angeles Project Section EIR/EIS. The basis of this project description is the HSR Build Alternative as defined in the *Burbank to Los Angeles Project Section Draft Preliminary Engineering for Project Definition* document (Authority 2018). This project description describes the physical design elements of the project and does not define all operating plans and scenarios, construction plans, or capital and operating costs. This project description will serve as the basis for Chapter 2, Alternatives, of the project EIR/EIS. Chapter 2 of the EIR/EIS will include additional detail beyond the content of this report.

This report documents the detailed geology, soils, and seismicity analyses conducted for the Burbank to Los Angeles Project Section of the California HSR System and includes the following:

- A brief description of the project and the alternatives under study
- A discussion of pertinent statutes and regulations
- A description of the existing environmental resource conditions in the study area
- A description of the analytical methodologies and assumptions used for this study
- The results of these analyses, including effects or benefits resulting from the project

2 PROJECT DESCRIPTION

The Burbank to Los Angeles Project Section of the California HSR System is approximately 14 miles long, crossing the cities of Burbank, Glendale, and Los Angeles on an existing railroad corridor. HSR for this project section would be within a narrow and constrained urban environment, crossing major streets and highways and, in some portions, adjacent to the Los Angeles River. The Los Angeles County Metropolitan Transportation Authority (Metro) owns the railroad right-of-way, the Southern California Regional Rail Authority owns the track and operates the Metrolink commuter rail service, the National Railroad Passenger Corporation (Amtrak) provides intercity passenger service, and the Union Pacific Railroad (UPRR) holds track access rights and operates freight trains.

This section describes the No Project Alternative and the HSR Build Alternative to be evaluated in the Burbank to Los Angeles Project EIR/EIS.

2.1 No Project Alternative

Under the No Project Alternative, the California HSR System would not be built. The No Project Alternative represents the condition of the Burbank to Los Angeles Project Section as it existed in 2015, and as it would exist without the HSR System at the horizon year (2040).

The No Project Alternative assumes that all currently known programmed and funded improvements to the intercity transportation system (highway, transit, and rail) and reasonably foreseeable local land development projects (with funding sources identified) would be developed by 2040. The No Project Alternative is based on a review of the following: regional transportation plans for all modes of travel; the State Transportation Improvement Program; the Federal Transportation Improvement Program; Southern California Regional Rail Authority strategic plans, transportation plans and programs for Los Angeles County; airport master plans; and city and county general plans.

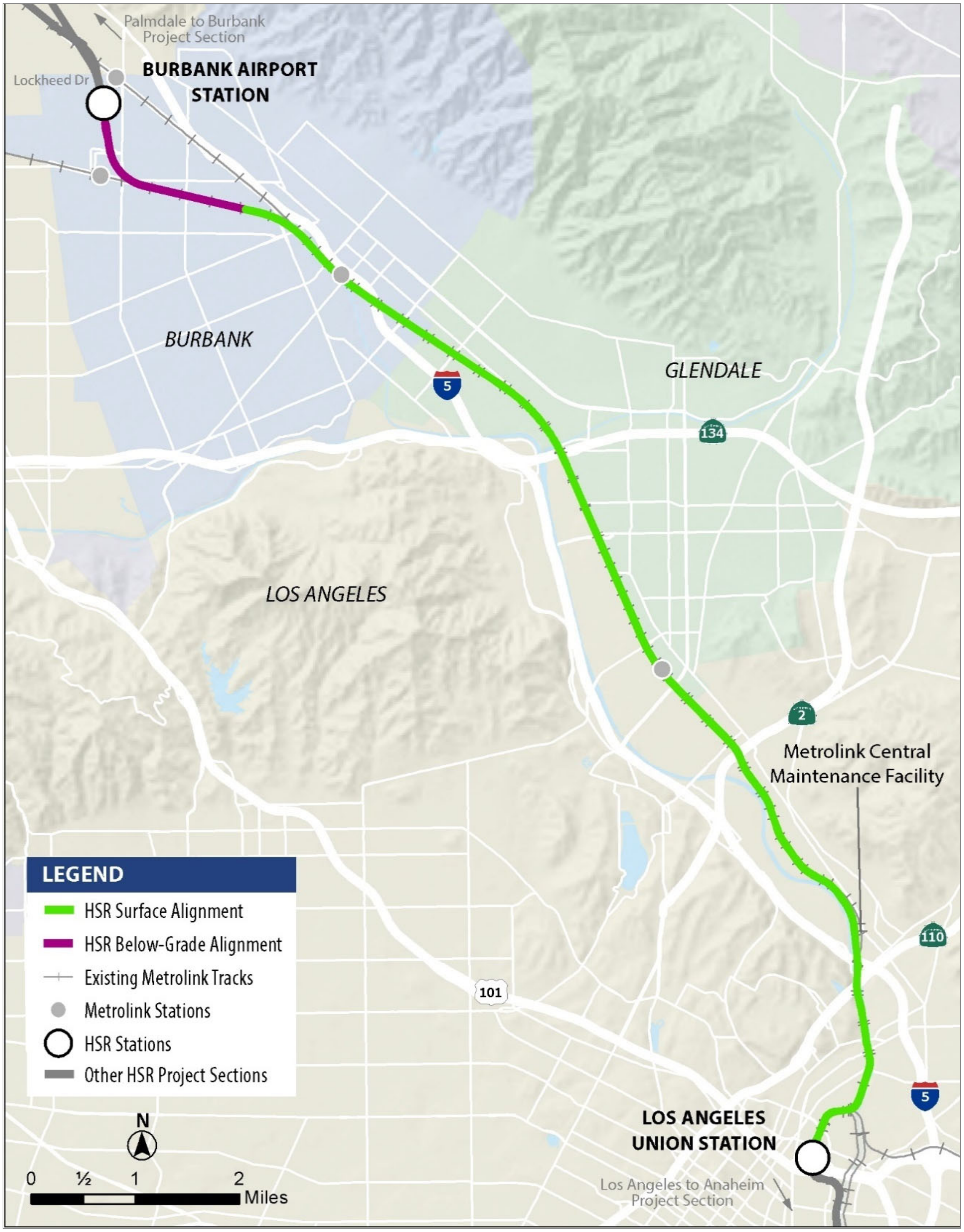
2.2 High-Speed Rail Build Alternative

The HSR Build Alternative includes new and upgraded track, maintenance facilities, grade separations, drainage improvements, communications towers, security fencing, passenger train stations, and other necessary facilities to introduce HSR service into the Los Angeles-San Diego-San Luis Obispo (LOSSAN) Corridor from near Hollywood Burbank Airport to LAUS. In portions of the alignment, new and upgraded tracks would allow other passenger trains to share tracks with the HSR system. HSR stations would be located near Hollywood Burbank Airport and at LAUS. The alignment would be entirely grade-separated at crossings, meaning that roads, railroads, and other transport facilities would be at different heights so the HSR system would not interrupt or interface with other modes of transportation, including vehicle, bicycle, and pedestrian.

For most of the project section, the HSR alignment would be within the existing railroad right-of-way, which is typically 70 to 100 feet wide. The HSR alignment includes northbound and southbound electrified tracks for high-speed trains. The right-of-way would be fenced to prohibit pedestrian and public or unauthorized vehicle access.

The project footprint (the area required to build, operate, and maintain HSR service) is based on the following elements of design: station areas, hydrology, track, roadway, structures, systems, and utilities.

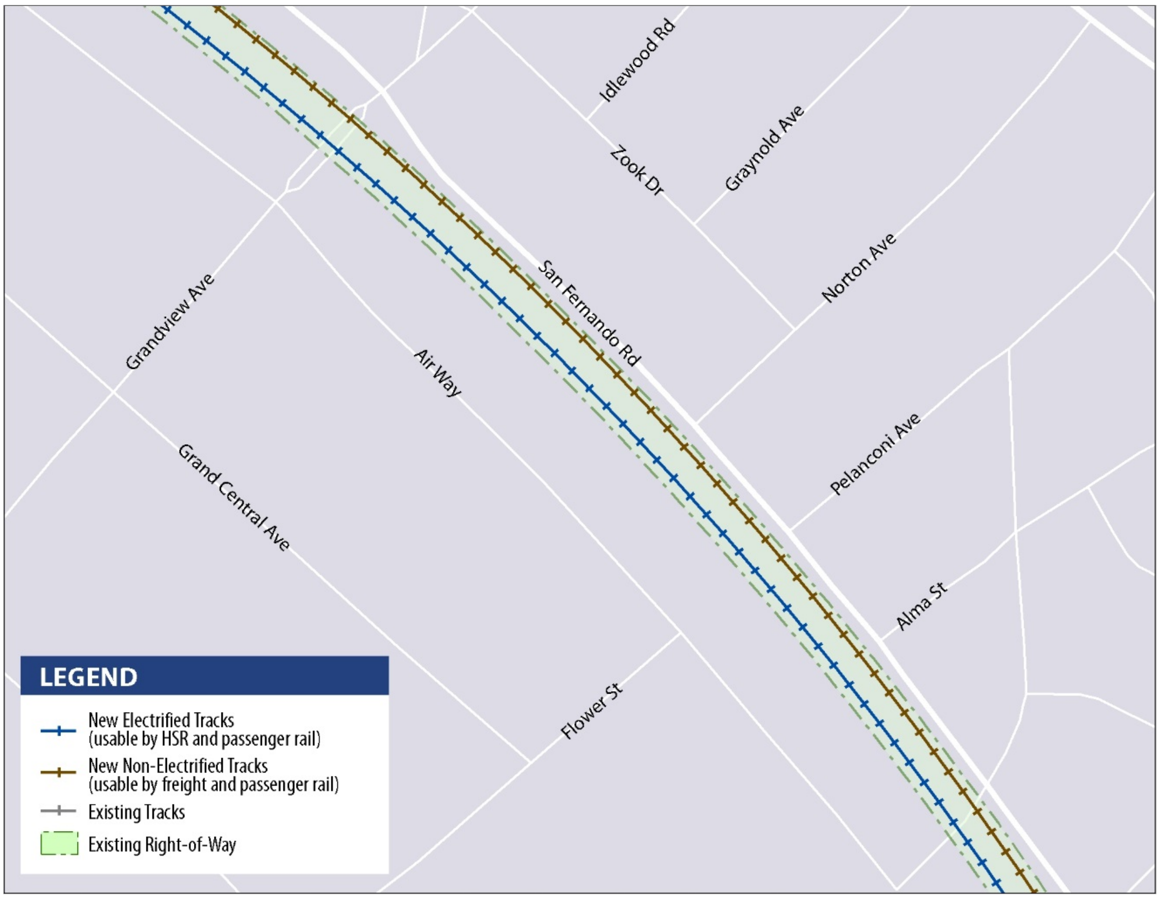
Figure 2-1 shows an overview of the Burbank to Los Angeles Project Section.



Source: California High-Speed Rail Authority, 2019

Figure 2-1 Overview of Burbank to Los Angeles Project Section

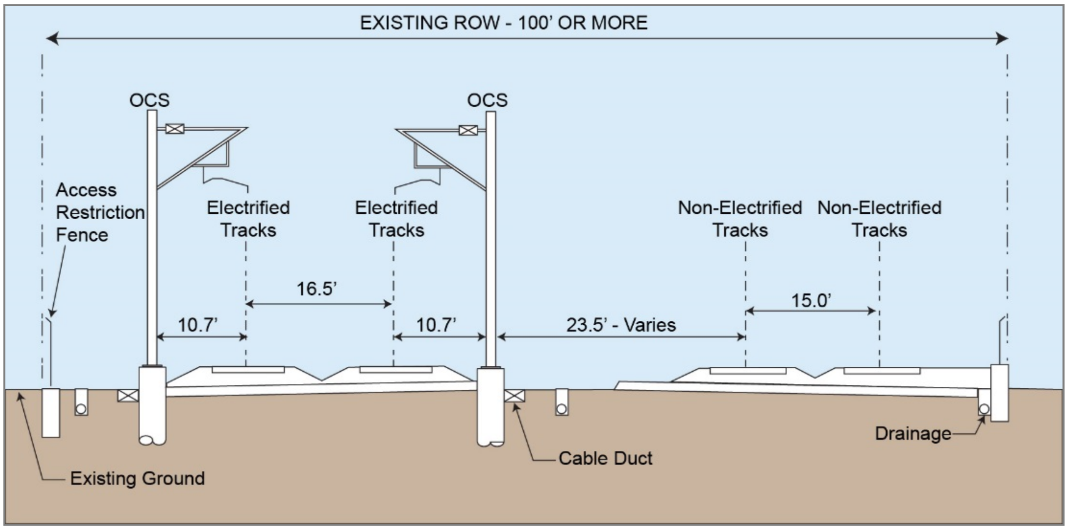
The Burbank to Los Angeles Project Section includes a combination of at-grade, below-grade, and retained-fill track, depending on corridor and design constraints. The at-grade and retained-fill portions of the alignment would be designed with structural flexibility to accommodate shared operations with other passenger rail operators. Throughout most of the project section (between Alameda Avenue and State Route [SR] 110), two new electrified tracks would be placed along the west side of the existing railroad right-of-way and would be useable for HSR and other passenger rail operators. The existing non-electrified tracks would be realigned closer to the east side of the existing right-of-way, for a total of four tracks; these realigned, non-electrified tracks would be usable for freight and other passenger rail operators, but not for HSR. Figure 2-2**Error! Reference source not found.** illustrates the placement of the new electrified tracks and realigned, non-electrified tracks relative to the existing tracks.



Source: California High-Speed Rail Authority, 2019

Figure 2-2 New Electrified and Non-Electrified Tracks within Existing Right-of-Way

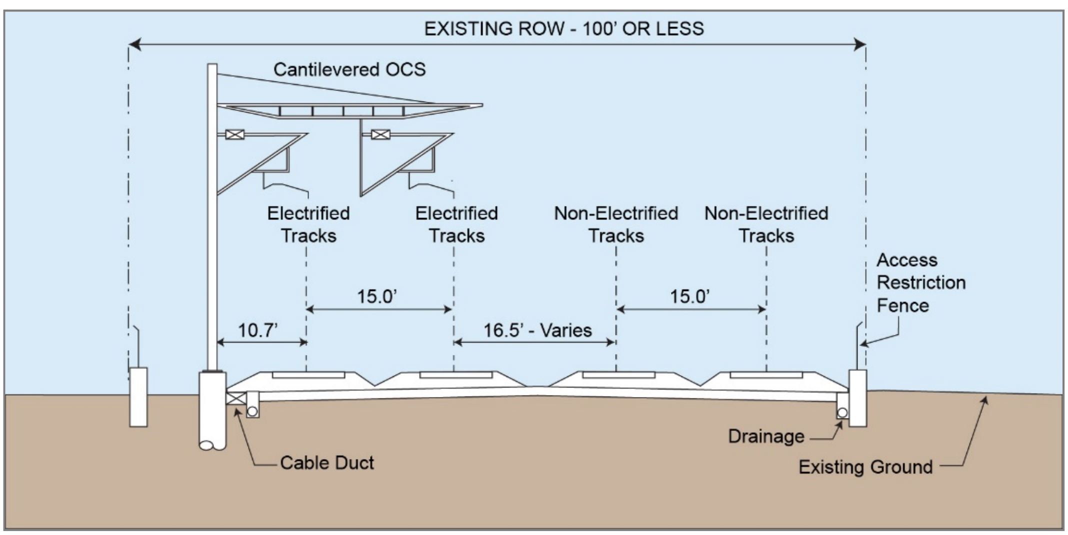
Throughout most of the Burbank to Los Angeles Project Section, the electrified track centerline and the non-electrified track centerline would have a minimum separation of 23.5 feet, and the northbound and southbound electrified tracks would have a separation of 16.5 feet, following the Authority's *Technical Memorandum 1.1.21 Typical Cross Sections for 15% Design* (2013). These standard separations are illustrated on Figure 2-3**Error! Reference source not found.**.



Source: California High-Speed Rail Authority, 2019
This illustration shows the standard separations between the electrified and non-electrified tracks in areas where the railroad right-of-way is at least 100 feet wide. (Figure not to scale.)

Figure 2-3 Standard Track Separations within Non-Constrained Right-of-Way

However, in several areas of the corridor, the right-of-way is less than 100 feet wide, a threshold that constrains the design. As a result, reduced track separations were used in these constrained areas in order to stay within the existing right-of-way to the greatest extent possible and thus minimize property impacts. The reduced separations between the electrified and non-electrified track centerlines would be a minimum of 16.5 feet, and between the two electrified track centerlines would be 15 feet. The narrower cross-section separations are illustrated on Figure 2-4**Error! Reference source not found.**.



Source: California High-Speed Rail Authority, 2019
This illustration shows the narrow separations between the electrified and non-electrified tracks, which would minimize property impacts in areas where right-of-way is constrained. The reduced separations are applied in areas where the railroad right-of-way is less than 100 feet wide. (Figure not to scale.)

Figure 2-4 Reduced Track Separations within Constrained Right-of-Way

2.2.1 High-Speed Rail Build Alternative Description

The following section describes the HSR Build Alternative in greater detail. Figure 2-5 (Sheets 1 to 3) shows the HSR Build Alternative, including the HSR alignment, new/modified non-electrified tracks, and roadway crossings.

The HSR alignment would begin at the underground Burbank Airport Station and would consist of two new electrified tracks. After exiting the underground station, the alignment would travel southeast beneath the Hollywood Burbank Airport runway in a tunnel, which would be constructed using the sequential excavation method without any disruptions to airport operations. The alignment from south of the airport to where it would join the Metrolink Ventura Subdivision would be constructed as cut-and-cover, and the alignment would then transition to a trench within the Metrolink Ventura Subdivision. The existing Metrolink Ventura Subdivision tracks would be realigned north within the existing right-of-way, and an existing UPRR siding track between Buena Vista Street and Beachwood Drive would be realigned north of the relocated Metrolink Subdivision tracks within the existing right-of-way. These non-electrified tracks would remain at-grade. The trench, which would be south of and parallel to the relocated non-electrified tracks, would be dedicated for HSR tracks only. Figure 2-6, Figure 2-7**Error! Reference source not found.**, and Figure 2-8**Error! Reference source not found.** depict the typical cross-sections of the below-grade portion of the alignment. During construction of the below-grade alignment, shoofly tracks would be provided to support Metrolink operations. The proposed shoofly tracks would be aligned between Hollywood Way and Buena Vista Street outside the existing right-of-way and would result in temporary roadway impacts to Vanowen Street.

The HSR tracks would transition from the trench and emerge to at-grade within the existing railroad right-of-way near Beachwood Drive in the city of Burbank Near Beachwood Drive, the HSR tracks would curve south out of the existing railroad right-of-way and cross Victory Place on a new railroad bridge, which would be directly south of the existing Victory Place Bridge. South of Burbank Boulevard, the HSR tracks would re-enter the railroad right-of-way and run parallel to the Metrolink Antelope Valley Subdivision tracks. Between Burbank Boulevard and Magnolia Boulevard, several UPRR industry tracks west of the right-of-way would be removed.

Continuing south, the HSR alignment would pass the Downtown Burbank Metrolink Station, which would be modified. HSR tracks would be placed within the existing parking lot west of the southbound platforms, and new pedestrian connections and relocated parking would be provided. Section 2.6.1 provides more details on design modifications for the Downtown Burbank Metrolink station.

Source: California High-Speed Rail Authority, 2019

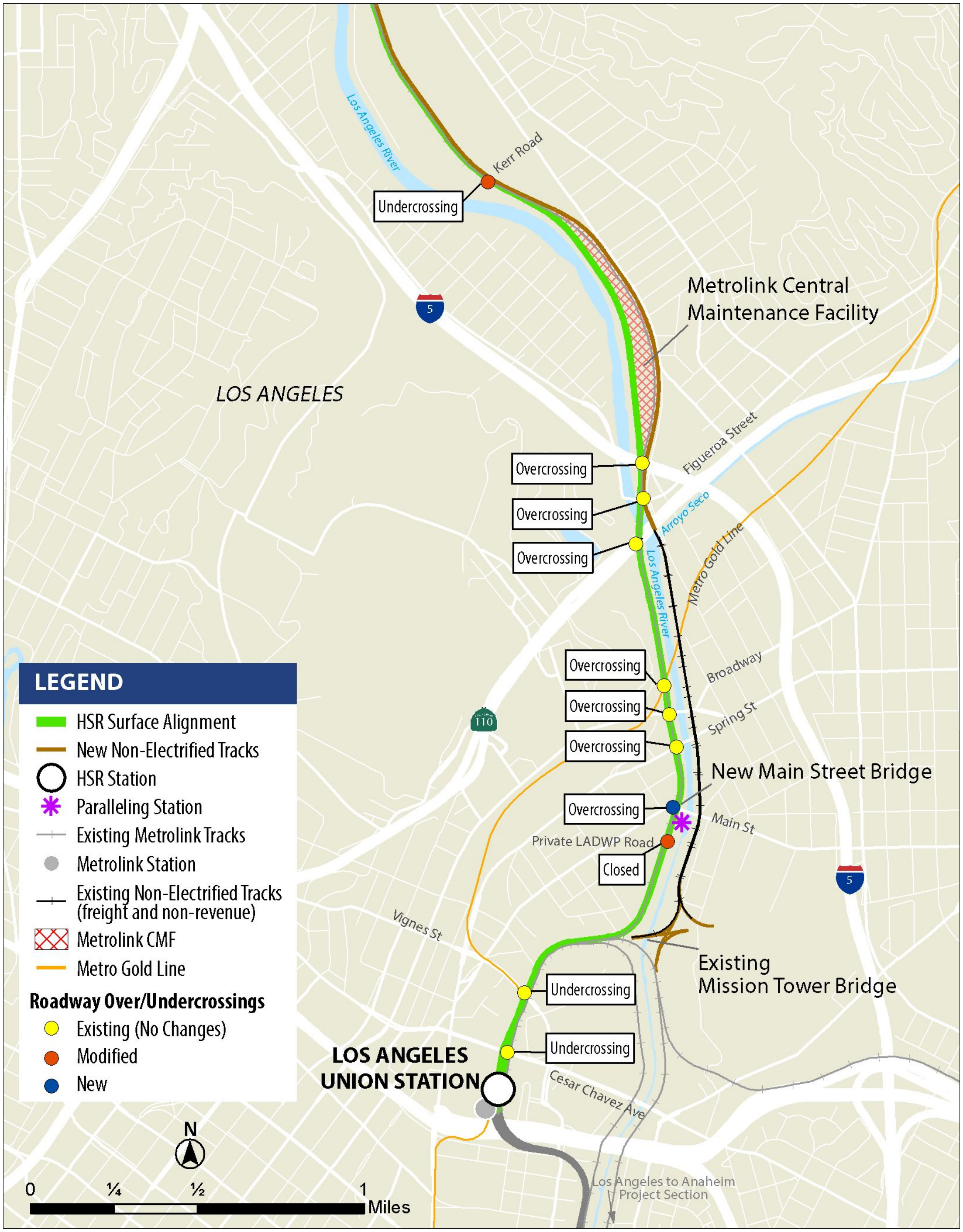
Figure 2-5 HSR Build Alternative Overview

(Sheet 1 of 3)

Source: California High-Speed Rail Authority, 2019

Figure 2-5 HSR Build Alternative Overview

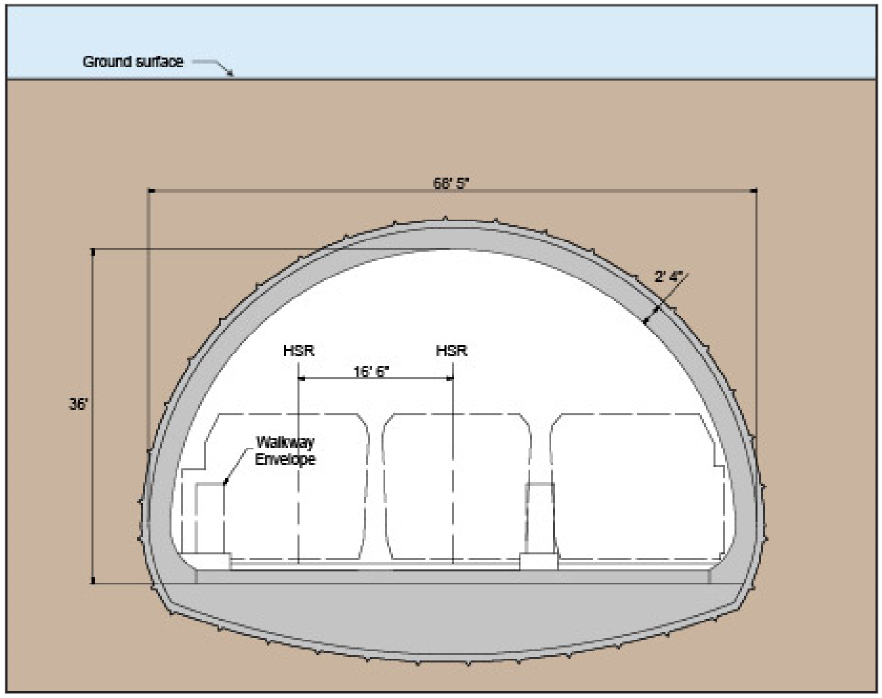
(Sheet 2 of 3)



Source: California High-Speed Rail Authority, 2019

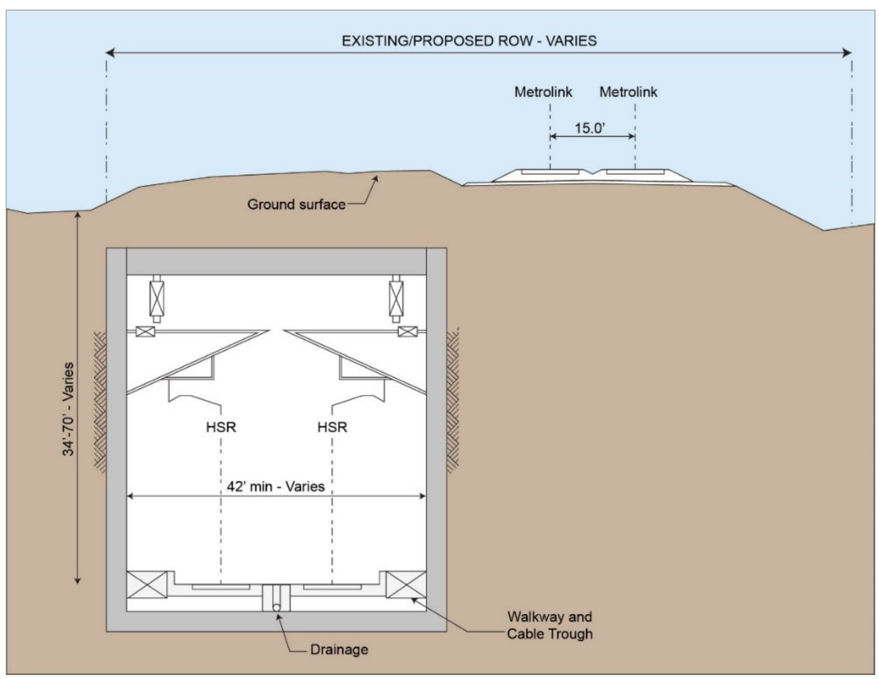
Figure 2-5 HSR Build Alternative Overview

(Sheet 3 of 3)



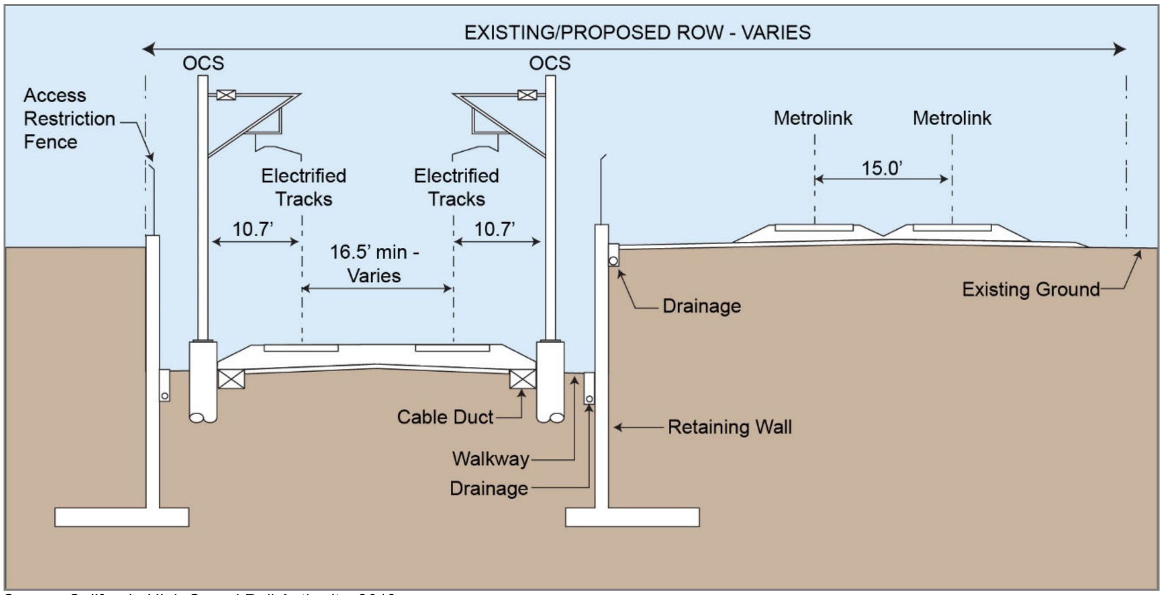
Source: California High-Speed Rail Authority, 2019

Figure 2-6 Typical Tunnel Cross-Section



Source: California High-Speed Rail Authority, 2019

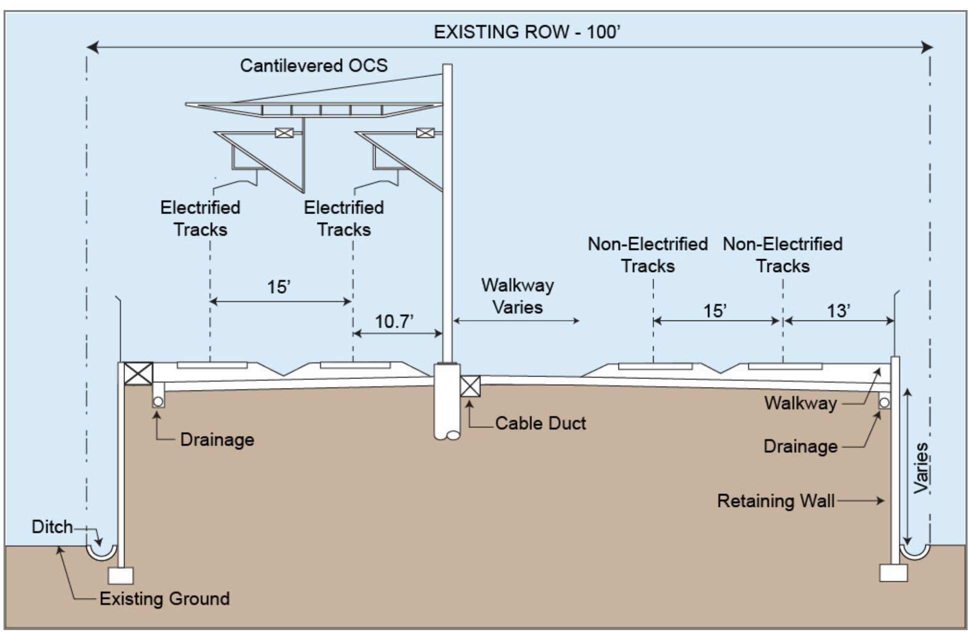
Figure 2-7 Typical Cut-and-Cover Tunnel Cross-Section



Source: California High-Speed Rail Authority, 2019

Figure 2-8 Typical Trench Cross-Section

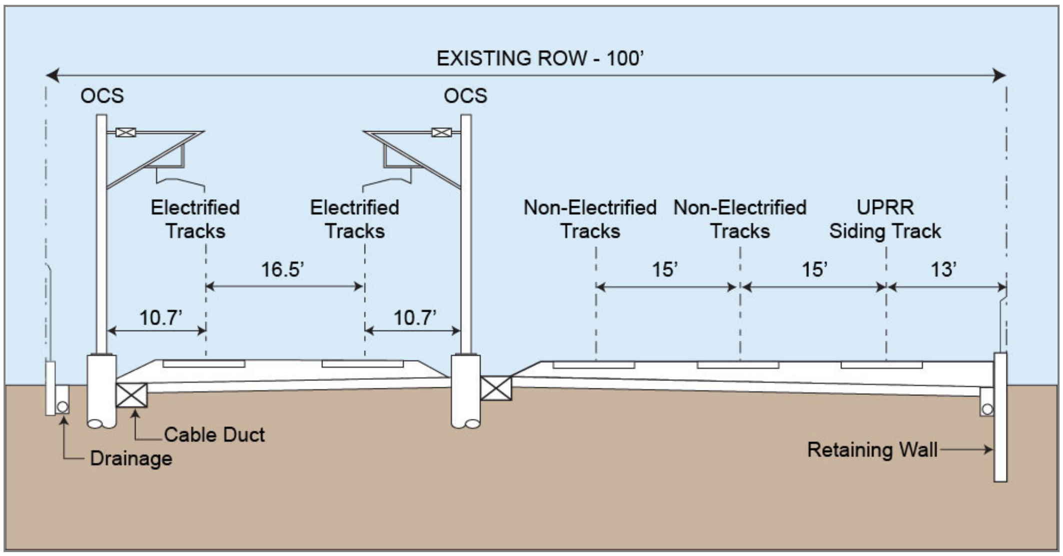
Between Olive Avenue to the north end of the Metrolink Central Maintenance Facility (CMF), the existing non-electrified tracks would be shifted east within the right-of-way to accommodate the addition of the electrified tracks within the right-of-way. Throughout this area, both sets of tracks would be at-grade, with a retained fill segment between Western Avenue and SR 134. Figure 2-9 shows a typical cross-section of the alignment on retained fill.



Source: California High-Speed Rail Authority, 2019

Figure 2-9 Typical Retained-Fill Cross-Section

The alignment would cross Verdugo Wash, where an existing railroad bridge would be rebuilt as a new clear-span structure, to accommodate the additional set of electrified tracks. The alignment would continue south within the existing railroad right-of-way, which follows the Glendale and Los Angeles city borders. Between SR 134 and Chevy Chase Drive, a UPRR siding track would be realigned to the east of the non-electrified tracks, for a total of five tracks within the right-of-way through this area. This siding track is currently located at the Metrolink Central Maintenance CMF but would need to be relocated to accommodate HSR at the CMF. Figure 2-10 shows the typical cross-section for this area.



Source: California High-Speed Rail Authority, 2019

Figure 2-10 Typical Cross-Section between State Route 134 and Chevy Chase Drive

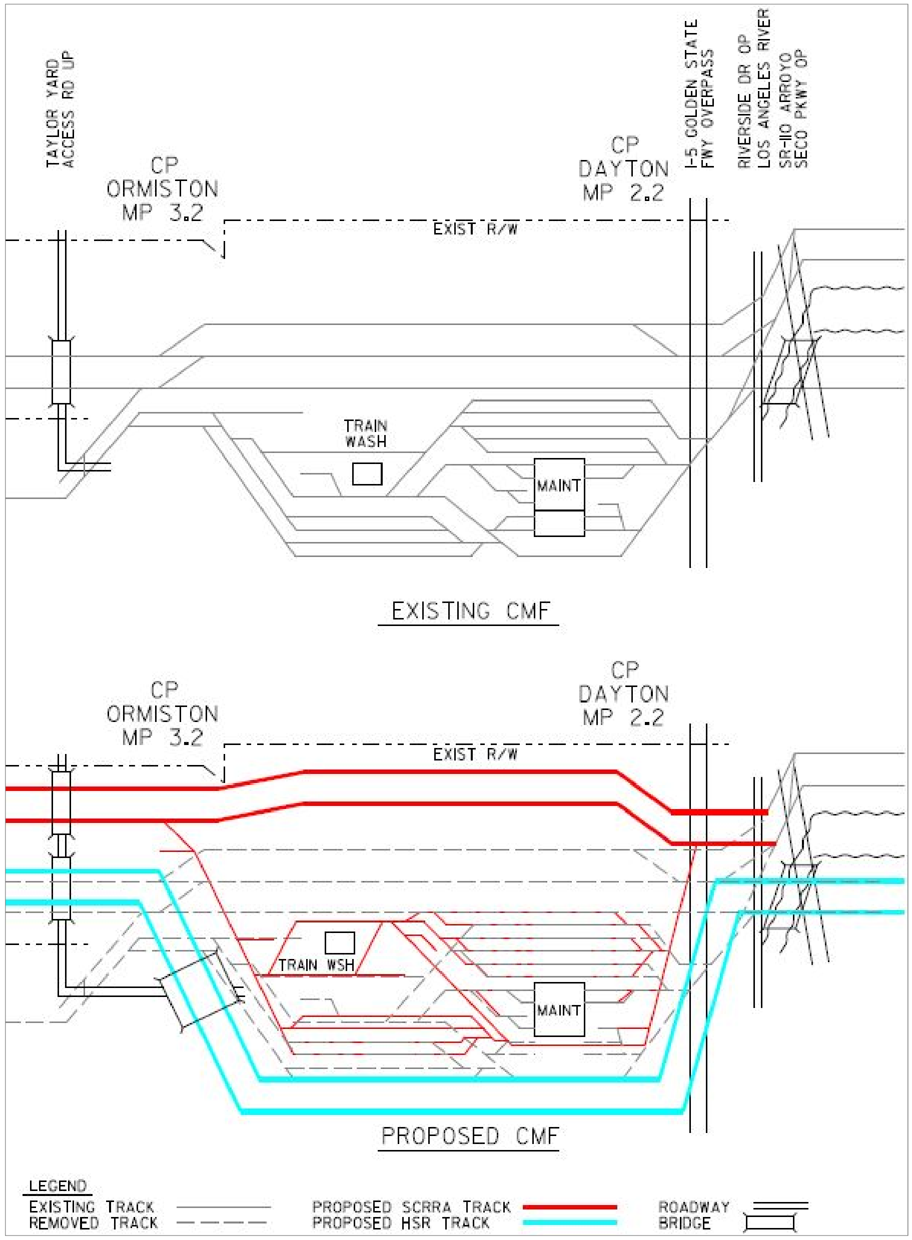
The alignment would pass by the Glendale Metrolink Station (originally known as the Southern Pacific Railroad Depot), a known historical resource listed on the National Register of Historic Places and located north of Glendale Boulevard. No modifications would be needed for the Glendale Metrolink Station. At Tyburn Street, the alignment would enter the city of Los Angeles. Continuing south, the two sets of tracks would diverge at the north end of the Metrolink CMF. The electrified tracks would travel along the west side of the CMF, and the non-electrified, mainline tracks would travel along the east side of the facility.

The CMF is Metrolink's major daily servicing location and maintenance facility in the region. The Burbank to Los Angeles Project Section proposes reconfiguring the various yard and maintenance facilities within the CMF to accommodate HSR, while maintaining as many of the existing yard operations as possible. Figure 2-11 displays a schematic diagram of the existing CMF and the proposed changes, which include new mainline-to-yard track connections, partial demolition of the existing maintenance shop, a revised roadway network with reconfigured parking areas, track relocation shifts, and construction to provide additional storage capacity. Additionally, several facilities would need to be relocated or reconstructed within the CMF, including a train washing/reclamation building, a yard pumphouse, and two service and inspection tracks. Utilities would also need to be relocated with the CMF, including domestic and fire water, underdrains and reconstructed catch basins, power facilities, fueling facilities and storage tanks, and sanitary sewer systems. The proposed design would not be able to accommodate wheel truing operations or progressive maintenance bays; these would relocate to another Metrolink facility. All other facilities and infrastructure would remain in place. The construction work at the CMF would be phased to minimize the disruption to the existing operations and to maintain the key operational facilities.

At the south end of the CMF, the two electrified and two non-electrified tracks would converge briefly within the right-of-way and then diverge again south of Figueroa Street. The electrified tracks would cross over to the west bank of the Los Angeles River on the existing Metrolink Downey Bridge. The existing tracks on the Downey Bridge would be electrified, which would allow for both HSR and passenger rail operations. The non-electrified tracks would remain on the east bank of the Los Angeles River and cross the Arroyo Seco on an existing railroad bridge, which would not require modifications. These non-electrified tracks would connect with the existing tracks on the east bank, which currently serve UPRR and nonrevenue trains. An illustrative cross-section for this area is shown on Figure 2-12.

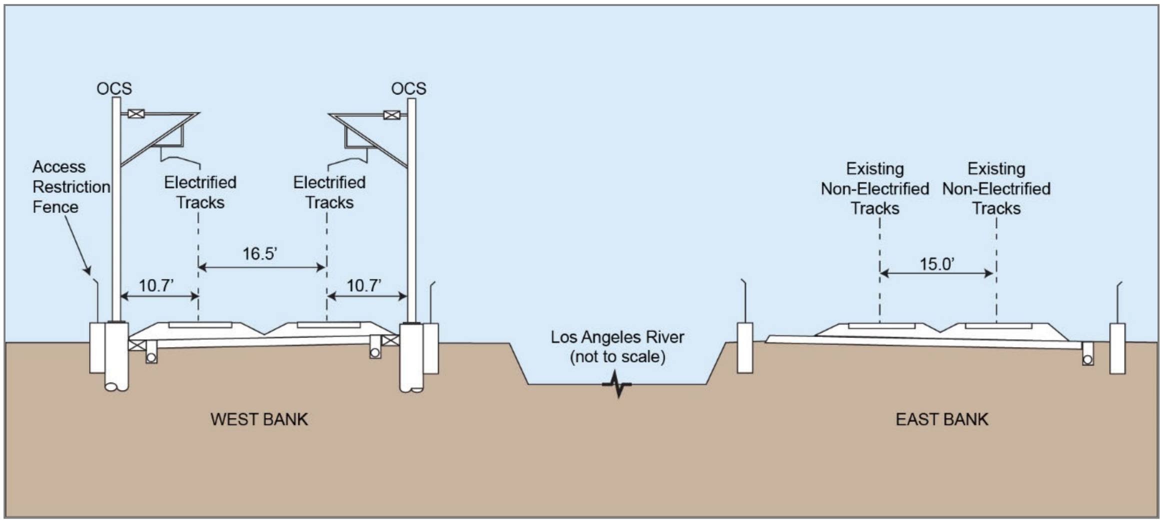
South of Main Street, on the east bank of the river, the existing tracks would be modified at Mission Junction to be used by freight and passenger rail. They would cross the Los Angeles River on the existing Mission Tower Bridge to join the electrified tracks within the railroad right-of-way. The existing Mission Tower Bridge has two tracks, but currently only one track is functional and used by Metrolink. The HSR Build Alternative would replace the trackwork to conform to the most current design standards and specifications, which may require a retrofit to the bridge.

The two sets of tracks would continue south to terminate at LAUS. The electrified tracks and HSR station platforms would be located on the west side of the station, while the non-electrified tracks would merge with the Metrolink and Amtrak tracks. The configuration at LAUS is described in further detail in Section 2.3.2.



Source: Burbank to Los Angeles Draft Preliminary Engineering for Project Description Design Submittal, 2019

Figure 2-11 Diagram of Existing and Proposed Metrolink Central Maintenance Facility



Source: California High-Speed Rail Authority, 2019
The electrified tracks would cross the Los Angeles River just north of State Route 110 and run along the west bank of the river. The non-electrified tracks would run along the east bank of the river. (Figure not to scale.)

Figure 2-12 Typical Cross-Section from State Route 110 to Mission Junction

2.2.2 Roadway Crossings

The HSR Build Alternative would cross a total of 34 roadways, 15 of which would require modifications. Figure 2-5 shows the crossings throughout the project section, and Figure 2-6 lists their configurations before and after the introduction of the HSR Build Alternative.

Modifications to existing crossings

- Victory Place: A new bridge for the HSR tracks would be constructed directly south of the existing railroad bridge over Victory Place, and the roadway would be lowered to cross under the new bridge.
- Burbank Boulevard: The roadway bridge would be reconstructed to cross over the tracks, and Burbank Boulevard would be raised in elevation on the west side.
- Alameda Avenue: The railroad bridge would be reconstructed to be wider.
- Colorado Street: The railroad bridge would be reconstructed to be wider.
- Los Feliz Boulevard: The railroad bridge would be reconstructed to be wider, and the roadway would be lowered slightly
- Glendale Boulevard: The railroad bridge would be reconstructed to be wider, and the roadway would be lowered slightly
- Kerr Road: The railroad bridge would be reconstructed to be wider, and the roadway would be lowered slightly

New grade separations

- Buena Vista Street: The crossing would be modified and remain at-grade for Metrolink and UPRR tracks, but a new undercrossing would be constructed to grade-separate the HSR tracks only from the roadway.
- Sonora Avenue: T new roadway undercrossing would be constructed, with the tracks slightly raised on retained fill and the roadway slightly lowered (see Section 2.6).

- Grandview Avenue: A new roadway undercrossing would be constructed, with the tracks slightly raised on retained fill and the roadway slightly lowered (see Section 2.6).
- Flower Street: A new roadway undercrossing would be constructed, with the tracks slightly raised on retained fill and the roadway slightly lowered (see Section 2.6).
- Goodwin Avenue: The road currently does not cross the railroad right-of-way, but the project would grade-separate it as a new roadway undercrossing (see Section 2.6).
- Main Street: A new roadway bridge would be constructed north of the existing Main Street bridge, which would cross the railroad right-of-way and the Los Angeles River (see Section 2.6).

Closures

- Chevy Chase Drive: The roadway would be closed, and a new pedestrian undercrossing would be provided (see Section 2.6).
- Private driveway: A driveway that currently provides access to a Los Angeles Department of Water and Power facility parking lot would be closed, and the Los Angeles Department of Water and Power parking would be relocated to a new facility on Main Street.

Table 2-1 Roadway Crossings within the Burbank to Los Angeles Project Section

Roadway	Current Crossing Configuration	Proposed Crossing Configuration[1]
Buena Vista Street	At-Grade*	**At-Grade* (modified)** **Undercrossing** (new)**
Victory Place	Undercrossing”	Undercrossing* **Undercrossing (new)**
Burbank Boulevard	Overcrossing	**Overcrossing (modified)**
Magnolia Boulevard	Overcrossing	Overcrossing
Olive Avenue	Overcrossing	Overcrossing
Interstate 5	Overcrossing	Overcrossing
Alameda Avenue	Undercrossing	**Undercrossing (modified)**
Western Avenue	Overcrossing	Overcrossing
Sonora Avenue	At-Grade	**Undercrossing (new)**
Grandview Avenue	At-Grade	**Undercrossing (new)**
Flower Street	At-Grade	**Undercrossing (new)**
Fairmont Avenue	Overcrossing	Overcrossing
SR 134	Overcrossing	Overcrossing
Salem/Sperry St[2]	No Crossing	Overcrossing (Metro project)
Colorado Street	Undercrossing	**Undercrossing (modified)**
Goodwin Avenue	No Crossing	**Undercrossing (new)**
Chevy Chase Drive	At-Grade	**Closed**
Los Feliz Boulevard	Undercrossing	**Undercrossing (modified)**
Glendale Boulevard	Undercrossing	**Undercrossing (modified)**
Fletcher Drive	Undercrossing	Undercrossing

Roadway	Current Crossing Configuration	Proposed Crossing Configuration[1]
SR 2	Overcrossing	Overcrossing
Kerr Road	Undercrossing	**Undercrossing (modified)**
Interstate 5	Overcrossing	Overcrossing
Figueroa Street	Overcrossing	Overcrossing
SR 110	Overcrossing	Overcrossing
Metro Gold Line	Overcrossing	Overcrossing
Broadway	Overcrossing	Overcrossing
Spring Street	Overcrossing	Overcrossing
Main Street	At-Grade	**Overcrossing (new)**
Private LADWP road	At-Grade	**Closed**
Vignes Street	Undercrossing	Undercrossing
Cesar E. Chavez Avenue	Undercrossing	Undercrossing

Source: California High-Speed Rail Authority, 2019
[1] All proposed grade crossing configurations are pending Public Utilities Commission approval.
[2] Salem/Sperry Street would be grade-separated as a part of the Metro Doran Street and Broadway/Brazil Grade Separation Project. The project also proposes closing the existing at-grade railroad crossings at Doran Street and Broadway/Brazil Street. As the Metro project would be completed before the introduction of HSR service, the crossing configurations are considered part of the existing conditions for the HSR project.
*Crossings apply to Metrolink and/or UPRR tracks only
**Crossing applies to HSR tracks only
Bold denotes change from existing condition under the HSR Build Alternative.
Overcrossing = Road over train tracks Undercrossing = Road under train tracks
HSR = high-speed rail
LADWP = Los Angeles Department of Water and Power
Metro = Los Angeles County Metropolitan Transportation Authority
SR = State Route
UPRR = Union Pacific Railroad

2.3 Station Sites

The HSR stations for the Burbank to Los Angeles Project Section would be in the vicinity of Hollywood Burbank Airport and at LAUS. Stations would be designed to optimize access to the California HSR System, particularly to allow for intercity travel and connections to local transit, airports, highways, and the bicycle and pedestrian network. Both stations would include the following elements:

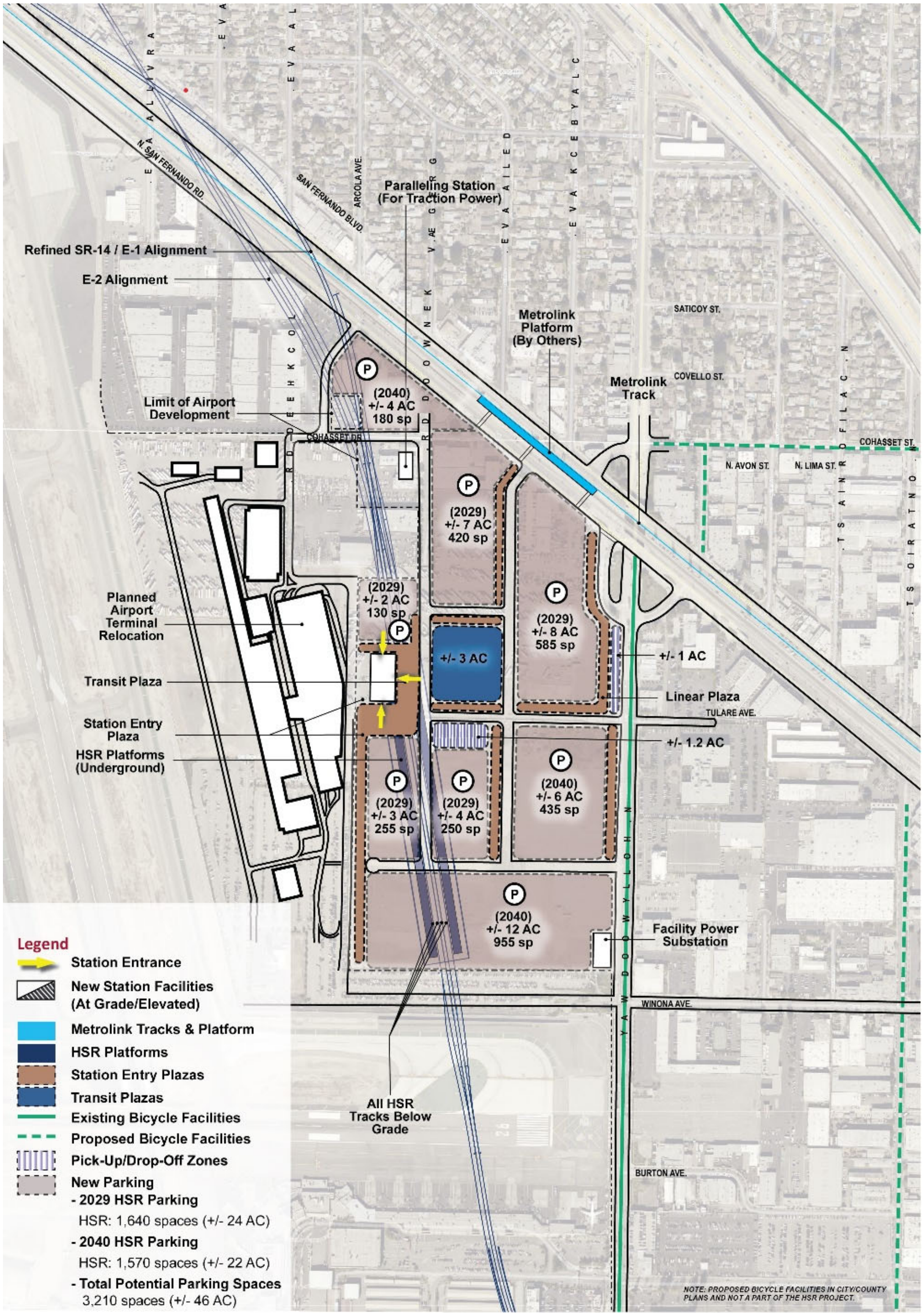
- Passenger boarding and alighting platforms
- Station head house with ticketing, waiting areas, passenger amenities, vertical circulation, administration and employee areas, and baggage and freight-handling service
- Vehicle parking (short-term and long-term)
- Pick-up and drop-off areas
- Motorcycle/scooter parking
- Bicycle parking
- Waiting areas and queuing space for taxis and shuttle buses
- Pedestrian walkway connections

2.3.1 Burbank Airport Station

The Burbank Airport Station site would be located west of Hollywood Way and east of Hollywood Burbank Airport. The airport and ancillary properties occupy much of the land south of the Burbank Airport Station site, while industrial and light industrial land uses are located to the east and residential land uses are found north of the Burbank Airport Station site. Interstate (I) 5 runs parallel to the station site, approximately 0.25 mile north of the proposed Metrolink platform.

The Burbank Airport Station would have both underground and aboveground facilities that would span approximately 70 acres. Station facilities would include train boarding platforms, a station building (that would house ticketing areas, passenger waiting areas, restrooms, and related facilities), pick-up/drop-off facilities for private autos, a transit center for buses and shuttles, and surface parking areas. Underground portions of the station would be beneath Cohasset Street, along which runs the boundary between the city of Los Angeles to the north and the city of Burbank to the south. There would be two HSR tracks at the station.

The Burbank Airport Station would have up to 3,200 surface parking spaces. About 2,980 spaces would be located between the proposed Replacement Terminal and N Hollywood Way. An additional 220 spaces would be located in surface lots in the area bounded by Lockheed Drive to the west, Cohasset Street to the south, and N San Fernando Boulevard to the north and east. The preliminary station layout concept plan is shown on Figure 2-13. The Burbank to Los Angeles Project Section EIR/EIS analyzes the Burbank Airport Station project footprint displayed on Figure 2-13 as permanently impacted because no additional temporary construction easements are identified beyond the permanent area required to construct, operate, and maintain the station. This is the assumption based on the current level of design.



Source: California High-Speed Rail Authority, 2019

Figure 2-13 Preliminary Station Concept Layout Plan, Burbank Airport Station

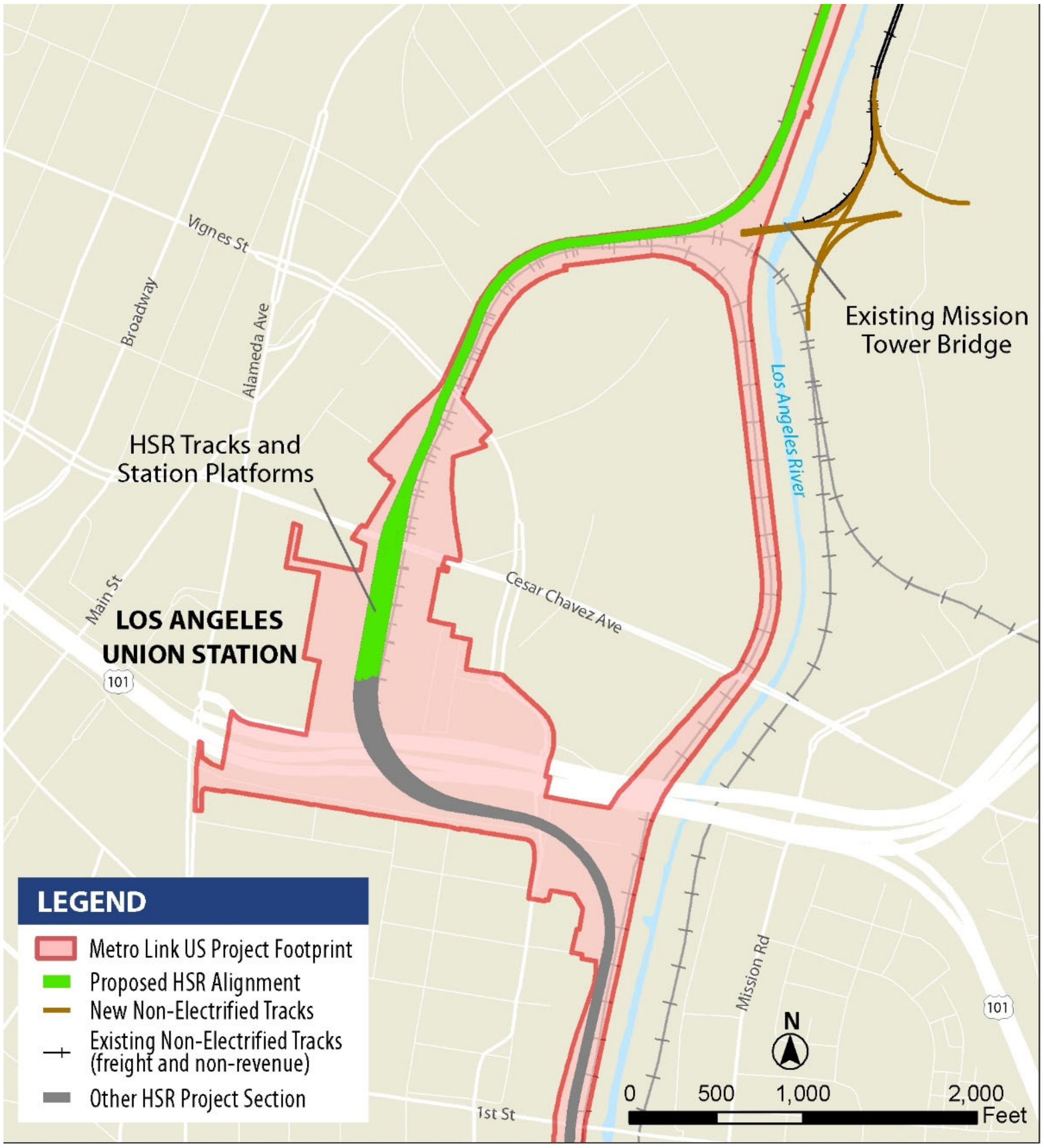
2.3.2 Los Angeles Union Station

The existing LAUS campus and surrounding tracks are being reconfigured as a part of the Metro Link Union Station (Link US)[5] Project. The Metro Link US Project would reconfigure the station entry tracks from north of Mission Junction and construct an elevated structure through the station arrival and boarding area, which would extend south over U.S. Route 101 and come back to grade near First Street. Reconfiguration would take place over two construction phases. The first phase would include an elevated structure for non-HSR passenger rail operators between Vignes Street and First Street. The second phase would add additional tracks to the structure for use by HSR. The Metro Link US EIR/EIS, on which the Authority is a cooperating agency, would evaluate these changes, along with an expanded passenger concourse area and changes to the Metro Gold Line. These changes would be completed prior to the introduction of HSR service.

While Metro would environmentally clear and construct the trackwork and new passenger concourse, the HSR project would require additional modifications within the Link US area. HSR improvements include raising the platform heights and installing an overhead contact system. The Burbank to Los Angeles Project EIR/EIS evaluates these modifications, as well as potential increases in traffic associated with the introduction of HSR service.

The proposed HSR station at LAUS would include up to four HSR tracks and two 870-foot platforms (with the possibility of extending to 1,000 feet). The HSR system would share passenger facilities, such as parking and pick-up/drop-off, with other operators. HSR would require 1,180 parking spaces in 2029 and 2,010 spaces in 2040. This new demand may be met by existing underutilized parking supply within 0.5 mile of LAUS. This parking would be shared with other LAUS service providers and businesses.

[5] Link US will transform LAUS from a “stub-end” station to a “run-through” station by extending tracks south over U.S. Route 101. The project will add a new passenger concourse that will provide improved operational flexibility for rail service. The Draft FIR is available at: https://www.metro.net/projects/link-us/final-ei-report/.



Sources: California High-Speed Rail Authority (2019); Los Angeles Metropolitan Transportation Authority, 2018

Figure 2-14 Preliminary Station Elements Plan, Los Angeles Union Station

2.4 Maintenance of Infrastructure

The California HSR System includes four types of maintenance facilities: maintenance of infrastructure facilities (MOIF), Maintenance of infrastructure siding facilities (MOIS), heavy maintenance facilities, and light maintenance facilities (LMF).[6] The California HSR System would require one heavy maintenance facility for the system, located in the Central Valley. The design and spacing of maintenance facilities along the HSR system do not require the Burbank to Los Angeles Project Section to include any of the maintenance facilities within the limits of the project section.

For purposes of environmental analysis, FRA and the Authority have defined each project section to have the capability to operate as a stand-alone project in the event that other project sections

[6] Maintenance facilities are described in the Authority's *Summary of Requirements for O&M Facilities* (2013).

of the HSR system are not constructed. Because this project section does not provide a heavy maintenance facility or MOIF, an independent contractor would need to be retained to handle all maintenance functions for vehicles and infrastructure if this project section were built as a stand-alone project for purposes of independent utility. Independent utility is discussed further in Section 2.9.

2.4.1 Maintenance of Infrastructure Facilities

The HSR system infrastructure will be maintained from regional MOIFs located at approximately 150-mile intervals. Each MOIF is estimated to be approximately 28 acres in size and would provide a location for regional maintenance machinery servicing storage, materials storage, and maintenance and administration. The MOIFs could be co-located with the MOIS within each 75-mile segment. The MOIFs would be located outside of the Burbank to Los Angeles Project Section.

2.4.2 Maintenance of Infrastructure Sidings

The MOISs would be centrally located within the 75-mile maintenance sections on either side of each MOIF. Each MOIS would support MOIF activities by providing a location for the layover of maintenance of infrastructure equipment and temporary storage for materials. The MOIS is estimated to be about 4 acres in size. The MOISs would be located outside of the Burbank to Los Angeles Project Section.

2.4.3 Heavy Maintenance Facility

Only one heavy maintenance facility is required for the HSR system, and it would be within either the Merced to Fresno Project Section or the Fresno to Bakersfield Project Section. The heavy maintenance facility would include all activities associated with train fleet assembly, disassembly, and complete rehabilitation; all on-board components of the trainsets; and overnight layover accommodations and servicing facilities. The site would include a maintenance shop, a yard Operations Control Center building, one traction power substation (TPSS), other support facilities, and a train interior cleaning platform.

2.4.4 Light Maintenance Facility

An LMF would be used for all activities associated with fleet storage, cleaning, repair, overnight layover accommodations, and servicing facilities. The LMF closest to the Burbank to Los Angeles Project Section would be sited in proximity to LAUS but within the Los Angeles to Anaheim Project Section, and would likely support the following functions:

- **Train Storage:** Some trains would be stored at the LMF prior to start of revenue service.
- **Examinations in Service:** Examinations would include inspections, tests, verifications, and quick replacement of certain train components on the train.
- **Inspection:** Periodic inspections would be part of the planned preventive maintenance program requiring specialized equipment and facilities.

The LMF site will be sized to support the level of daily revenue service dispatched by the nearby terminal at the start of each revenue service day. The Authority defines three levels of maintenance that can be performed at an LMF:

- **Level I:** Daily inspections, pre-departure cleaning, and testing
- **Level II:** Monthly inspections
- **Level III:** Quarterly inspections, including wheel-truing

A Level I LMF is proposed on the west bank of the Los Angeles River at the existing Amtrak Railroad Yard. The facility would be where the current BNSF Railway storage tracks are located and would require their relocation.

2.5 Ancillary and Support Facilities

2.5.1 Electrification

Trains on the California HSR System would draw power from California's existing electricity grid distributed via an overhead contact system. The Burbank to Los Angeles Project Section would not include the construction of a separate power source, although it would include the extension of power lines from potential TPSSs to a series of independently owned power substations positioned along the HSR corridor if necessary. The transformation and distribution of electricity would occur in three types of stations:

- TPSSs transform high-voltage electricity supplied by public utilities to the train operating voltage. TPSSs would be adjacent to existing utility transmission lines and the right-of-way, and would be located approximately every 30 miles along the HSR system route.
- Switching stations connect and balance the electrical load between tracks, and switch overhead contact system power on or off to tracks in the event of a power outage or emergency. Switching stations would be midway between, and approximately 15 miles from, the nearest TPSSs. Each switching station would be 120x80 feet and be adjacent to the HSR right-of-way.
- Paralleling stations, or autotransformer stations, provide voltage stabilization and equalize current flow. Paralleling stations would be located approximately every 5 miles between the TPSSs and the switching stations. Each paralleling station would approximately be 100x80 feet and located adjacent to the right-of-way.

Table 2-2 lists the proposed switching station and paralleling station sites within the Burbank to Los Angeles Project Section. A TPSS is not required for the Burbank to Los Angeles Project Section because of the HSR system's facilities spacing requirements. The Burbank to Los Angeles Project Section would be able to use the TPSSs within the Palmdale to Burbank Project Section and/or Los Angeles to Anaheim Project Section. In the event the other project sections of the HSR system are not constructed, a standalone TPSS would be required within the Burbank to Los Angeles Project Section for purposes of independent utility. Independent utility is discussed further in Section 2.8.

Table 2-2 Traction Power Facility Locations for the Burbank to Los Angeles Project Section

Type of Facility	Location
Paralleling Station	Los Angeles, south of Main Street between railroad right-of-way and Los Angeles River
Switching Station	Los Angeles, south of Verdant Street and west of railroad right-of-way

Source: California High-Speed Rail Authority and Federal Railroad Administration, 2019

2.5.2 Signaling and Train-Control Elements

To reduce the safety risks associated with freight and passenger trains, the National Transportation Safety Board, the FRA, and other agencies have mandated Positive Train Control (PTC). PTC is a train safety system designed to automatically implement safety protocols and provide communication with other trains to reduce the risk of a potential collision. The U.S. Rail Safety Improvement Act of 2008 requires the implementation of PTC technology across most railroad systems; in October 2015, Congress extended the deadline for implementation to December 31, 2018. The FRA published the Final Rule regarding PTC regulations on January 15, 2010.

Communication towers and ancillary facilities are included in the Burbank to Los Angeles Project Section to implement the FRA PTC requirements. PTC infrastructure consists of integrated command, control, communications, and information systems for controlling train movements that improve railroad safety by significantly reducing the probability of collisions between trains, casualties to roadway workers and equipment, and over-speed accidents. PTC is especially important in “blended”[7] corridors, such as in the Burbank to Los Angeles Project Section, where passenger and freight trains need to share the same tracks safely.

PTC for the HSR project would use a radio-based communications network that would include a fiber-optic backbone and communications towers approximately every 2 to 3 miles, depending on the terrain and selected radio frequency. The towers would be located in the fenced HSR corridor in a fenced area of approximately 20x15 feet, including a 10x8-foot communications shelter and a 6- to 8-foot-diameter, 100-foot-tall communications pole. These communications facilities could be co-located within the TPSSs. Where communications towers cannot be located with TPSSs or other HSR facilities, the communications facilities would be located near the HSR corridor in a fenced area of approximately 20 feet by 15 feet.

2.6 Early Action Projects

As described in the 2016 Business Plan, the Authority has made a commitment to invest in regionally significant connectivity projects in order to provide early benefits to transit riders and local communities while laying a solid foundation for the HSR system. These early actions will be made in collaboration with local and regional agencies. These types of projects include grade separations and improvements at regional passenger rail stations, which increase capacity, improve safety, and provide immediate benefits to freight and passenger rail operations. Local and regional agencies may take the lead on coordinating the construction of these early action projects. Therefore, they are described in further detail below and are analyzed within the Burbank to Los Angeles Project Section EIR/EIS to allow the agencies, as Responsible Agencies under CEQA, to adopt the findings and mitigation measures as needed to construct these projects.

2.6.1 Downtown Burbank Metrolink Station

Although the HSR system will not serve the Downtown Burbank Metrolink Station, modifications at the station would be required to ensure continued operations of existing operators. The HSR tracks would be located within the existing parking lot west of the southbound platforms; the platforms and existing Metrolink tracks would not change. The parking would be relocated to between Magnolia Boulevard and Olive Avenue, and Flower Street would be extended from where it currently ends at the south side of the Metrolink Station. Pedestrian bridges would be provided for passengers to cross over the HSR tracks to access the Metrolink platforms. Other accessibility improvements would include additional vehicle parking, bus parking, and bicycle pathways. Figure 2-15 shows the proposed site plan for the Downtown Burbank Metrolink Station.

2.6.2 Sonora Avenue Grade Separation

Sonora Avenue is an existing at-grade crossing. The existing roadway configuration consists of two traffic lanes in both the eastbound and westbound directions. The Burbank to Los Angeles Project Section proposes a “hybrid” grade separation, with Sonora Avenue slightly depressed and the HSR alignment and non-electrified tracks raised on a retained-fill structure. A 10-foot-wide median would be added and the lanes would be narrowed, so the overall width of Sonora Avenue would not change. Sonora Avenue would be lowered in elevation between Air Way and San Fernando Road, and the lowest point of the undercrossing would be approximately 10 feet below the original grade. The height of the new retained-fill structure would be approximately 28 feet. Figure 2-16 shows the temporary and permanent project footprint areas.

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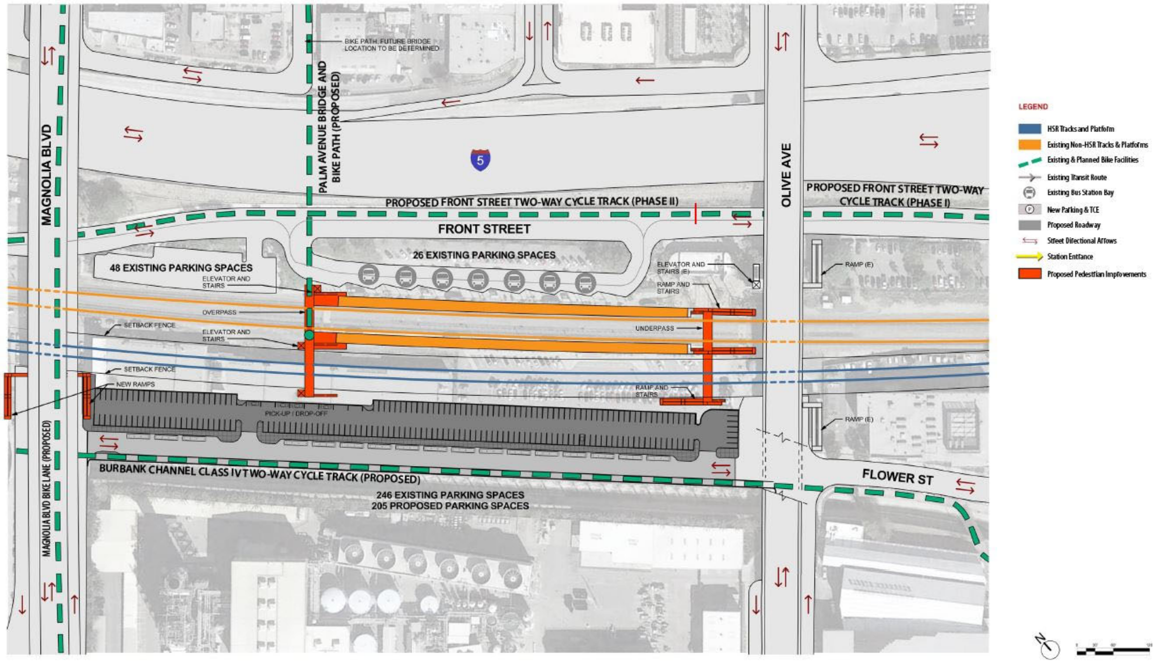
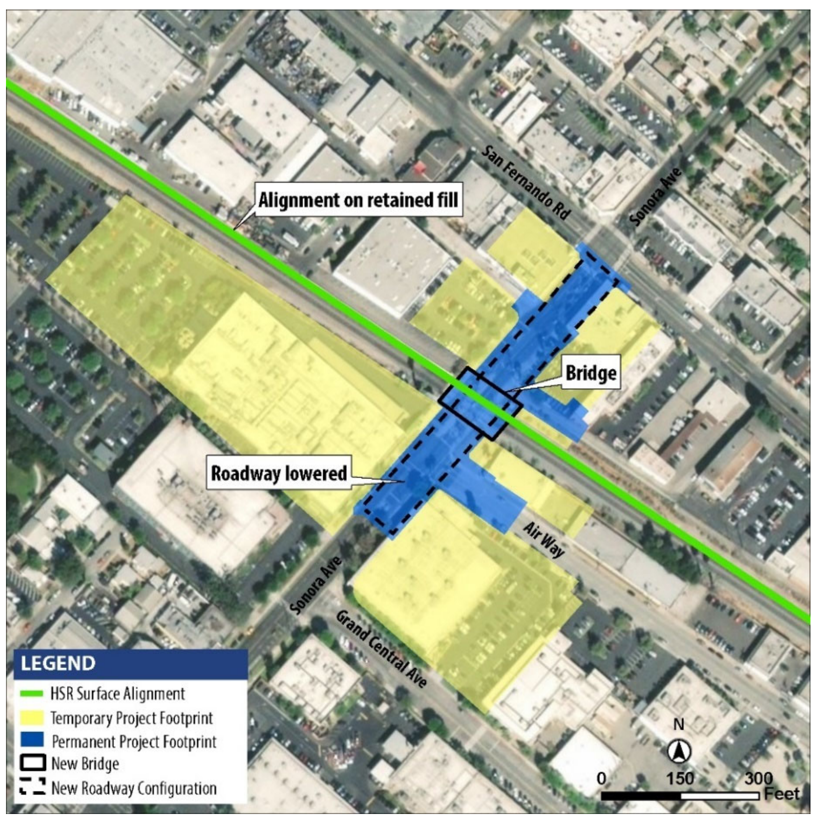
[7] California HSR Project Business Plans (http://www.hsr.ca.gov/About/Business_Plans/) suggest blended railroad systems and operations. These terms refer to integrating the HSR system with existing intercity, and commuter and regional rail systems through coordinated infrastructure (blended systems) and scheduling, ticketing, and other means (blended operations).



Source: California High-Speed Rail Authority, 2019

Figure 2-15 Downtown Burbank Metrolink Station Site Plan



Source: California High-Speed Rail Authority, 2019

Figure 2-16 Sonora Avenue Grade Separation Footprint

2.6.3 Grandview Avenue Grade Separation

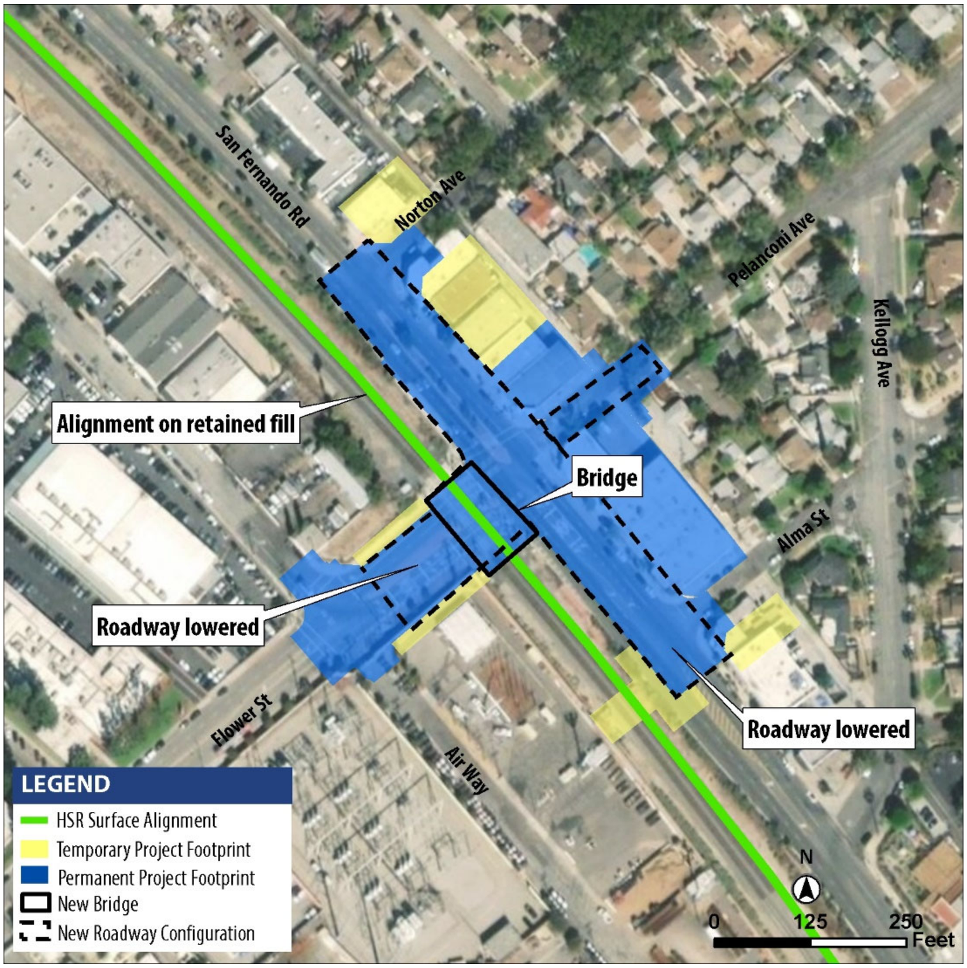
Grandview Avenue is an existing at-grade crossing. The existing roadway configuration consists of three traffic lanes in both the eastbound and westbound directions. The Burbank to Los Angeles Project Section proposes a "hybrid" grade separation, with Grandview Avenue slightly depressed and the HSR alignment and non-electrified tracks raised on retained fill. Grandview Avenue would be lowered in elevation between Air Way and San Fernando Road, and the lowest point of the undercrossing would be approximately 3 feet below original grade. The lanes and overall width of Grandview Avenue would not change. The height of the new retained-fill structure would be approximately 30 feet. Figure 2-17 shows the temporary and permanent project footprint areas.

Source: California High-Speed Rail Authority, 2019

Figure 2-17 Grandview Avenue Grade Separation Footprint

2.6.4 Flower Street Grade Separation

Flower Street is an existing at-grade crossing, with Flower Street ending in a T-shaped intersection with San Fernando Road, which runs parallel on the east side of the railroad right-of-way. Existing Flower Street consists of two traffic lanes in both the westbound and eastbound directions, with a right-turn-only lane in the westbound direction. The Burbank to Los Angeles Project Section proposes a "hybrid" grade separation, with Flower Street and San Fernando Road slightly depressed, and the HSR alignment and non-electrified tracks raised on a retained-fill structure. Flower Street would be lowered in elevation between Air Way and San Fernando Road, and the lowest point of the undercrossing would be approximately 10 feet below original grade. The existing median would be modified on Flower Street, and the overall width of Flower Street would remain the same. San Fernando Road would be lowered in grade between Norton Avenue and Alma Street, and Pelanconi Avenue would be extended to connect to San Fernando Road. The height of the new retained-fill structure would be approximately 28 feet. Figure 2-18 shows the temporary and permanent project footprint areas.



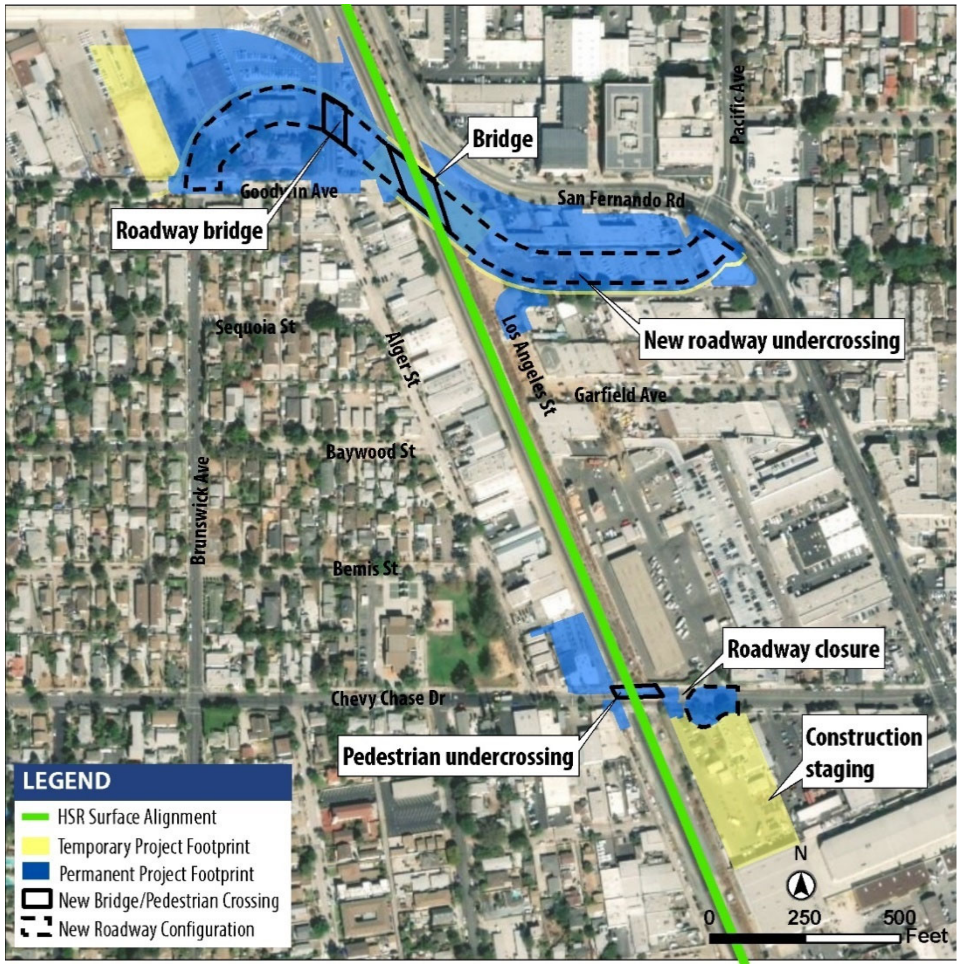
Source: California High-Speed Rail Authority, 2019

Figure 2-18 Flower Street Grade Separation Footprint

2.6.5 Goodwin Avenue/Chevy Chase Drive Grade Separation

There is currently no crossing at Goodwin Avenue, which ends in a cul-de-sac on the west side of the railroad right-of-way. The Burbank to Los Angeles Project Section proposes a grade separation, with Goodwin Avenue realigned and depressed to cross under a new railroad bridge supporting the HSR and non-electrified tracks. A new roadway bridge would also be required to carry Alger Street over the depressed Goodwin Avenue, connecting to W San Fernando Road. The new depressed roadway would curve north from Brunswick Avenue, cross under the new roadway and railroad bridges, and connect with Pacific Avenue on the east side of the railroad right-of-way. The lowest point of the undercrossing would be approximately 28 feet below original grade.

Chevy Chase Drive is an at-grade crossing. With the construction of a new grade separation at Goodwin Avenue, Chevy Chase Drive would be closed on either side of the rail crossing and a pedestrian undercrossing would be provided. Figure 2-19 shows the temporary and permanent project footprint areas for Goodwin Avenue and Chevy Chase Drive.



Source: California High-Speed Rail Authority, 2019

Figure 2-19 Goodwin Avenue Grade Separation

2.6.6 Main Street Grade Separation

Main Street is an existing at-grade crossing. It crosses the existing tracks at-grade on the west bank of the Los Angeles River, crosses over the river on a bridge, and then crosses the existing tracks at-grade on the east bank of the river. The existing bridge carries two traffic lanes in both directions. The Burbank to Los Angeles Project Section proposes a grade separation, with a new Main Street Bridge spanning the tracks on the west bank, the Los Angeles River, and the tracks on the east bank. The new Main Street Bridge would be 86 feet wide and 75 feet high at its highest point over the Los Angeles River and would place three columns within the river channel. Main Street would be raised in elevation, starting from just east of Sotello Street on the west side of the Los Angeles River. The new bridge would come down to grade at Clover Street on the east side of the Los Angeles River. Several roadways on the east side of the Los Angeles River would be reconfigured, including Albion Street, Lamar Street, Avenue 17, and Clover Street. The existing Main Street Bridge would not be modified, but it would be closed to public access. Figure 2-20 shows the temporary and permanent project footprint areas.

Source: California High-Speed Rail Authority, 2019

Figure 2-20 Main Street Grade Separation Footprint

2.7 Project Construction

For the Burbank to Los Angeles Project Section of the California HSR System, specific construction elements would include at-grade and underground track, grade-separated roadway crossings, retaining walls, and installation of a PTC system. Surface track sections would be built using conventional railroad construction techniques. A typical construction sequence includes clearing, grubbing, grading, and compacting the railbed; applying crushed rock ballast; laying track; and installing electrical and communications systems. The at-grade track would be laid on an earthen railbed topped with rock ballast approximately 3 feet off the ground. Fill and ballast for the railbed would be obtained from permitted borrow sites and quarries.

Retaining walls are used when it is necessary to transition between an at-grade and elevated profile. In this project section, retained fill would be used between Western Avenue and SR 134. The tracks would be raised in elevation on a retained-fill platform made of reinforced walls, much like a freeway ramp. Short retaining walls would have a similar effect and would protect the adjacent properties from a slope extending beyond the proposed rail right-of-way.

The preferred construction method for the tunnel alignment underneath the Burbank Airport runway is the sequential excavation method. The tunnel alignment south of the airport would be constructed using cut-and-cover.

Pre-construction activities would be conducted during final design and would include geotechnical investigations, interpretation of anticipated ground behavior and ground support requirements, identification of staging areas, initiation of site preparation and demolition, relocation of utilities, and implementation of temporary, long-term, and permanent road closures. Additional studies and investigations to develop construction requirements and worksite traffic control plans would be conducted as needed.

Major construction activities for the Burbank to Los Angeles Project Section would include earthwork and excavation support, systems construction, bridge and aerial structure construction, and railway systems construction (including trackwork, traction electrification, signaling, and communications).

During peak construction periods, work is envisioned to be underway at several locations along the route simultaneously, with overlapping construction of various project elements. Working hours and the number of workers present at any time would vary depending on the activities being performed but could be expected to extend to 24 hours per day, seven days per week.

2.8 Independent Utility of the Burbank to Los Angeles Project Section

The Burbank to Los Angeles Project Section would have independent utility if it is able to operate as a standalone project in the event the other project sections of the HSR system are not constructed. As none of the four types of maintenance facilities would be located within the limits of the Burbank to Los Angeles Project Section, all maintenance functions for vehicles and infrastructure would be handled through an independent contractor to achieve independent utility. For power, one potential location for a TPSS has been preliminarily identified within the project section. Because the addition of a TPSS would alter the spacing of the other systems facilities, further design and environmental study would be required to environmentally clear the TPSS site and the alteration of the other systems facilities in the absence of the Palmdale to Burbank and Los Angeles to Anaheim project sections being built and operated.

Any electrical interconnections between a potential future TPSS site and existing utility providers would also have to be environmentally evaluated and cleared in subsequent documentation.

2.9 Operations of the Burbank to Los Angeles Project Section

The conceptual HSR service plan for Phase 1, starting in 2029, begins with service between Los Angeles/Anaheim running through the Central Valley from Bakersfield to Merced, and traveling northwest into the Bay Area. Subsequent sections in Phase 2 of the HSR system include a southern extension from Los Angeles to San Diego and an extension from Merced to north of Sacramento. These extensions do not have an anticipated implementation date.

Currently, the Metrolink Ventura and Antelope Valley Lines, Amtrak Pacific Surfliner and Coast Starlight, and UPRR freight trains operate within the Burbank to Los Angeles Project Section. As the proposed HSR Build Alternative is within the active Los Angeles–San Diego–San Luis Obispo passenger and freight rail corridor, all existing operators would have to change their operation patterns and frequency. New and realigned tracks would change the tracks on which the various users operate, with passenger rail and freight trains shifted closer to the east side of the right-of-way. With the introduction of HSR service, the proposed general operational characteristics are shown in Table 2-3.

Table 2-3 Existing and Future Trains per Day in the Los Angeles–San Diego–San Luis Obispo Rail Corridor within the Burbank and Los Angeles Project Section

Operator	2016 Existing Conditions	2029 Opening Day	2040 Horizon Year
California High-Speed Rail Authority[1]	N/A	196	196
Metrolink[2]	61	99	99
Amtrak[3]	12	16	18
UPRR[4]	11	18	23

[1] 2029 Opening Day and 2040 Horizon Year projections are from the California High-Speed Rail Authority's "Year 2029 and Year 2040 Concept Timetable for EIR/EIS Analysis."
[2] Existing Conditions data are from the 2016 Metrolink Schedule (effective October 3, 2016); 2029 Opening Day projections are extrapolated from the 2016 Metrolink 10-Year Strategic Plan, "Growth Scenario 2: Overlay of Additional Service Patterns."
[3] Existing Conditions data are from the 2016 LOSSAN Corridor Schedule; 2029 Opening Day projections are extrapolated from 2012 LOSSAN Corridorwide Strategic Implementation Plan "Long-Term Operations Analysis" (increase of approximately one train every four years for the Amtrak Pacific Surfliner and no growth for the Amtrak Coast Starlight between Hollywood Burbank Airport and LAUS).
[4] Existing Conditions data are from the 2012 LOSSAN Corridorwide Strategic Implementation Plan "Long-Term Operations Analysis"; 2029 Opening Day projections are extrapolated from the 2012 LOSSAN Corridorwide Strategic Implementation Plan "Long-Term Operations Analysis" (increase of approximately one train every 2 years for UPRR between Hollywood Burbank Airport and LAUS).
Amtrak = National Railroad Passenger Corporation
LAUS = Los Angeles Union Station
N/A = not applicable
UPRR = Union Pacific Railroad

3 LAWS, REGULATIONS, ORDERS

3.1 Federal

3.1.1 National Environmental Policy Act (42 United States Code Section 4321 et seq.)

The National Environmental Policy Act (NEPA) requires the consideration of potential environmental effects—including potential effects on geology, soils, and geologic resources—in the evaluation of any proposed federal agency action. NEPA also obligates federal agencies to consider the environmental consequences and costs in their projects and programs as part of the planning process. General NEPA procedures are set forth in the Council on Environmental Quality regulations 40 Code of Federal Regulations Parts 1500-1508. General NEPA procedures are set forth in the Council on Environmental Quality regulations (Code of Federal Regulations Title 23, Part 771).

3.1.2 Procedures for Considering Environmental Impacts (64 Federal Register 28545)

These FRA procedures for implementing NEPA state that an EIS should consider possible impacts on energy and mineral resources.

3.2 State

3.2.1 California Environmental Quality Act (Section 21000 et seq.) and California Environmental Quality Act Guidelines (Section 15000 et seq.)

The California Environmental Quality Act (CEQA) requires state and local agencies to identify the significant environmental effects of their actions, including potential significant effects on geology, soils, and geologic resources, and discuss measures to avoid or mitigate those effects, when feasible.

3.2.2 Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code, § 2621 et seq.)

This act provides policies and criteria to assist cities, counties, and state agencies in the exercise of their responsibilities to prohibit the location of developments and structures for human occupancy across the traces of active faults. The act also requires site-specific studies by licensed professionals for some types of proposed construction within delineated earthquake fault zones.

3.2.3 Seismic Hazards Mapping Act (California Public Resources Code, §§ 2690-2699.6)

The Seismic Hazards Mapping Act of 1990 (Public Resources Code, Chapter 7.8, Division 2) directs the California Department of Conservation (DOC), Division of Mines and Geology (now called the California Geological Survey or CGS) to delineate seismic hazard zones. The purpose of the act is to reduce the threat to public health and safety and to minimize the loss of life and property by identifying and mitigating seismic hazards. Cities, counties, and state agencies are directed to use the seismic hazard zone maps in their land-use planning and permitting processes. This act requires that site-specific hazards investigations be conducted by licensed professionals within the zones of required investigation to identify and evaluate seismic hazards and formulate mitigation measures prior to permitting most developments designed for human occupancy. Evaluation and mitigation of seismic hazards are to be conducted under guidelines established by the California State Mining and Geology Board (DOC 2008).

3.2.4 Surface Mining and Reclamation Act (California Public Resources Code, § 2710 et seq.)

This act addresses the need for a continuing supply of mineral resources and is intended to prevent or minimize the adverse impacts of surface mining on public health, property, and the environment. The act also assigns specific responsibilities to local jurisdictions in permitting and oversight of mineral resources extraction activities.

3.2.5 California Building Standards Code (California Public Resources Code, tit. 24)

The California Building Standards Code (CBC) governs the design and construction of buildings, associated facilities, and equipment and applies to buildings in California.

3.2.6 Oil and Gas Conservation (California Public Resources Code, §§ 3000-3473)

The Division of Oil Gas and Geothermal Resources (DOGGR) within the Department of Conservation oversees the drilling, operation, maintenance, and plugging and abandonment of oil, natural gas, and geothermal wells. DOGGR's regulatory program emphasizes the wise development of oil, natural gas, and geothermal resources in the state through sound engineering practices that protect the environment, prevent pollution, and ensure public safety.

3.3 Regional and Local

3.3.1 County or Municipal General Plans

California state law requires each city and county to adopt a general plan. The policies of the general plan are intended to underlie most land-use decisions. General plans are required to address the specified provisions of each of seven mandated elements. The safety elements (including the accompanying technical background reports) of the general plans of Los Angeles County and all the other cities that the alignment would traverse identify various hazards that may occur within their jurisdictions, including seismic and geologic hazards. The safety elements provide basic policies that consider geologic conditions for land development and use to preserve life and protect property in the event of a natural disaster. These policies provide basic guidelines and requirements for analysis and mitigation of seismic and geologic hazards.

The City of Burbank General Plan, City of Glendale General Plan, and City of Los Angeles General Plan contain hillside development policies and ordinances based on geologic considerations and the building, grading, or zoning codes. These hillside policies and ordinances address preservation of the aesthetic aspects of hillside areas, evaluation, and mitigation of seismic and geologic hazards, and specifies hillside-specific grading requirements and design and construction specifications for building structures and roadway improvements.

Because of the known presence of subsurface methane gas associated with oil fields, the City of Los Angeles has implemented special building code provisions for “methane zones” and “methane buffer zones” within the city to address this natural occurrence and provide mitigation. The project alignment traverses or is in very close proximity to several of these zones in the San Fernando Valley. These special building code measures include, but are not limited to, proper investigation of gases, construction of methane barriers/liners and vent systems beneath building slabs, special heating, ventilation, and air conditioning (HVAC) requirements, and/or methane detection and eradication equipment/systems, among other possibilities.

3.3.2 Ordinance and Codes

The City of Burbank Grading Code is based on Appendix J of the CBC. Local amendments to the CBC are found in Title 9, Chapter 1, of the City of Burbank Municipal Code.

The grading code for the City of Glendale is found in Title 15 (Building and Construction), Chapter 15.12 (Hillside Areas and Excavation Blasting) of the City of Glendale Municipal Code.

The City of Los Angeles Building Code is based on the CBC, which is based on the International Building Code; however, certain pages of the CBC are replaced by City of Los Angeles codes.

- **Chapter 16: Structural Design Requirements, Division IV Earthquake Design.** This section requires structural designs to be based on geologic information for seismic parameters, soil characteristics, and site geology.

- **Chapter 18: Foundations and Retaining Walls, Division I.** This section sets requirements for excavations and fills, foundations, and retaining structures, with regard to expansive soils, subgrade bearing capacity, seismic parameters, and also addresses waterproofing and damp-proofing foundations. In Seismic Zones 3 and 4, as defined by the Uniform Building Code, liquefaction potential at the site should be evaluated. Division III contains requirements for mitigating effects of expansive soils for slab-on-grade foundations.
- **Chapter 33: Site Work, Demolition and Construction.** These sections establish rules and regulations for construction of cut-and-fill slopes, fill placement for structural support, and slope setbacks for foundations.

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4 METHODS FOR EVALUATING IMPACTS

This section discusses the resource study area (RSA), the physical setting, and the methodologies used for the geology, soils, and seismicity impacts assessment.

4.1 Definition of Resource Study Area

The project footprint includes the existing railroad alignment, column sites for aerial structures, road overcrossing and undercrossing sites, and construction-related facility sites, such as equipment staging areas, borrow and disposal areas, access roads, and utility yards or components. The RSA for geology, soils, and seismicity is defined as the project footprint plus a 150-foot buffer around surface portions of the alignment and a 200-foot buffer around below-grade portions of the alignment. Resource hazards, such as soil failures (e.g., adequacy of load-bearing soils), settlement, corrosivity, shrink-swell, erosion, earthquake-induced liquefaction risks, subsidence, and subsurface hazards, has a larger RSA, which is the project footprint plus a 0.5-mile buffer along the project alignment with the buffer increasing to 2 miles around station sites. For seismicity, the RSA considered faults as far as 30 miles away from the project footprint. The RSAs are shown on Figure 4-1.

4.2 Methods for Evaluating Effects

Effects related to geology, soils, and seismicity are analyzed both quantitatively and qualitatively, based on a review of published geologic and soils information for the RSA and on professional judgment, in accordance with the current standard of care for geotechnical engineering and engineering geology in Southern California. The effects analysis addresses both the effects of the project on geologic resources and the effects of geologic conditions and hazards on project design, construction, and operation.

To establish the baseline for the analysis (existing conditions), the geologic setting, seismicity, minerals resources, and energy resources (oil and natural gas) are identified. The setting also includes risks such as primary and secondary seismic hazards, and unstable slopes and soils.

This analysis used information from publicly available sources such as the U.S. Geological Survey (USGS), California Geological Survey (CGS; formerly known as California Division of Mines and Geology), the California Department of Transportation (Caltrans), the California Department of Water Resources, local planning departments, and published geologic reports and maps. The following geologic, soils, and seismic hazards are discussed:

- Surface rupture along hazardous faults
- Ground shaking
- Liquefaction and other seismically induced ground deformations
- Surface water and groundwater
- Flooding and dam inundation
- Tsunami and seiche
- Static and seismically induced landslides
- Erosion and scour
- Land subsidence
- Collapsible soils
- Expansive soils
- Corrosive soils
- Mineral resources
- Oil and natural gas resources

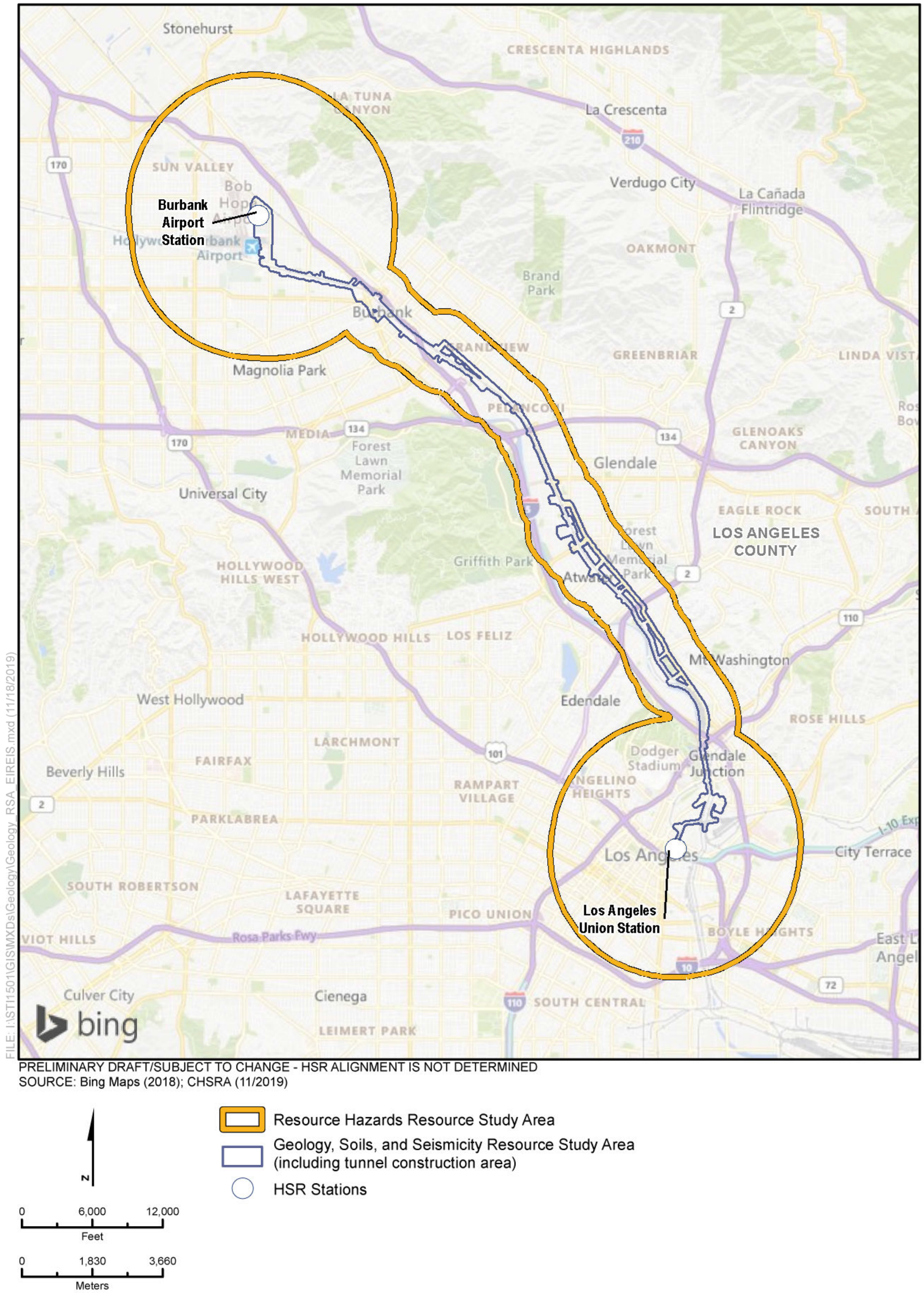

Figure 4-1 Geology, Soils, and Seismicity Resource Study Area

4.3 Determining Significance under the National Environmental Policy Act

NEPA does not provide a definitive threshold to determine significant or potentially significant impacts. For the purposes of the Burbank to Los Angeles Project EIR/EIS, the evaluation of NEPA impact significance does not use intensity thresholds. Pursuant to NEPA regulations (Code of Federal Regulations Title 40, Parts 1500–1508), project effects are evaluated based on the criteria of *context* and *intensity*, and implementation of mitigation measures are considered together when determining whether an impact is significant under NEPA. Context means the affected environment in which a proposed project occurs. Intensity refers to the severity of the effect, which is examined in terms of the type, quality, and sensitivity of the resource involved, location and extent of the effect, duration of the effect (short- or long-term), and other considerations. The intensity of adverse effects is the degree or magnitude of a potential adverse effect, described as negligible, moderate, or substantial. Beneficial effects are identified and described. When there is no measurable effect, no adverse effect is found to occur.

4.4 Determining Significance under the California Environmental Quality Act

Based on the CEQA Guidelines and the *Environmental Methodology Guidelines, Version 5* (Authority 2014), the project would have a significant impact related to geology, soils, and seismicity if it:

- Directly or indirectly causes potential substantial adverse effects, including the risk of loss of life, injuries, or destruction beyond what people are exposed to currently in the area's environment due to seismic activity or its related hazards, including fault rupture,[8] ground shaking, ground failure including liquefaction, dam failure, seiche or tsunami, and landslides
- Results in substantial soil erosion or the loss to topsoil in a large area that adversely affects the viability of the ecosystem or productivity of farming present in the area
- Is located on a geologic unit or soil that is unstable or that renders a currently stable geologic unit or soil unstable to a degree that it would result in increased exposure of people to loss of life or structures to destruction due to geologic hazards, such as primary and secondary seismic hazards
- Is constructed on expansive or corrosive soils as defined in Table 18-1-B of the Uniform Building Code (1994), or most recent applicable Uniform Building Code, International Building Code, or CBC, creating substantial direct or indirect risks to life or property.
- Makes a known petroleum or natural gas resource of regional or statewide value unavailable to extraction through the physical presence of the project either at the ground surface or the subsurface
- Results in the loss of availability of a locally important mineral resource recovery site
- Is located in an area of subsurface gas hazard, including landfill gas, and provides a route of exposure to that hazard that results in a substantial risk of loss of life or destruction of property

The mitigations and the significance and effect after mitigation can be found in the EIR/EIS for this project.

[8] Refer to the most recent Alquist-Priolo Earthquake Fault Zoning map issued by the State Geologist for the area or other substantial known evidence of known faults to identify known faults in the project vicinity. Refer to Division of Mines and Geology Special Publication 42.

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5 AFFECTED ENVIRONMENT

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

5.1 Regional Geologic Setting

The affected environment for geology, soils, and seismicity includes the following elements:

- Physiography and regional geologic setting
- Geology
- Groundwater
- Soils
- Geologic hazards
- Primary seismic hazards
- Secondary seismic hazards
- Geological resources

5.1.1 Physiography

The Burbank to Los Angeles Project Section would be located within the Los Angeles Basin. The Los Angeles Basin is within the northern portion of the Peninsular Ranges geomorphic province of California, one of the 11 geomorphic provinces in California, each with distinct and unique landforms, topographic relief, climate, and geology (Harden 2004; Norris and Webb 1990). The cities of Burbank and Glendale are a part of the San Fernando Valley region of the Los Angeles Basin, which is 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.

The Santa Monica Mountains, San Gabriel Mountains, and the Santa Susana Mountains are all a part of the Transverse Ranges geomorphic province of California. The Transverse Ranges are a chain of east-west trending mountain ranges with many ridges and peaks rising above 5,000 feet above mean sea level (MSL) and the highest peaks rising more than 10,000 feet above MSL (Yerkes et al. 1965).

The Burbank to Los Angeles Project Section would be located in a portion of the San Fernando Valley that ranges in elevation from approximately 1,200 feet above MSL near the Burbank Airport Station to 400 feet above mean sea level where the alignment crosses SR 2, and 300 feet above MSL at LAUS. Ground surface generally slopes to the south and southwest due to a merging of alluvial fan surfaces, except at the far southern end, adjacent to the Santa Monica Mountains, where surfaces slope to the north and northeast.

The Los Angeles Basin is characterized primarily by four sub-parallel structural blocks, composed of the Northeastern, Northwestern, Southwestern, and Central blocks, sliced longitudinally by the steeply dipping, northwest-trending Newport-Inglewood and Whittier fault zones. The Central Block is wedge-shaped in map view and extends from the Santa Monica Mountains on the northwest to, and including, the San Joaquin Hills to the southeast. The Central Block widens from approximately 10 miles in the northwest to more than 20 miles in the southeast. The northeastern margin of the Central Block underlies the Elysian and Puente Hills, located northeast to east of downtown Los Angeles.

The northern portion of the RSA is within the San Fernando Valley. The San Fernando Valley, which is part of the Northwestern Block of the Los Angeles Basin, is underlain by a thick (several thousand feet) sequence of Tertiary-age (66 to 2.58 million years ago) 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). Each formation is composed of rock layers alternating between sandstone, conglomerate, and siltstone.

The RSA transitions from the Northwestern Block of the Los Angeles Basin, at the Raymond Fault, to the Northeastern Block for approximately 5 miles and then transitions into the Central Block of the Los Angeles Basin in the Elysian Hills vicinity. The Central Block of the Los Angeles Basin is bounded to the northwest by the Santa Monica Mountains and the Transverse Ranges province and is bounded to the east and southeast by the Santa Ana Mountains and the San Joaquin Hills. To the west, the basin extends beneath the Pacific Ocean (Yerkes et al. 1965).

5.1.2 Geology

As described above, the area of Burbank to Los Angeles Project Section that would be located in San Fernando Valley is underlain by alluvial fan deposits. Older and younger Quaternary (Holocene through early Pleistocene age; 1.8 million years to 11,000 years or younger) alluvial fan deposits located in the San Fernando Valley (Yerkes and Campbell 2005; CGS 1997, 1998) 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 general geology and soils RSA (shown on Figure 5-1) consist of loose to moderately dense sand. Abbreviated unit descriptions of geologic units within the general geology and soils RSA are as follows:

- **Af—Artificial Fill:** Artificial fill extends along I-5 (Golden State Freeway) (CGS 1997, 1998). Other fill materials likely exist in areas scattered across the San Fernando Valley and the Los Angeles region; therefore, even though not shown on published maps, these materials potentially exist to some extent in the general geology and soils RSA. 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 would 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 are generally present near the Los Angeles River and extend from the northern to southern extent of the general geology and soils RSA. Qf deposits generally consist of unconsolidated gravelly, sandy, or silty alluvial deposits with cobbles and boulders; and are generally present on active and recently active streambeds.
- **Qyf—Young Alluvial Fan Deposits (Holocene to late Pleistocene):** Qyf are young alluvial fan deposits located in the northern and southern segments of the general geology and soils RSA. As described by Yerkes and Campbell (2005), Qyf consists of unconsolidated gravel, sand, and silt, with coarser-grained material closer to the mountains, deposited from flooding streams and debris flows.
- **Tpna—Puente Formation (late Miocene to early Pliocene):** The Puente Formation consists of marine sandstone, siltstone, and shale deposits with a maximum thickness of 8,500 feet in the Elysian Park Hills area (Lamar 1970). The Puente Formation within the general geology and soils RSA is found in the southern portion of the project section near the I-5/SR-110 interchange and in the vicinity of LAUS. These formations consist of very fine to very coarse-grained sandstone and siltstone.

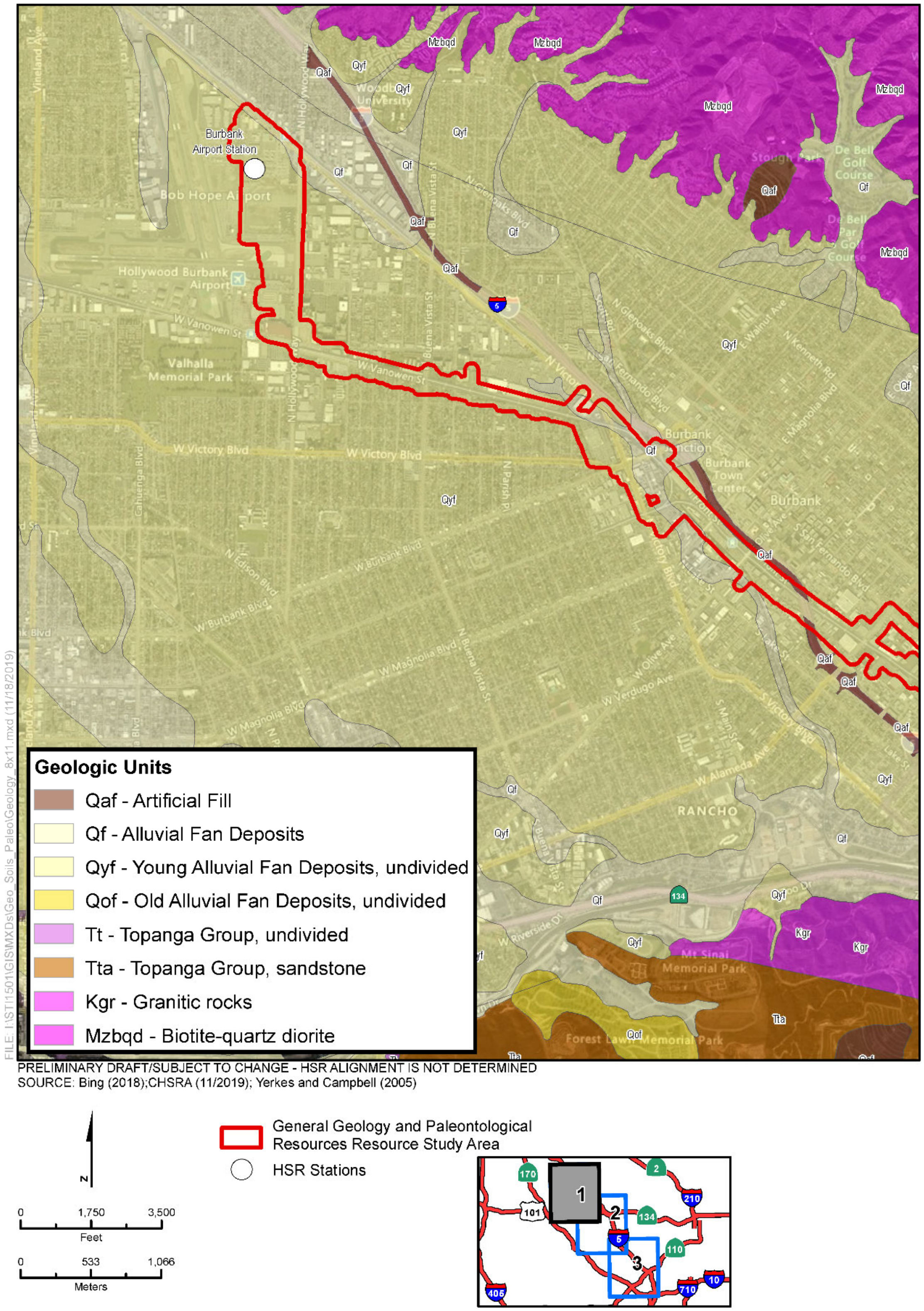

Figure 5-1 Geologic Units in the General Geology Resources Resource Study Area

(Sheet 1 of 3)

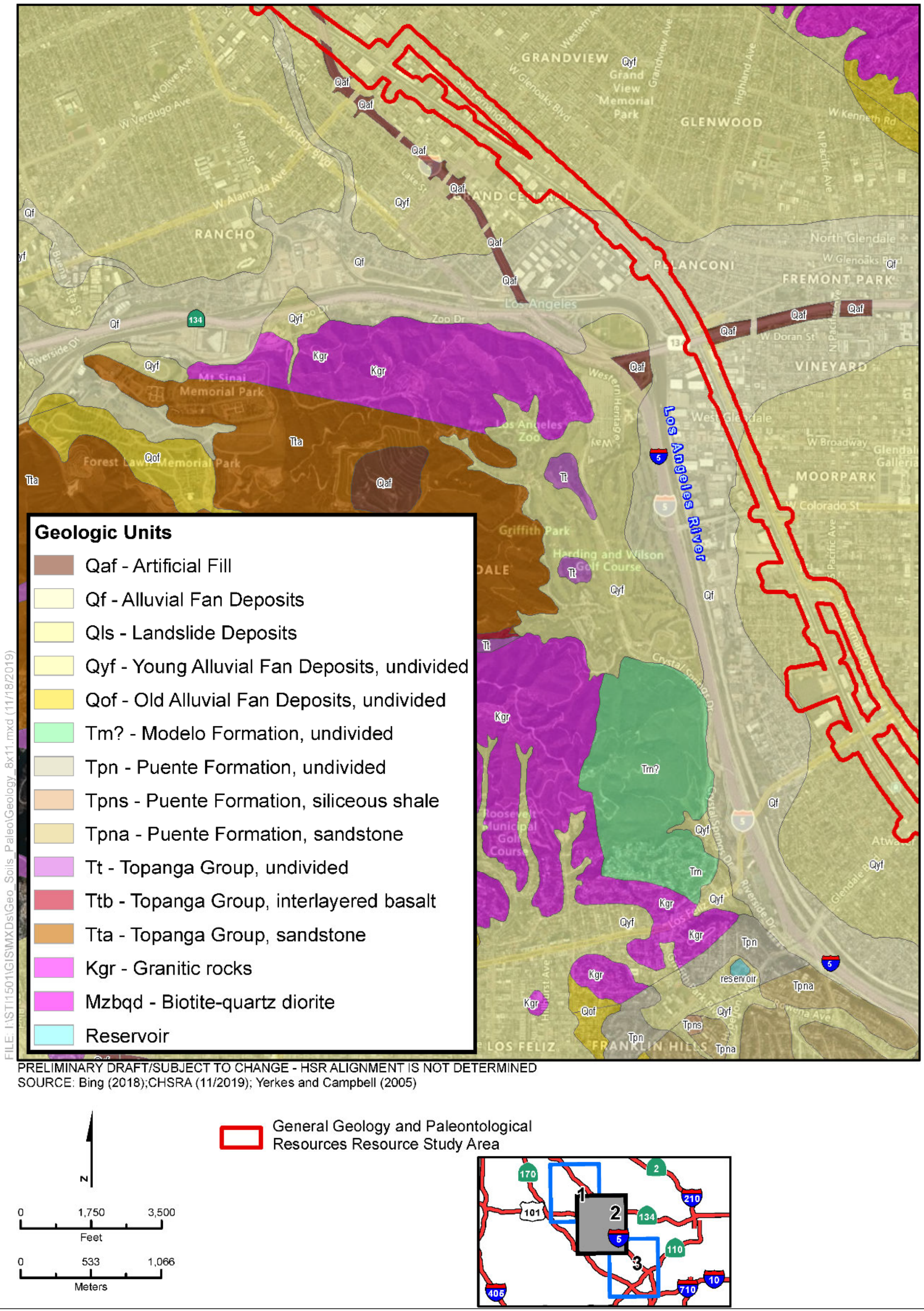

Figure 5-1 Geologic Units in the General Geology Resources Resource Study Area (Sheet 2 of 3)

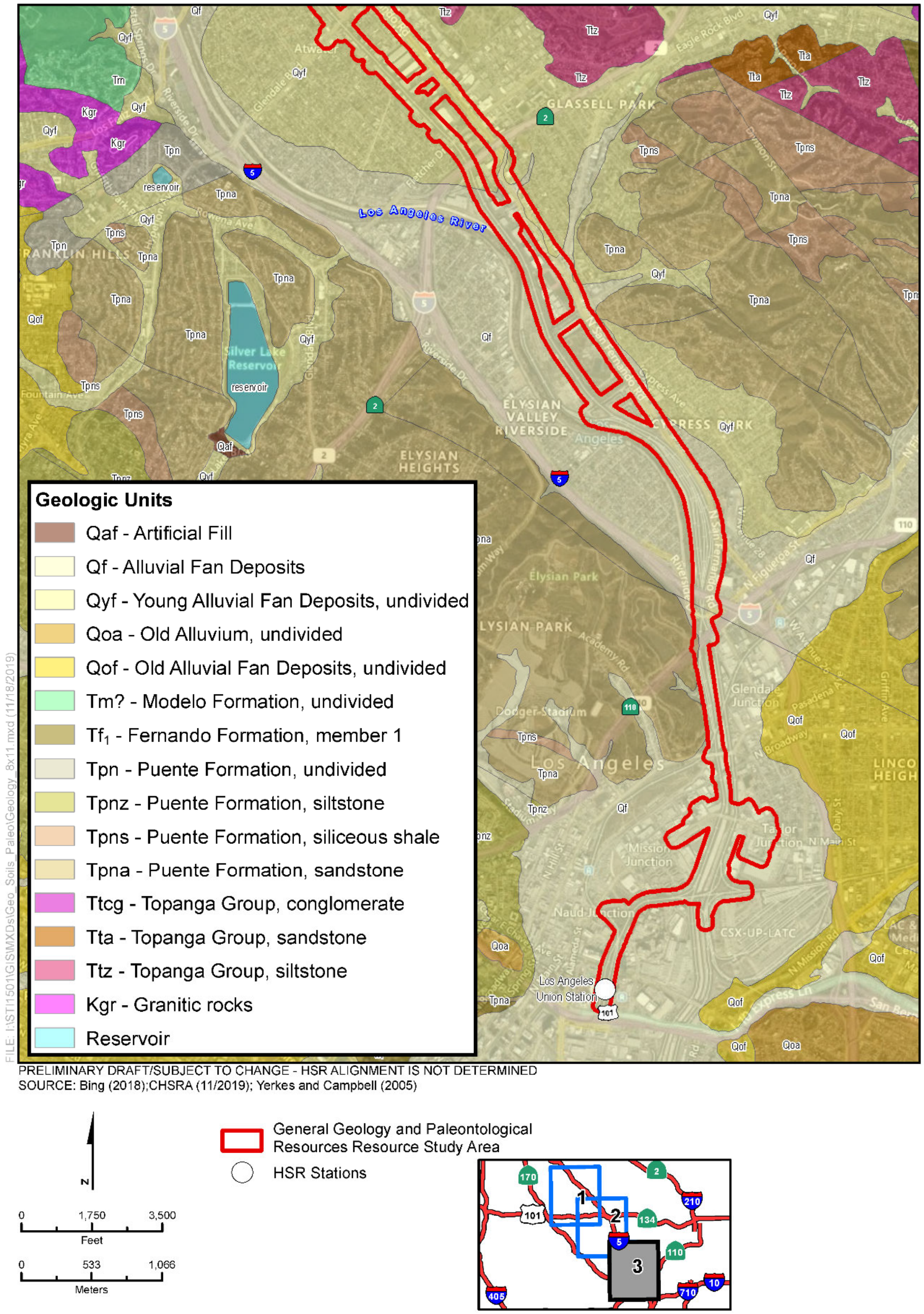

Figure 5-1 Geologic Units in the General Geology Resources Resource Study Area

(Sheet 3 of 3)

5.1.3 Groundwater

Groundwater levels are shallow throughout the city of Burbank within the RSA adjacent to the Los Angeles River, becoming deeper as the alignment travels farther away from the Los Angeles River in the city of Glendale. Groundwater levels become shallow again as the alignment nears the Los Angeles River in the city of Los Angeles. Based on the review of the Caltrans Logs of Test Borings and CGS data, groundwater at the southern segment of the RSA was detected in previous borings (not project-related) at approximately 25 feet below ground surface where the elevation was approximately 635 feet above MSL. Borings in the city of Burbank south of Alameda Avenue, where the elevation was approximately 680 feet above MSL, did not encounter groundwater. These reports were done over previous decades and groundwater elevations can change in conjunction with annual precipitation and groundwater pumping. Historically, groundwater has been as shallow as 20 feet below ground surface at the southern end of the RSA near the Los Angeles River (CGS 1997). The historically high groundwater levels specified by the CGS are shown on Figure 5-2. Historically high groundwater data was obtained by the CGS from technical publications, geotechnical boreholes, and water well logs dating back to the early 1900s (CGS 1998c). Section 5.2.1 has additional discussion of subsidence conditions within the RSA.

5.1.4 Soils

Soils within the resource hazards RSA have been mapped by the Natural Resources Conservation Service (NRCS), an agency within the U.S. Department of Agriculture (USDA; USDA/NRCS 2017). Figure 5-3 illustrates generalized soil associations within the resource hazard RSA and represents a recent database compiled by the NRCS. Soil types presented on the figure are summarized in Table 5-1, which also indicates each type's susceptibility to corrosion hazards. Depending on type, some soils are susceptible to erosion and/or expansive behavior, whereas others are more suitable for construction. Soil-type mapping, emphasizing a soil's agricultural and engineering properties, is conducted on a countywide (or geographic) basis using nomenclature that changes with time. Section 5.2.4 has additional discussion of soil conditions within the RSA.

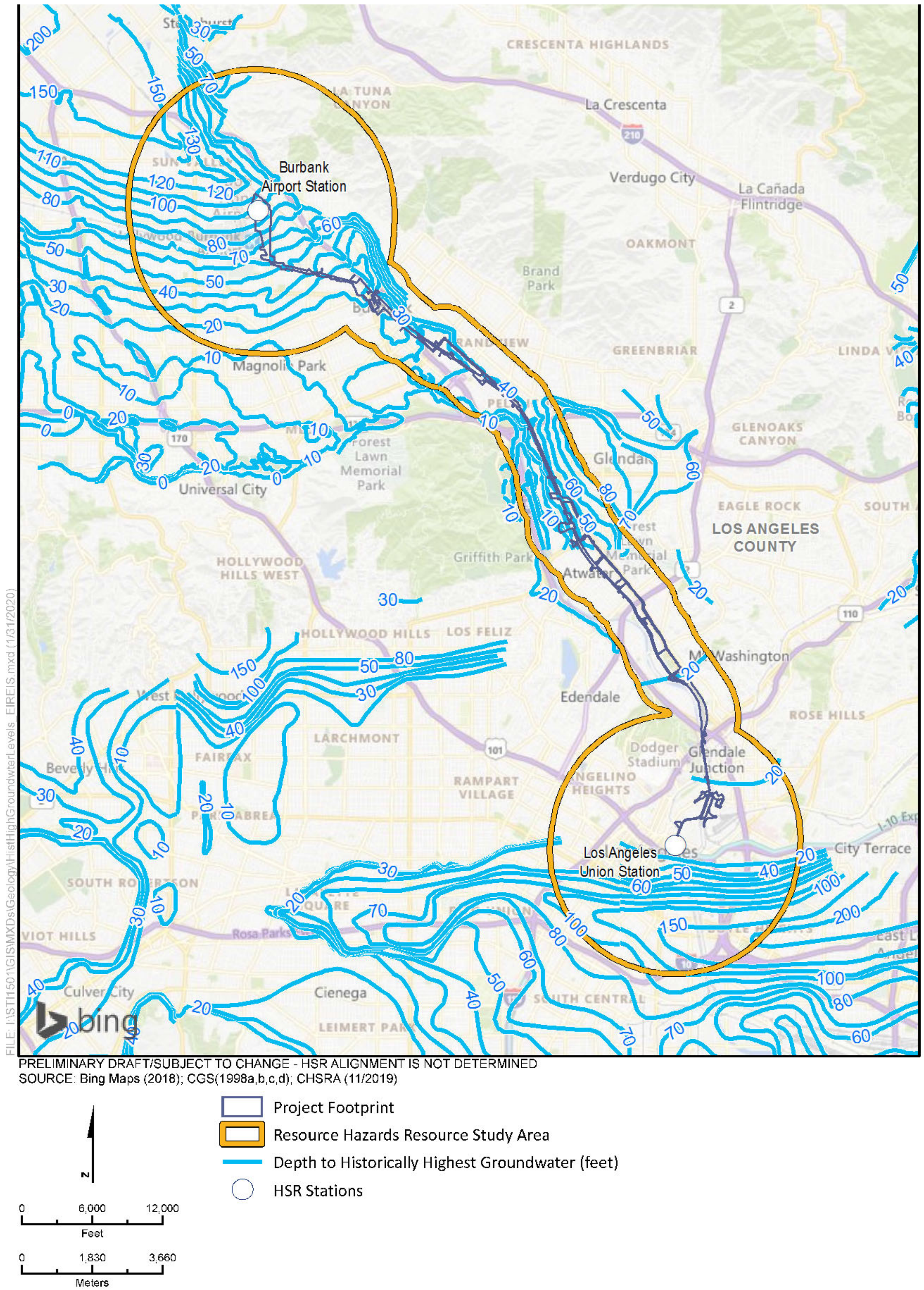

Figure 5-2 Historically High Groundwater Levels Map

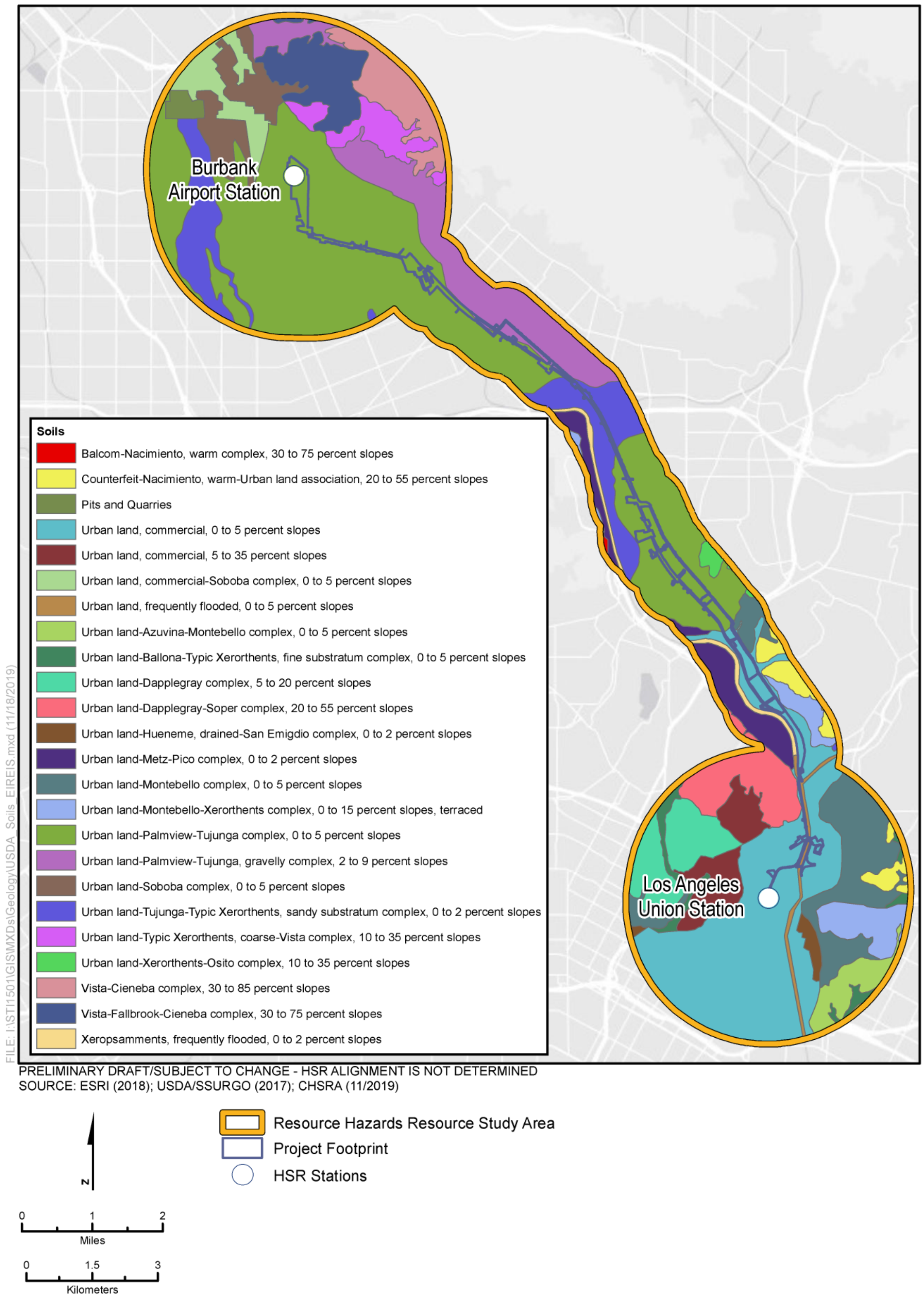

Figure 5-3 Soil Associations in the Resource Hazards Resource Study Area

Table 5-1 Properties of Major Soil Types Within the Resource Study Area

Soil Association Description		Risk of Corrosion-Uncoated Steel	Risk of Corrosion-Concrete	Erosion Potential	Expansion Potential
Urban land-Metz-Pico complex	Urban land	---	---	---	---
	Metz	High	Low	Low - High	Low - High
	Pico	Low	Low	Low - High	Low - Moderate
Urban land-Palmview-Tujunga complex	Urban land	---	---	---	---
	Palmview	Low	Low	Moderate	Moderate
	Tujunga	Low	Moderate	Low	Low - Moderate
Urban land-Palmview-Tujunga, gravelly complex	Urban land	---	---	---	---
	Palmview	Low	Low	Low - Moderate	Moderate
	Tujunga, gravelly	Low	Low	Low	Low
Urban land-Tujunga-Typic Xerorthents, sandy substratum complex	Urban land	---	---	---	---
	Tujunga	Low	Low	Low - Moderate	Low - High
	Typic Xerorthents, sandy substratum	Low	Low	Low - Moderate	Low - Moderate
Vista-Fallbrook-Cieneba complex	Vista	Low	Low	Low - Moderate	Low - Moderate
	Fallbrook	Moderate	Moderate	Low - Moderate	High
	Cieneba	Low	Low	Moderate	Moderate
Urban land-Xerorthents-Osito complex	Urban land	---	---	---	---
	Xerorthents, shallow	Low	Low	Moderate	Low - Moderate
	Osito	Low	Moderate	Low - Moderate	Moderate
Urban land, commercial	Urban land, commercial	---	---	---	---
Urban land, commercial	Urban land, commercial	---	---	---	---
Urban land-Montebello-Xerorthents complex	Urban land	---	---	---	---
	Montebello	Moderate	Low	Moderate	High
	Xerorthents, coarse fill	Moderate	Low	Low - Moderate	Moderate - High
Urban land-Montebello complex	Urban land	---	---	---	---
	Montebello	Moderate	Moderate	Moderate	High
Counterfeit-Nacimiento, warm-Urban land association	Counterfeit	Moderate	Low	Moderate	High
	Nacimiento, warm	Moderate	Low	Moderate	High
	Urban land	---	---	---	---
Urban land-Dapplegray-Soper complex	Urban land	---	---	---	---
	Dapplegray	Moderate	Low	Moderate	High
	Soper	Moderate	Low	Moderate	High
Urban land, frequently flooded	Urban land, frequently flooded	Low	Low	---	---

Soil Association Description		Risk of Corrosion-Uncoated Steel	Risk of Corrosion-Concrete	Erosion Potential	Expansion Potential
Xeropsamments, frequently flooded	Xeropsamments	High	Low	Low	Low

Source: U.S. Department of Agriculture, 2017

5.2 Geologic Hazards

A geologic hazard area is defined as an area that poses a potential threat to the health and safety of the general public when incompatible commercial, residential, or industrial developments are located in areas of significant geologic hazard. Two broad categories of geologic hazards exist: seismic and nonseismic. The following sections address the types of nonseismic hazards that could be considerations for the Burbank to Los Angeles Project Section. Rockfalls due to steep slopes are possible within the limits of the resource hazards RSA. There are steep slopes (varying from vertical to a horizontal-to-vertical ratio of 1.5:1) within some portions of the resource hazards RSA: however, the majority of the RSA occurs within well-developed urban areas. In order to identify the areas of steep slopes and evaluate the potential for rockfalls to occur within the resource hazards RSA, a comprehensive geotechnical/geological investigation program must be performed; therefore, discussions on rockfalls were omitted from this analysis. The comprehensive geotechnical/geological investigation program is an industry standard required by reviewing agencies and would be conducted during a future design phase. Seismic-related geologic hazards are presented in Section 5.3 and Section 5.4.

5.2.1 Landslide Hazards

Landslides may occur in areas of generally moderate-to-steep topography (e.g., commonly, slopes greater than a horizontal-to-vertical ratio of 3:1) where a combination of soil, rock, and groundwater conditions results in ground movement. Landslides can be initiated by soil saturation, earthquakes, volcanic activity, changes in groundwater, disturbance, a change of a slope by construction activities, or any combination of these factors.

A small area near the I-5/SR 110 interchange (Elysian Park area), the area aligning with Griffith Park and an area near the northeast portion of Hollywood Burbank Airport have been mapped by CGS as seismic landslide hazard zones. A comprehensive geotechnical investigation program would assess the likelihood of slope failure at this area as well as other areas along the Burbank to Los Angeles Project Section. The comprehensive geotechnical/geological investigation program is an industry standard required by reviewing agencies and would be conducted during a future design phase.

5.2.2 Ground Subsidence

Land subsidence is a form of ground settlement that usually results from change in fluid content within soil or rock. The volume change can result from localized dewatering of peat, organic soils, or soft silts and clay. Ongoing decomposition of organic-rich soils may also result in land subsidence. This type of subsidence generally occurs in localized areas.

A second type of land subsidence is from a regional withdrawal of groundwater, petroleum, or geothermal resources from sedimentary source rocks. It 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 or well. If the volume of water or petroleum removed is sufficiently great, the amount of resulting subsidence may suffice to cause damage to nearby engineered structures.

While the potential for ground subsidence exists, the RSA is not within areas of documented land subsidence (USGS 2016b). A comprehensive geotechnical/geological investigation program conducted during final design would assess the magnitude and extent of ground subsidence as a result of localized dewatering of peat, organic soils, and soft silts and clays. The comprehensive geotechnical/geological investigation program is an industry standard required by reviewing agencies and would be conducted during a future design phase.

5.2.3 Poor Soil Conditions

Generally, soils can be classified as competent (capable of resisting maximum considered earthquake-level forces while experiencing small deformations), poor (traditionally characterized as having a standard penetration of N[9]<10 [i.e., structures placed within poor soils require project-specific design criteria that addresses soil structure-related phenomena]), or marginal (the range of soils that cannot readily be classified as either competent or poor). Soil conditions that may have a negative effect on engineered facilities include expansive potential, corrosion potential, collapsible properties, and erosion potential. These property characteristics are presented below.

5.2.3.1 Expansive Soils

Expansive soils shrink and swell significantly as they lose and gain moisture. The resulting volumetric changes can heave and crack lightly loaded foundations and structures. Soils are generally classified as having low, moderate, and high expansive potentials, where the type and percentage of clay particles present in the soil are indicative of the soil's expansion potential. Predominantly fine-grained soils containing a high percentage of clays are potentially expansive, whereas predominantly coarse-grained soils such as sands and gravels are generally non-expansive. Localized areas underlain by expansive soils are likely to occur within the resource hazards RSA given the Burbank to Los Angeles Project Section's regional geologic circumstances. A comprehensive geotechnical/geological investigation program conducted during final design would determine the locations of expansive soils as well as their deformation potential. The comprehensive geotechnical/geological investigation program is an industry standard required by reviewing agencies. Soil types within the resource hazards RSA with the potential to cause expansion to infrastructure are indicated in Table 5-1.

5.2.3.2 Soil Corrosivity

Soil corrosivity involves the measure of the potential of corrosion for steel and concrete caused by contact with some types of soil. Knowledge of potential soil corrosivity is often critical for the effective design parameters associated with cathodic protection of buried steel and concrete mix design for plain or reinforced concrete buried project elements. Factors—including soil composition, soil and pore water chemistry, moisture content, and pH—affect the response of steel and concrete to soil corrosion. Soils with high moisture content, high electrical conductivity, high acidity, high sulfates, and high dissolved salts content are most corrosive. Generally, sands and silty sands do not present a corrosive environment. Clay soils, including those that contain interstitial salt water, can be highly corrosive. Soil types within the resource hazards RSA with the potential to cause corrosion to infrastructure are indicated in Table 5-1.

While no corrosion test results from subsurface soils were available for the project site, sands and silty sands are expected to be encountered within the resource hazards RSA. These soil types typically do not present a corrosive environment. However, highly corrosive soils may potentially be present within the resource hazards RSA.

5.2.3.3 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. However, not all of these soil types (aeolian, alluvial, or colluvial) are collapsible. Artificial fills that are loose and unconsolidated may also be subject to collapse. When these soils are saturated from irrigation water or a rise in the groundwater table, pores and voids between the soil particles are removed, and the soils collapse.

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[9] N = The uncorrected blow count from the Standard Test Method for Penetration Test and Split-Barrel Sampling of Soil.

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. Based on previous data in the area, soils with collapse potential may exist in isolated areas of the resource hazards RSA would be identified in a comprehensive geotechnical/geological investigation program. The comprehensive geotechnical/geological investigation program is an industry standard required by reviewing agencies and would be conducted during a future design phase.

5.2.3.4 Erodible Soils

Erosion includes the detachment and transportation of soil materials by wind or water. Rainfall and potential surface runoff may produce different types of erosion. Potentially erosive conditions are identified as areas having a combination of potentially erosive soils and uncovered slopes.

Certain soil types demonstrate a higher potential for erosion by rainfall and runoff than other soil types. Soil erodibility depends upon many factors, including grain size, organic matter content, structure, permeability, and percentage of rock fragments. This is expressed in the Revised Universal Soil Loss Equation by a factor designated as "K," the soil erodibility factor. K is defined as a function of texture, organic matter content and cover, structure size class, and subsoil-saturated hydraulic conductivity. Fine-textured soils, which are high in clay, express low erodibility because the strong adherence between individual particles reduces their ability to detach. Coarse-textured soils also have low erodibility because their ability to rapidly infiltrate water reduces surface runoff rates. Medium-textured soils, which are high in silt, have the greatest potential for erosion. The potential for erosion of the onsite soils within the resource hazards RSA is summarized in Table 5-1. Per Table 5-1, Metz and Pico soil associations, which are generally mapped in the central to southern portions of the resource hazards RSA near the Los Angeles River, are presumed to have high erosion potential.

Soils on steep slopes are often erodible, especially during heavy rain events. In addition, soils and alluvial deposits present in stream channels are susceptible to erosional scour, especially around foundation elements where erosive forces can be concentrated. Within the resource hazards RSA (as discussed in Section 5.2.1) a small area at the south end near the I-5/SR 110 interchange (near Elysian park), a portion in the central area aligning with Griffith park, area near the northwest portion of Hollywood Burbank Airport which are mapped by CGS as landslide hazard zone may be susceptible to erosion.

Scour, or concentrated stream erosion, is a naturally occurring geomorphic process that can be initiated or accelerated by altering the flow of a stream. The introduction of structures to a stream channel can change the cross-sectional area and/or current patterns, and potentially initiate scour. Scour analysis is required to determine the necessary depth of bridge abutments and piers based on the procedures and guidelines presented in the Federal Highway Administration Evaluating Scour at Bridges, HEC-18 (Federal Highway Administration 1990). Within the resource hazards RSA, the alluvial soils near the Los Angeles River and Verdugo Wash are considered potentially subject to scour.

5.2.4 Areas of Difficult Excavation

Areas of difficult excavation are defined as those requiring more than standard earth-moving equipment or requiring special controls that enable excavation to proceed. Difficult excavation is most likely to occur in bedrock formations and possibly cemented or hardpan strata not amenable to excavation with a ripper-equipped bulldozer. The use of rippers and roadheaders would take place in weaker strength rock or highly weathered and/or jointed rock masses. The depth to bedrock within the resource hazards RSA ranges from outcrops near Elysian Park to hundreds of feet deep at either end of the resource hazards RSA. A comprehensive geotechnical/geological investigation program conducted during final design would determine areas of difficult excavation.

The comprehensive geotechnical/geological investigation program is an industry standard required by reviewing agencies.

5.3 Primary Seismic Hazards

Primary seismic hazards are those hazards directly associated with earthquakes and include ground surface fault rupture and strong ground shaking. The HSR Build Alternative is within a seismically active area that has a documented history of significant and recurrent seismic activity and may be subject to moderate to severe ground shaking. Within the resource hazards RSA, there are hazardous fault crossings at the Verdugo, Hollywood, and Raymond faults, as shown in Figure 5-4. There are also potentially hazardous faults in the region that could produce significant ground shaking within the resource hazards RSA. Faults crossing near the resource hazards RSA are detailed in the sections below and categorized by activity level.

5.3.1 Surface Fault Rupture

Surface fault rupture refers to the extension of a fault from depth to the ground surface along which the ground breaks, resulting in displacement, such as vertical or horizontal offset. Surface fault ruptures are the result of stress relief during an earthquake event and often cause damage to structures within the rupture zone.

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. Regional faults of concern are:

- Strike-slip faults (e.g., San Andreas, San Jacinto, Elsinore, Newport-Inglewood), which are vertical fractures where the blocks have mostly moved horizontally.
- Normal, reverse, and thrust faults (e.g., Santa Monica, Hollywood, Sierra Madre, San Fernando, Palos Verdes, Raymond, and Verdugo) which are inclined fractures where the blocks have mostly shifted vertically. If the rock mass above an inclined fault moves down, the fault is termed normal, whereas if the rock above the fault moves up, the fault is termed reverse. A thrust fault is a reverse fault with a dip of 45 degrees or less.
- Blind (buried) thrust faults (e.g., Puente Hills, Northridge, and Elysian Park) which do not rupture all the way up to the surface, so there is no evidence of it on the ground.

California’s Alquist-Priolo Earthquake Fault Zoning Act (AP Act; CGS 1994a) was enacted to identify and to reduce the hazard from surface fault rupture by regulating development projects near active faults. The purpose of the AP Act is to prohibit the location of most structures intended for human occupancy across the trace of an active fault. The AP Act requires that projects in defined “Earthquake Fault Zones” conduct geologic investigations that demonstrate that the sites are not threatened by surface displacement from future fault rupture. To be zoned under the AP Act, a fault must be considered active, or both sufficiently active and well-defined (CGS 1997). The CGS defines an active fault as one that has had surface displacement within Holocene time (approximately the last 11,000 years); and a sufficiently active fault as one that has evidence of Holocene surface displacement along one or more of its segments or branches (CGS 1997). The CGS considers a fault to be well defined if its trace is clearly detectable as a physical feature at or just below the ground surface. The City of Los Angeles Safety Element (1996) identifies a Fault Rupture Study Area similar to an Alquist-Priolo Earthquake Fault Zone where fault rupture potential is less well known and is less than that required for the Alquist-Priolo Earthquake Fault Zone designation.

To reduce confusion concerning fault activity and to avoid duplication of the terms “active” and “potentially active” (which are codified in the text of the AP Act), this document follows the nomenclature proposed by Technical Memorandum 2.9.3 (Authority 2011b) and Technical Memorandum 2.10.6 (Authority 2010b). These documents define fault activity levels as follows:

- **Hazardous Faults:** Faults that, as documented in peer-reviewed reports, have slip rates greater than or equal to 1 millimeter per year and/or equal to or less than 1,000-year recurrence interval. This type of fault is designated as “active” under the AP Act.

- **Potentially Hazardous Faults:** Faults that have known or documented Holocene activity or known Quaternary faults with suspected Holocene activity. This type of fault is designated as "potentially active" under the AP Act.

5.3.1.1 Hazardous Faults

Faults near or crossing the HSR Build Alternative are shown in Table 5-2. According to the General Plans for the cities of Burbank and Glendale, the Verdugo, Hollywood, and Raymond faults have the potential to cause surface fault rupture within the resource hazards RSA. The Verdugo fault is approximately 1.5 miles northeast of the project alignment near the proposed locations of three grade separations (Sonora Avenue, Grandview Avenue, and Flower Street). The faults discussed in this section and shown on Figure 5-4 are considered in the City of Los Angeles Safety Element (1996). A portion of the resource hazards RSA, approximately from SR 134 to south to Tyburn Street in the city of Los Angeles, falls within a Fault Rupture Study Area.

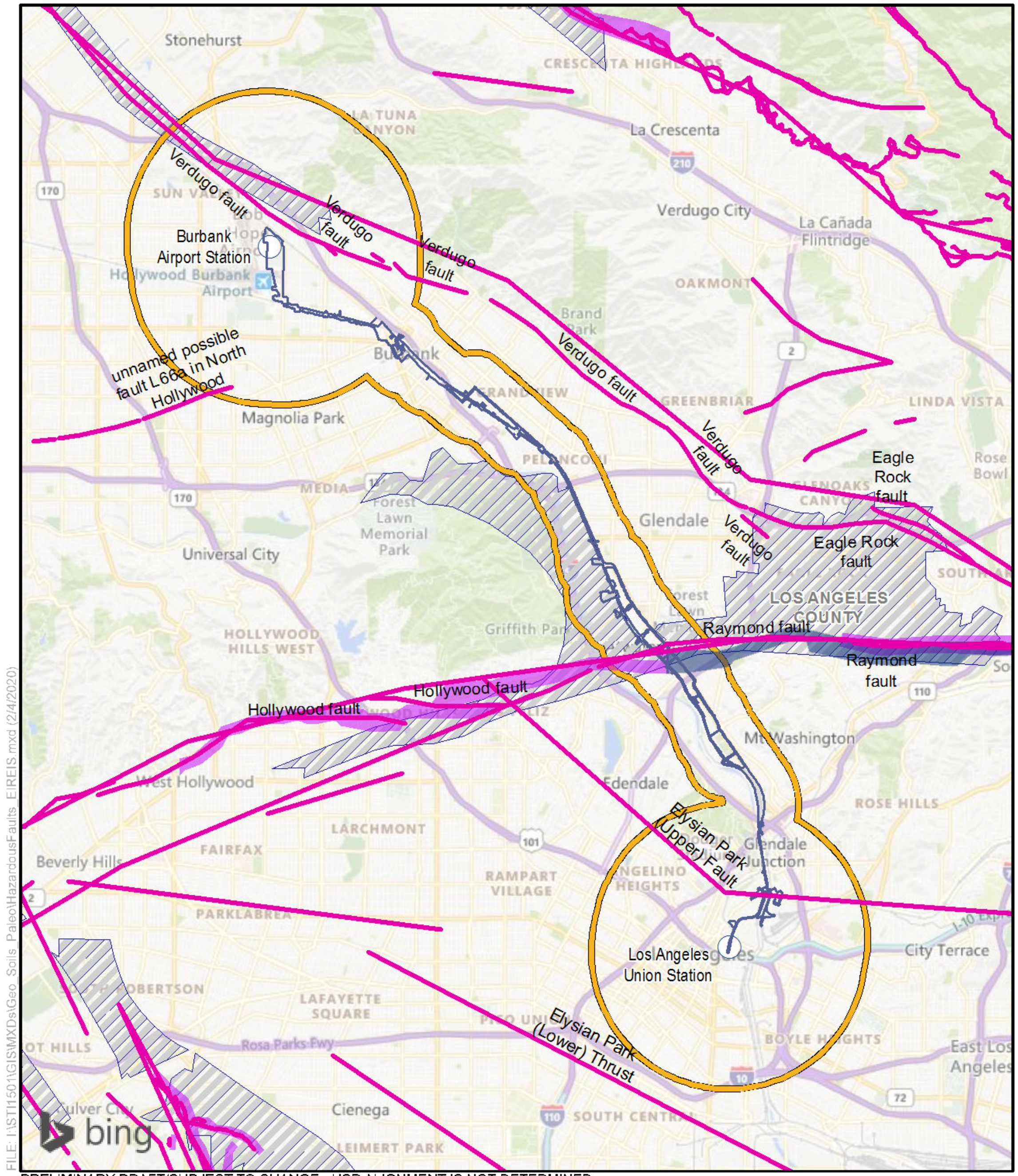
Table 5-2 Hazardous and Potentially Hazardous Faults Near or Crossing the HSR Build Alternative

Fault Name	Fault Type	Slip Rate, (mm/yr)[1]	Probable Maximum Earthquake Magnitude	Approximate Distance and Bearing to HSR Build Alternative
Verdugo	Reverse	0.5	6.9	Located 0.3 mile northeast of the Burbank Airport Station and 1.5 miles northeast parallel to the alignment near the proposed locations of three grade separations (Sonora Avenue, Grandview Avenue, and Flower Street).
Hollywood	Strike-slip	1.0	6.7	Crosses the HSR Build Alternative just north of SR-2.
Raymond	Strike-slip	2.0	6.8	Crosses the HSR Build Alternative just north of SR-2.
Elysian Park (Upper)	Reverse	1.9	6.7	Crosses the HSR Build Alternative just north of Los Angeles Union Station
Possible fault in North Hollywood (Unnamed fault L66a)	Unspecified	Not available	Unspecified	Located 1.5 miles southwest of the intersection of N Hollywood Way and Vanowen Street

Sources: U.S. Geological Survey and supporting agency California Geological Survey, 2006; Southern California Earthquake Data Center, 2016
mm/yr = millimeters per year
SR = State Route
1 = Values obtained from the U.S. Geological Survey website on U.S. Quaternary Fault and Fold Database page

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 Alquist-Priolo Earthquake Fault Zone. Weber et al. (1980) reported possible fault scarps 6 to 10 feet high in Qyf/Qf-age deposits in the Burbank area.



PRELIMINARY DRAFT/SUBJECT TO CHANGE - HSR ALIGNMENT IS NOT DETERMINED
SOURCE: Bing Maps (2018); City of Los Angeles (1996), CGS (1994, 2010), USGS (2015); CHSRA (11/2019)

- Resource Hazards Resource Study Area
- Project Footprint
- HSR Stations
- Faults Crossing Resource Hazards Resource Study Area
- Alquist-Priolo Earthquake Fault Zone
- Preliminary Alquist-Priolo Earthquake Fault Zone
- Fault Rupture Study Areas

N

0 6,000 12,000
Feet

0 1,830 3,660
Meters

Figure 5-4 Faults near or crossing the Resource Hazards Resource Study Area

The General Plans for the cities of Burbank and Glendale address the potential for seismic activity of the Verdugo fault in more detail from a planning perspective. The City of Glendale (2003), in its 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) 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 [C]ity 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."

Hollywood Fault

The CGS (2010) shows the Hollywood fault projecting from approximately 1.25 miles west of the city of Los Angeles and city of Glendale boundary near Tyburn Street. The Southern California Earthquake Data Center (SCEDC 2016), states that a rupture of the entire fault zone could produce an earthquake of a magnitude ranging from 6 to 7. The dip of the fault (the angle of inclination from horizontal) is estimated to be about 70 degrees dipping north (SCEDC 2016). The City of Glendale General Plan also recognizes the fault zone. The Hollywood fault is a strike-slip fault of about 17 kilometers (10.5 miles) in length.

Raymond Fault

The CGS (2010) shows the Raymond fault transecting the HSR Build Alternative near Tyburn Street at the boundary between the city of Los Angeles and the city of Glendale. The Southern California Earthquake Data Center (2016) states that a rupture of the entire fault zone could produce an earthquake of a magnitude ranging from 6 to 7. The dip of the fault (angle of inclination from horizontal) is estimated to be about 79 degrees dipping north (Southern California Earthquake Data Center, 2016). The City of Glendale General Plan also recognizes the fault zone. The Raymond fault is a strike-slip fault of about 22 kilometers (13.7 miles) in length.

Elysian Park (Upper)

The CGS (2010) shows the Elysian Park (Upper) Fault parallel to the HSR Build Alternative and crossing Raymond fault. The national seismic hazard maps—source parameters models the earthquake magnitude range from 6.5 to 6.7 with a slip rate of 1.3 millimeters per year (0.05 inch). The dip of the fault is estimated to be 50 degrees, dipping to the northeast. Elysian Park (Upper) is a reverse fault of about 20 kilometers (12.4 miles) in length.

Unnamed Fault L66a

The CGS (2010) shows unnamed fault L66a projecting from approximately 1.5 miles southwesterly from Burbank Airport Station and the HSR Build Alternative. The fullest description of this fault (identified as unnamed fault L66a by Weber, et.al. [1980]) indicates that it is defined on the 1901 USGS 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 may be associated with subsidence north of the Benedict Canyon Fault. Given the south-facing break in slope and the subsidence observed north of the Benedict Canyon Fault, L66a is inferred to be an east-trending fault. The unnamed fault L66a lies outside any City of Los Angeles Fault Rupture Study Area.

5.3.1.2 Other Faults

Other smaller, potentially hazardous faults, such as the Northridge Hills fault and the unnamed fault in North Hollywood, are northwest of the HSR Build Alternative. Uncertainty remains 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 fault (the source of the 1994 Northridge earthquake) underlies northeastern San Fernando Valley at a depth of several thousand feet. There are many hazardous and potentially hazardous faults in the seismicity RSA (i.e., within 30 miles of the HSR Build Alternative as shown on Figure 5-5**Error! Reference source not found.**). These faults are listed in Table 5-3 and Table 5-4 respectively.

Table 5-3 Hazardous Faults in the Seismicity Resource Study Area

Fault	Approximate Distance from HSR Build Alternative (miles)	Type of Fault	Recurrence Interval (years)[1]	Slip rate (mm/yr)[1]	Maximum Earthquake Magnitude
Hollywood Fault	0	Strike-slip	6,000 to 11,000	1	6.7
Raymond Fault	0	Strike-slip	3,000 to 5,000	2	6.8
Elysian Park (Upper)	0	Reverse	NA	1.9	6.7
Elysian Park Thrust (Lower CFM)	2.3	Thrust	340 to 540	1.7	Unspecified
Santa Monica Fault alt 2	4.8	Strike-Slip	7000 to 8000	2.4	7.4
Sierra Madre Fault	500 to 7,500	Reverse	625	3	7.3
Northridge Thrust	6.9	Thrust	NA	1.5	6.9
Sierra Madre Fault (San Fernando)	7.6	Reverse	200 to 2,000	2	7.3
San Gabriel Fault Zone	8.5	Strike-Slip	NA	1	7.3
Newport-Inglewood Fault Zone	8.5	Strike-Slip	1,200 to 3,000	1.3	7.3
Santa Monica alt 2	9.8	Strike-Slip	7,000 to 8,000	2.4	7.3
Whittier Fault alt 1	10.5	Strike-Slip	1,800 to 3,050	1 to 5	NA
Sierra Madre, Santa Susana Section	14.3	Reverse	NA	5	6.9
Simi-Santa Rosa Fault Zone	15.0	Strike-Slip	1,000	1	6.9
Compton Thrust	17.8	Thrust	700 to 13,700	0.2 to 1	Unspecified
Palos Verdes Fault Zone	17.6	Strike-Slip	NA	3	7.7
San Cayetaro Fault	19.2	Thrust	NA	6	7.2
Redondo Canyon Fault alt 2	22	Reverse	NA	0.2 to 1	Unspecified
Oak Ridge Fault	25.5	Reverse	NA	3.6	7.4
Anacapa-Dume Fault alt 2	26.3	Thrust	NA	3	7.2
San Andreas Fault Zone	29.7	Strike-slip	100 to 135	29	7.56

Source: U.S. Geological Survey National Seismic Hazard Maps, 2008
Distances measured from the nearest fault trace to the HSR Build Alternative
1 = Values obtained from U.S. Geological Survey online website on U.S. Quaternary Fault and Fold Database page
alt = fault model
HSR = high-speed rail
NA = Not Available
Unspecified = Unspecified in the U.S. Geological Survey online Faults Database

Table 5-4 Potentially Hazardous Faults in the Seismicity Resource Study Area

Fault	Approximate Distance from HSR Build Alternative (miles)	Type of Fault	Recurrence Interval (years)[1]	Slip rate (mm/yr)[1]	Maximum Earthquake Magnitude
Verdugo Fault	0.3	Reverse	NA	0.5	6.9
Possible Fault in North Hollywood (Unnamed Fault L66a)	1.5	Unspecified	NA	NA	Unspecified
Eagle Rock Fault	2.5	Thrust	NA	NA	Unspecified
Puente Hills Thrust (Los Angeles)	4.5	Thrust	NA	0.7	7.0
Mission Hills Fault	8.0	Reverse	NA	NA	Unspecified
Puente Hills Thrust (Santa Fe Springs)	11.5	Thrust	NA	0.7	6.7
Chatsworth Fault	14.1	Unspecified	NA	NA	6.8
Clamshell-Sawpit	14.3	Reverse	2900	0.5	6.7
Anaheim	16.1	NA	NA	NA	NA
Holser Fault	18.6	Reverse	NA	NA	6.8
Del Valle Fault	18.8	Reverse	NA	NA	NA
San Jose Fault	20.0	Strike-slip	NA	0.5	6.7
Malibu Coast Fault	20.2	Strike-slip	NA	0.3	7.0
Yorba Linda Fault	24.5	NA	NA	NA	NA
Chino Fault alt 1	28.2	Strike-slip	9,500 to 11,600	0.06	NA
San Pedro Basin Fault	30.0	Strike-slip	NA	NA	Unspecified

Source: U.S. Geological Survey National Seismic Hazard Maps, 2008
Distances measured from the nearest fault trace to the HSR Build Alternative
alt = fault model
HSR = high-speed rail
1 = Values obtained from U.S. Geological Survey website on U.S. Quaternary Fault and Fold Database page
NA = Not Available
Unspecified = Unspecified in the U.S. Geological Survey online Faults Database

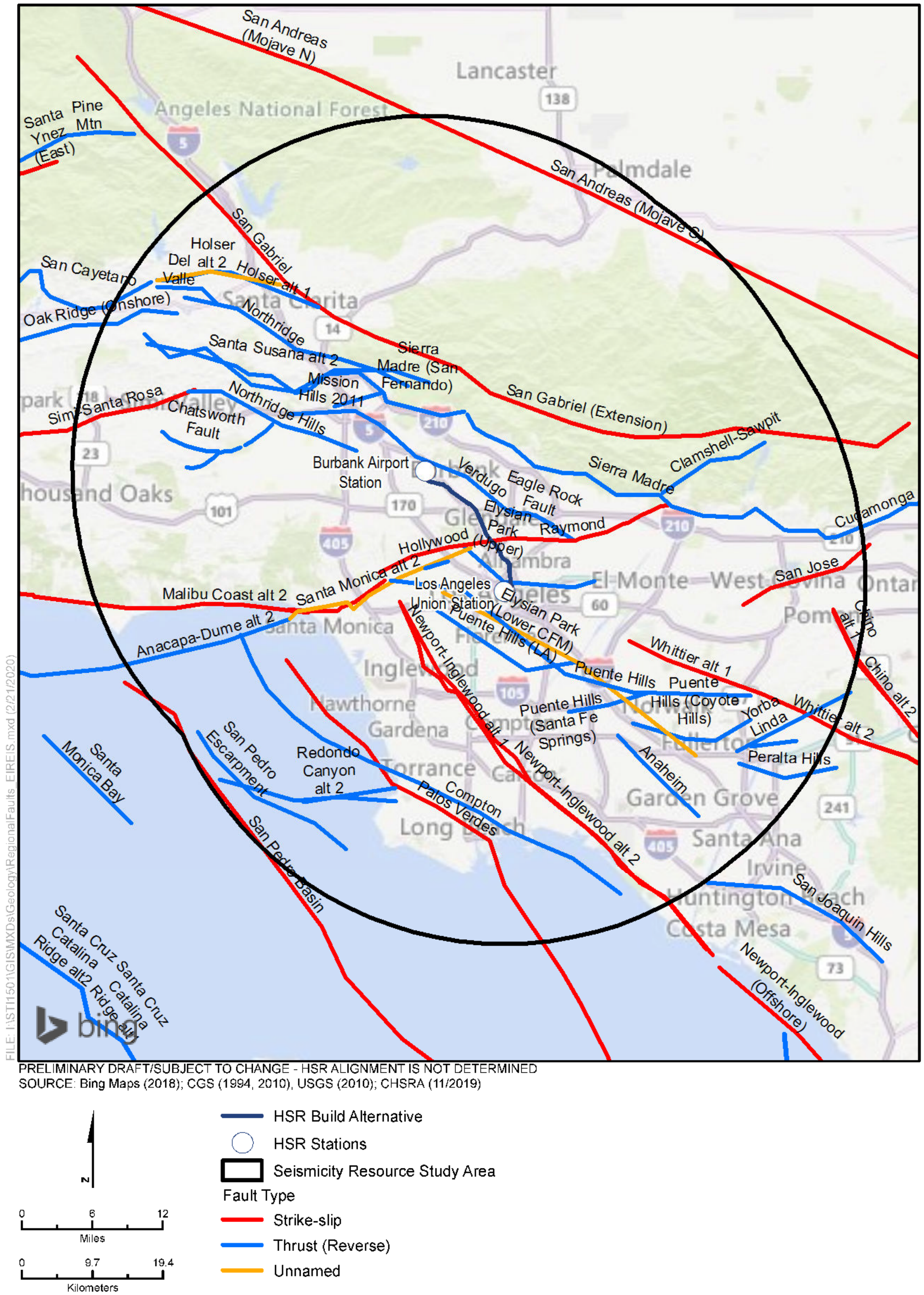


Figure 5-5 Hazardous and Potentially Hazardous Faults in the Seismicity RSA

5.3.2 Historic Seismicity

Southern California is one of the most seismically active regions in the U.S. The major seismic events in terms of their magnitude and the extent of the damage caused are summarized in Table 5-5. The largest magnitude earthquake recorded was a magnitude 7.9 along the San Andreas Fault at Fort Tejon on January 9, 1857. The most damaging earthquakes in the Los Angeles Basin have been the San Fernando event on February 9, 1971 (Magnitude 6.4) and the Northridge event on January 17, 1994 (Magnitude 6.7).

Table 5-5 Significant Seismic Events in Southern California

Date	Location/Event	Magnitude	Latitude (degrees)	Longitude (degrees)	Distance to HSR Build Alternative (miles)
09 Jan 1857	Fort Tejon	7.9	35.30	-119.80	110.34
21 Jul 1952	Kern County	7.7	35.00	-119.02	64.75
28 Jun 1992	Landers	7.3	34.20	-116.44	105.13
16 Oct 1999	Hector Mine	7.1	34.59	-116.27	117.47
19 May 1940	Imperial County	6.7	32.73	-115.50	182.55
17 Jan 1994	Northridge	6.7	34.21	-118.54	8.85
09 Feb 1971	San Fernando	6.4	34.41	-118.40	12.53

Source: U.S. Geological Survey, 2010
HSR = high-speed rail

5.3.3 Seismic Ground Motion

Ground shaking occurs in response to energy released during an earthquake or fault rupture. The energy travels through subsurface rock, sediment, and soil materials, resulting in motion experienced at the ground surface. Ground shaking intensity varies with the magnitude of the earthquake, the distance from the source of energy release, and the type of rock or sediment through which the seismic waves travel. Depending on the level of ground motion and the stiffness of the soil, the ground motions can amplify or de-amplify.

Table 5-2 and Table 5-4 present a list of hazardous and potentially hazardous faults within the seismicity RSA, along with the approximate closest distance from the HSR Build Alternative to these faults. Figure 5-5 illustrates the locations of these faults within the seismicity RSA.

The HSR Build Alternative would be subject to strong seismic shaking from moderate to large earthquakes occurring along any of the major active faults in the region. The intensity of the ground shaking at a given location depends primarily on the earthquake magnitude, source-to-site distance, fault length, style of faulting, dip angle, and slip rate, among several other factors. Ground motion is greatly amplified in areas underlain by deep deposits of loose, unconsolidated soils.

The area surrounding the HSR Build Alternative has been classified as Seismic Zone 4 by the most recent California Uniform Building Code (2016). The entire HSR Build Alternative is included in Seismic Zone 4 (1 in 10 chance that an earthquake with an active peak acceleration level of 0.40g [4/10 the acceleration of gravity] will occur in the next 50 years).

The intensity of the ground shaking estimated in terms of Geometric Mean Peak Ground Acceleration (PGA). American Society for Civil Engineer Standard ASCE/SEI 7-10 presents PGA across the United States. The maps are derived from ground-motion data calculated on a grid of sites across the United States. The PGA was estimated for maximum considered earthquake defined as an earthquake with a probability of exceedance of 2 percent in 50 years (a return period of 2,475 years), which is adopted by the Authority (2010) as the upper limit ground motion for seismic design consideration. The contours of PGA expressed as a percentage of the acceleration of gravity (g), are presented on Figure 5-6. These figures and the PGAs are provided to describe the affected environment and do not reflect the final seismic design criteria specified by the Authority.

5.4 Secondary Seismic Hazards

Secondary seismic hazards include phenomena that occur as a result of ground shaking, such as seismically induced liquefaction, lateral spreading, landslides, floods, dam failure, seiches, and tsunami.

5.4.1 Liquefaction

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.

In the cities of Burbank, Glendale, and Los Angeles, the HSR Build Alternative would be in areas identified by CGS (CGS 1998a, 1998b, 1998c, and 1998d) to be potentially susceptible to liquefaction. The specific areas are shown on Figure 5-7.

5.4.2 Lateral Spreading

Lateral spreading is permanent lateral ground displacement that can occur during liquefaction on gently sloping or level ground where the surficial soils move toward slope faces such as those of bridge abutments, and river and stream banks. The failed soils may exhibit a rapid, fluid-like flow. Lateral spreading potential exists at the same locations identified by CGS as having potential for liquefaction. These locations are shown on Figure 5-7.

5.4.3 Seismically Induced Landslide Hazards

Seismically induced landslides occur when shaking from an earthquake causes pre-existing landslides to reactivate or triggers new landslides along planes of weakness in bedrock material. Marginally stable slopes may be subject to landslides caused by seismic shaking. In most cases, this is limited to relatively shallow soil failures on the steeper natural slopes, although deep-seated failures of over-steepened slopes are also possible. Areas designated by CGS as having potential for landslide are shown on Figure 5-7. Within the resource hazards RSA, the CGS has identified a small area at the south end near the I-5/SR 110 interchange (near Elysian Park), a portion in the central area aligning with Griffith Park, and a portion at the north end near and northeast of Hollywood Burbank Airport as being prone to landslides, including potential rockfalls. A comprehensive geotechnical investigation program can assess the likelihood of slope failure at these areas as well as other areas along the HSR Build Alternative. Such investigations are typically performed during final design.

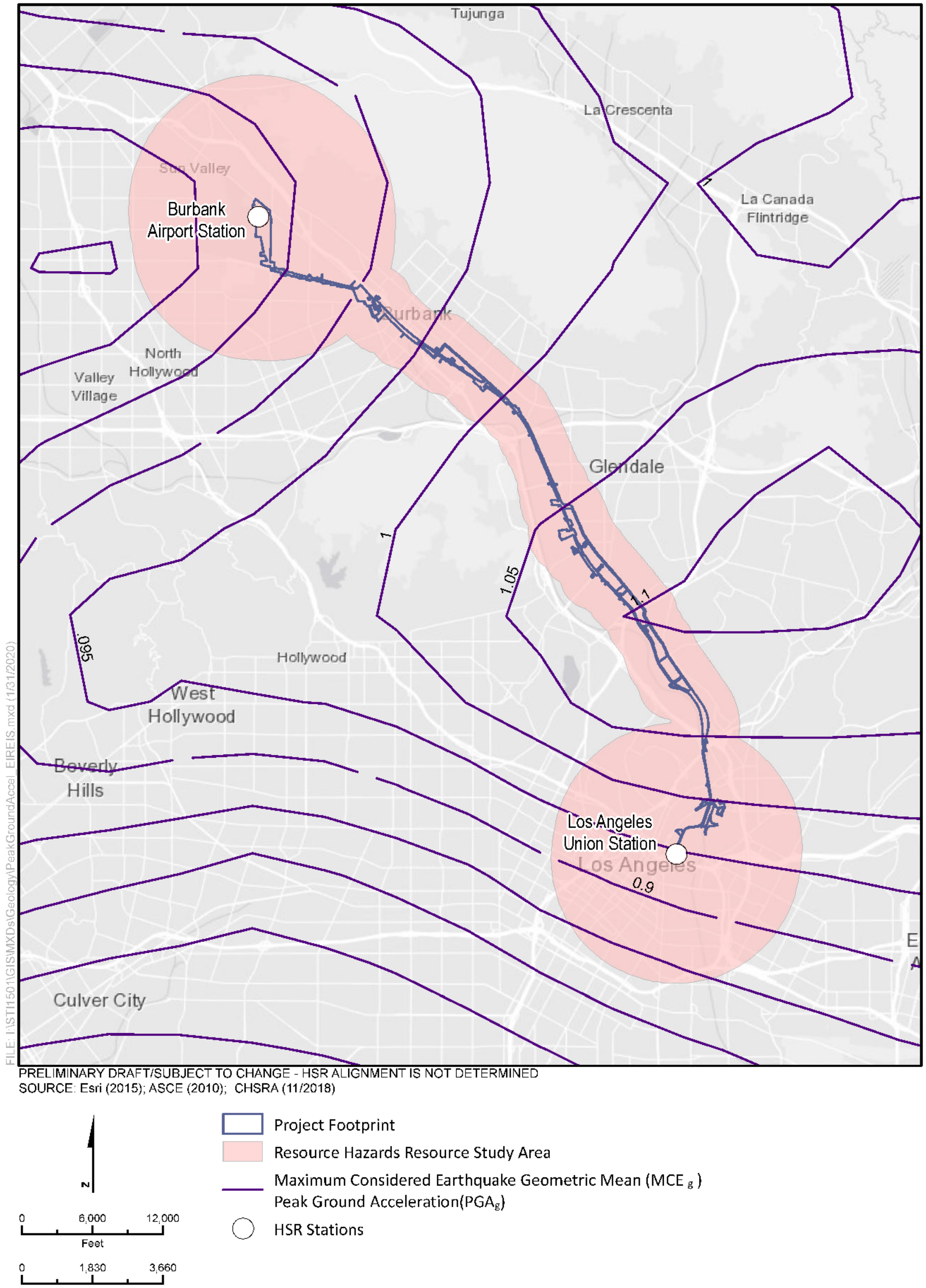


Figure 5-6 Peak Ground Acceleration

Figure 5-7 Secondary Seismic Hazard Zones

5.4.4 Seismically Induced Flood Hazards

Seismically induced flood hazards include flooding caused by failure of water-retaining structures such as dams, reservoirs, levees, or large storage tanks during a seismic event, as well as seiche or tsunami waves.

Dams near the resource hazards RSA that could potentially fail due to seismic shaking are the Hansen Dam and Eagle Rock Dam, which are approximately 5 and 4 miles from the HSR Build Alternative, respectively. The resource hazards RSA is within the inundation areas for the dams. Reservoirs near the HSR Build Alternative that could fail due to seismic shaking are Reservoirs Number 1, 4, and 5 in the city of Burbank; the 10th and Western Reservoir in the city of Glendale; and the Diederich Reservoir, Glenoaks 968 Reservoir, and Elysian Reservoir in the city of Los Angeles. City of Burbank Reservoirs 1, 4, and 5; the 10th and Western Reservoir; the Diederich Reservoir; and the Elysian Reservoir are within the resource hazards RSA. The Glenoaks 968 Reservoir is approximately 1 mile from the HSR Build Alternative. The HSR Build Alternative is within the inundation areas of the aforementioned reservoirs.

Other types of seismically induced flooding involve flooding caused by failures of dams or other water-retaining structures due to seismic shaking, resulting in damage to structures and properties downstream and possible injuries or loss of life. However, dam failures are more often caused by foundation failures, piping and internal erosion, overtopping caused by floods, inadequate capacity or inadequate spillways, or poor construction. The statutes governing dam safety in California are included in Division 3 of the Water Code and place responsibility of dam safety under the jurisdiction of the California Water Resources Division of Safety of Dams.

A seiche refers to the movement of an enclosed body of water, such as a bay, lake, or reservoir, due to periodic oscillation. Seiches commonly occur as a result of intense seismic shaking or catastrophic landslides that displace large amounts of water in a short period of time. The period of oscillation varies and depends on the size of the water body. The period of a seiche can last for minutes to several hours, and depends on the magnitude of oscillations, as well as the geometry of the water body. Seiches have been recorded to cause significant damage to nearby structures, including dams, shoreline facilities, and levees or embankments. Although the area immediately surrounding Hansen Dam and Eagle Rock Dam would likely see flooding due to seismic seiche effects, due to the distance to Hansen Dam (5.9 miles northwest), flooding within the resource hazards RSA as a result of seismic seiche is unlikely to occur.

Tsunamis are a series of large wavelength waves in a water body caused by a sudden large displacement of water. They are commonly generated by large magnitude, offshore earthquakes, or submarine landslides. The waves are of a very long period, such that there is a retreat of water away from the coastline followed by a subsequent surge of water along low-lying coastal areas. Due to its distance to the ocean (greater than 10 miles), flooding from a tsunami is unlikely to occur within the resource hazards RSA.

The HSR Build Alternative would not increase the risk of failure of the near dams and reservoirs. However, failure of the near dams and reservoirs would pose a hazard to the HSR Build Alternative.

5.5 Geological Resources

Geological resources in California include oil and gas fields, geothermal fields, and a wide range of mineral resources. The principal constraint associated with oil, gas, geothermal, and mineral resources is the need for planning to ensure that construction of new facilities would not conflict with the removal of economically important resources and would avoid known problem areas to the extent feasible. In addition, the presence of even small (non-economic) quantities of oil or gas in the subsurface can pose toxic or explosive hazards during construction, requiring specific precautions, and may also necessitate special designs and monitoring during the operation of subsurface structures.

5.5.1 Mineral Resources

This section refers to geologic materials, such as sand and gravel, that may be considered mineral resources within the resource hazards RSA. The Surface Mining and Reclamation Act of 1975 directs the State Geologist to classify the nonfuel Mineral Resource Zones (MRZ) of the state, based on scientific data, to show where economically significant mineral deposits occur.

Land studied by the CGS is classified as MRZs 1 through 3 to show where economically significant mineral deposits occur:

- **MRZ-1:** Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence
- **MRZ-2:** Areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood exists for their presence
- **MRZ-3:** Areas containing mineral deposits, the significance of which cannot be evaluated from available data

According to the CGS, the general geology and soils RSA passes through several areas designated as MRZ-2 and -3 (CGS 1994b). The resource hazards RSA south of San Fernando Road is predominantly zoned MRZ-2, whereas north of San Fernando Road is generally MRZ-3. A designation of MRZ-2 indicates that limited research has identified the presence of significant mineral resources. In contrast, a designation of MRZ-3 indicates that, due to insufficient data, the presence and extent of significant mineral resources is unknown. Information on the mineral resource potential in the general geology and soils RSA was obtained from CGS publications (Cole 1988; Koehler 1999; Busch 2009).

Five mining facilities are near the HSR Build Alternative. Table 5-6 summarizes the details of the facilities, including their current status and their commodities.

Table 5-6 Mining Facilities Near the High-Speed Rail Build Alternative

USGS Mineral Deposit Identification Number	Site Name	Approximate Distance to Alignment (miles)	Operation Type / Status	Commodity
10284752	Westlake & Sons	0.5	Past Producer	Sand and gravel
10235923	City of Los Angeles	0.3	Past Producer	Sand and gravel
10236501	Beyrle	0.2	Past Producer	Sand and gravel
10138910	Home Teaming and Transfer Co.	0.15	Past Producer	Sand and gravel
10235902	Davidson Brick Company	0.2	Producer	Clay

Source: U.S. Geological Survey, 2016
HSR = high-speed rail
USGS = U.S. Geological Survey

5.5.2 Fossil Fuel Resources (Methane, Oil, and Natural Gas)

Limited oil and gas exploration and pumping from proven reserves have taken place in the areas surrounding the HSR Build Alternative, and the general geology and soils RSA passes through the Los Angeles City Oil Field (DOGGR District 2 Oil Fields Map; DOGGR 2015). According to Wildcat Maps and the DOGGR digital wells database (DOGGR 2016), the wells within the general geology and soils RSA and vicinity fall into two categories: (1) idle (not being used for production, injection, or other purposes but also not permanently sealed), or (2) plugged and abandoned dry wells (permanently sealed and closed), or completed (ready for production [or injection]). The locations of these wells are shown on Figure 5-8.

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, hydrogen sulfide, and other compounds. 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.

Hazardous subsurface gases, including methane and hydrogen sulfide—which can occur naturally in soil, rock, or groundwater—may be found within the resource hazards RSA. Also shown on Figure 5-8 are areas identified by the City of Los Angeles as Methane Zones and Methane Buffer zones. The boundaries of the zones were primarily defined by the proximity to oil and natural gas extraction wells. These zones were established by the City of Los Angeles Department of Building & Safety to mitigate risks associated with subsurface methane deposits. As a consequence of idle or abandoned dry wells in the vicinity of LAUS, City of Los Angeles Methane Zones and Methane Buffer Zones have been identified near the general geology and soils RSA.

Hazards associated with the construction and the operation of the HSR Build Alternative and stations near established oil and gas fields, oil and gas wells, pipelines and refineries primarily involve the release of hazardous gases such as methane, carbon dioxide, and hydrogen sulfide.

5.5.3 Geothermal Resources

Geothermal resources were not identified by CGS maps within the general geology and soils RSA (DOGGR 2016).

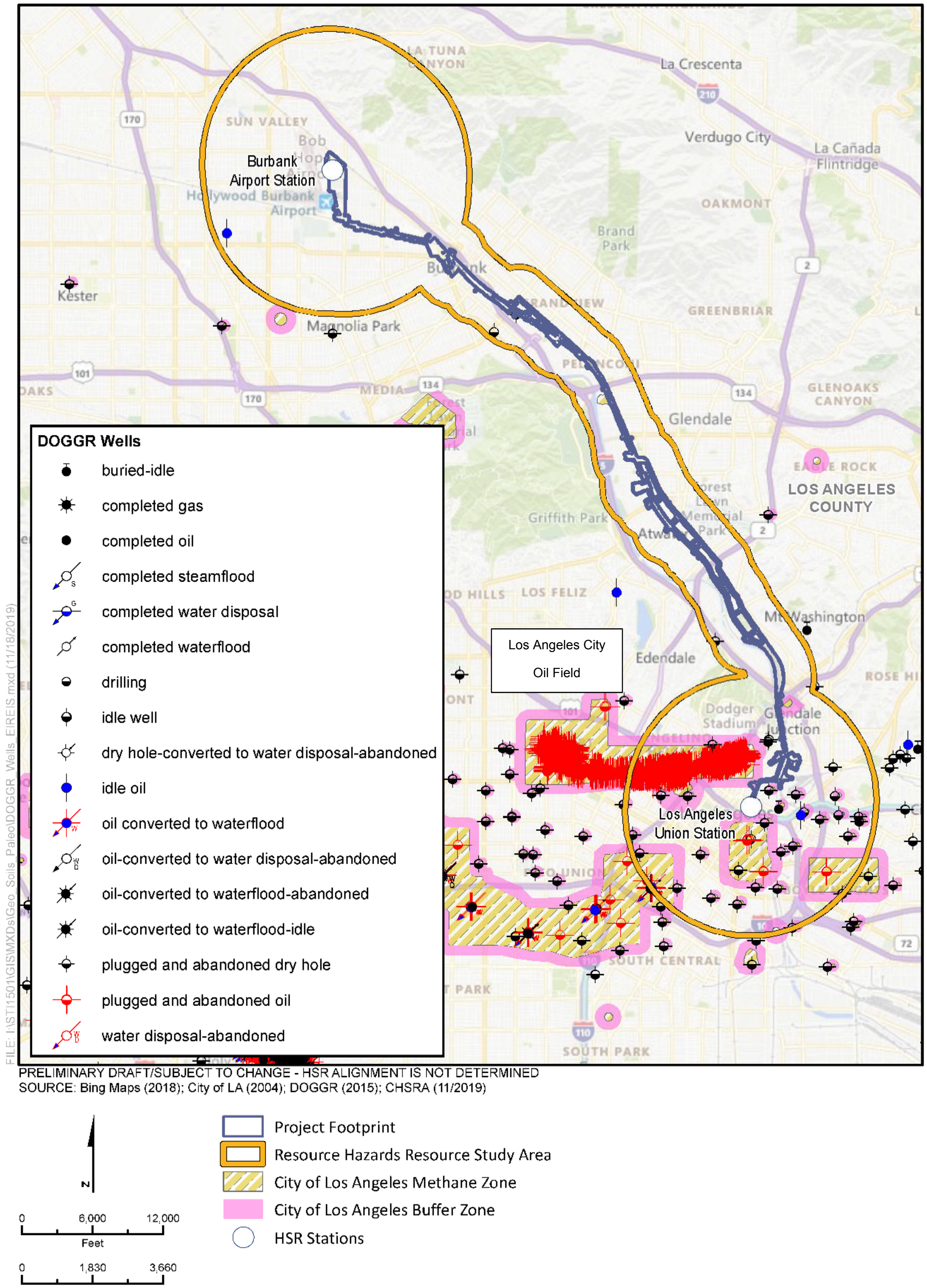


Figure 5-8 California Division of Oil, Gas, and Geothermal Resources Wells

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6 EFFECTS ANALYSIS

6.1 Introduction

This section presents the analysis of effects relating to geology, soils, and seismicity for the proposed project. Construction of the Burbank to Los Angeles Project Section has the potential to expose people or property to geologic hazards.

Geologic, soil, and seismic risks during construction and operation can be addressed with appropriate design methods and construction best management practices to reduce geologic risks where they are present. Design measures and best management practices are included in American Association of State Highway and Transportation Officials, American Railway Engineering and Maintenance-of-Way Association, Caltrans, and International Building Code standards and guidelines, Standard Engineering Protocols and Design Measures Incorporated as part of the project. Collectively, these design measures would reduce effects on public health from geologic hazards. Impact avoidance and minimization features (IAMF) would be incorporated into the project design and construction in order to avoid or minimize potential geologic hazards. These IAMFs are presented in Section 7.

The HSR Build Alternative is not expected to result in the loss or substantial reduction in availability of known mineral, fossil fuel, or geothermal resources because either the resource does not exist in the vicinity of the RSA or the HSR Build Alternative does not substantially affect availability of resources by directly traversing the resource areas, or by restricting access to resources (minerals and fossil fuel) in adjacent areas.

6.2 No Project Alternative

Under the No Project Alternative, the Burbank to Los Angeles Project Section of the California HSR System would not be built. The No Project Alternative represents the condition of the Burbank to Los Angeles Project Section as it existed in 2015, and as it would exist without the HSR Build Alternative at the planning horizon (2040).

The No Project Alternative assumes that all currently known programmed and funded improvements to the intercity transportation system (highway, transit, and rail) and reasonably foreseeable local land development projects (with funding sources identified) would be developed by 2040. The No Project Alternative is based on a review of the following: regional transportation plans for all modes of travel; the State Transportation Improvement Program; the Federal Transportation Improvement Program; Southern California Regional Rail Authority strategic plans, transportation plans and programs for Los Angeles County; airport master plans; and city and county general plans. Within the Burbank to Los Angeles Project Section, geology, soils, and seismicity effects would occur from other planned and committed projects to be constructed on or before 2040. However, projects that would occur as part of the No Project Alternative would include various forms of mitigation to address impacts on geologic, soil, and seismic risks when CEQA is applicable.

6.3 High-Speed Rail Build Alternative

Table 6-1 summarizes potential geology, soils, and seismicity effects as a result of the HSR Build Alternative.

Table 6-1 Summary of Potential Geologic, Soils, and Seismic Effects

Geologic Hazard	Effects of the HSR Project on the Environment	
	Construction Phase Effect	Operational Phase Effect
Surface fault rupture	No effect	No effect
Seismic ground shaking	No effect	No effect
Liquefaction ground lurching, and lateral spreading	No effect	No effect
Slope failure from cut-and-fill slopes	Potential effect	Potential effect
Landslide	No effect	No effect
Tsunami and seiche	No effect	No effect
Seismically induced dam failure	No effect	No effect
Ground subsidence	No effect	No effect
Expansive soils	No effect	No effect
Corrosive soils	No effect	No effect
Collapsible soils	Potential effect	Potential effect
Soil erosion	Potential effect	Potential effect
Difficult excavation	No effect	No effect
Subsurface gas	Potential effect	Potential effect
Mineral resources	Potential effect	No effect

HSR = high-speed rail

6.3.1 High-Speed Rail Build Alternative

6.3.1.1 Surface Fault Rupture

Construction

As indicated in Section 5.3.1, surface fault rupture has the potential to occur at the locations where the HSR Build Alternative crosses known hazardous or potentially hazardous faults. Ground surface rupture is a possibility either within or in close proximity to the project alignment. Of specific concern are the Verdugo, Hollywood, Raymond, Elysian Park (Upper) faults and Unnamed Fault L66a, all of which the alignment crosses or runs close to, as shown on Figure 5-4.

Prior to construction (during final design), hazardous and potentially hazardous faults crossed by the HSR Build Alternative would be evaluated (See GEO-IAMF#7) by conducting a field investigation to identify if the ground surface has been affected by the faults during the Holocene time period. The CGS defines an active fault as one that has had surface displacement (e.g., surface rupture) within Holocene time (approximately the last 11,000 years) and a sufficiently active fault as one that has evidence of Holocene surface displacement along one or more of its segments or branches (CGS 1997). In order to establish earthquake fault zones under the Alquist-Priolo Earthquake Fault Zoning Act, a fault must be determined to be sufficiently active and well defined (clearly detectable as a physical feature at or just below the ground surface). To the extent feasible, the HSR Build Alternative would avoid active fault traces. The types of construction required for the project would not include mining operations, deep excavation into the earth (greater than 150 feet), or boring of large areas, creating unstable seismic conditions or stresses in the Earth's crust. Because the project would not cause or accelerate the potential for surface fault rupture, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of surface fault rupture during construction.

Due to the design recurrence intervals of seismic events (i.e., estimated recurrence period of 2,475 years) from Technical Memorandum 2.10.6 (Authority 2010b) and the short duration of construction activities (i.e., estimated to be less than 10 years) relative to recurrence intervals, the probability that a surface fault rupture event would coincide with construction activities is low.

The project includes IAMFs to minimize the effects on people and structures in the event that a surface fault rupture occurs during construction. Construction procedures would adhere to accepted engineering and safety guidelines and standards (See GEO-IAMF#10). Where the HSR Build Alternative crosses mapped fault traces, specialized engineering design considerations would be required (see GEO-IAMF#6 and GEO-IAMF#7) to minimize the effects of surface fault rupture. These faults shall be evaluated during field investigation to confirm that they have not ruptured the ground surface during the Holocene time period. This evaluation will be conducted as part of the geotechnical/geological investigation program that will be performed during final design. Within hazardous fault zones, the appropriate design strategy depends on whether the dominant direction of fault displacement is lateral or vertical.

Operation

Similar to what was stated above, the project would not cause or accelerate the potential for surface fault rupture during operation. Therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction to surface fault rupture during operation beyond what they currently experience.

The project design includes several IAMFs to minimize the effects on people and structures should a surface fault rupture occur. The potential effects of surface fault rupture during operation include collapse of bridges that support the rails or at-grade damage to the rails that would result in train derailment. Train derailment could also cause secondary effects, such as automobile accidents or the interruption of emergency vehicle traffic where the alignment parallels or crosses streets and highways. Similarly, seismic shaking of station buildings or parking structures could cause them to collapse, resulting in potential risk to employees or the public. GEO-IAMF#6 would include the installation of early warning systems and routine maintenance on this section of the HSR system. GEO-IAMF#8 would include continuous monitoring and immediate shutdown in the event of an earthquake on any of the faults described above to allow confirmation of acceptable conditions before service would resume on this section of the HSR system.

6.3.1.2 Seismic Ground Shaking

Construction

Faults in the RSA have produced historic earthquakes with magnitudes up to 7.79. The level of ground shaking could vary along the HSR Build Alternative (including early action projects), depending on the amount of ground motion amplification or de-amplification within specific soil layers.

The types of construction required for the project would not include mining operations or deep excavation into the earth beyond a depth of 150 feet because the project may require cast-in-drill hole piles or similar deep foundation types generally less than 150 feet deep, creating unstable seismic conditions or stresses in the earth's crust. While tunnel boring and trench construction are required for the project, the locations of the tunnels and trench are not in areas with mapped faults that could lead to unstable seismic conditions. Therefore, the project would not cause or accelerate the potential for seismic ground shaking. The project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of seismic ground shaking during construction.

Due to the design recurrence intervals of seismic events (i.e., estimated recurrence period of 2,475 years) from Technical Memorandum 2.10.6 (Authority 2010b) and the short duration of construction activities (i.e., estimated to be less than 10 years) relative to recurrence intervals, the probability that significant seismic ground shaking would coincide with construction activities is low. The project includes several IAMFs to minimize the effects on people and structures in the event that seismic ground shaking occurs during construction. Under GEO-IAMF#6, GEO-

IAMF#7, and GEO-IAMF#10, prior to construction, the contractor would document through preparation of a technical memorandum how all HSR components were evaluated and designed for large seismic ground shaking to minimize harm to people or structures. In addition, the contractor will prepare a construction management plan stating how geologic constraints (GEO-IAMF#1) will be addressed. Standard earthquake safety measures would be implemented to protect construction workers and other individuals living and working in the vicinity of the HSR Build Alternative (including the early action projects). As stated above, appropriate project design features would be implemented to minimize seismically induced ground-shaking effects (see GEO-IAMF#7).

Operation

Similar to what was stated above, the project would not cause or accelerate the potential for seismic ground shaking; therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of seismic ground shaking during operation.

The project includes IAMFs to minimize the effects on people and structures should seismic ground shaking occur. The effects of seismic ground shaking are the same as discussed in Section 6.3.1.1. For GEO-IAMF#6, a technical memorandum would be prepared documenting how the project design incorporates the installation of early warning systems triggered by strong ground motion associated with ground rupture. Standard earthquake safety measures would be implemented to protect construction workers and other individuals living and working in the vicinity of the HSR Build Alternative. GEO-IAMF#7 would require preparation of a technical memorandum documenting how all HSR components were evaluated and designed for large seismic ground shaking. GEO IAMF#8 would include installation of a network of instruments to provide ground motion data that would be used with the HSR instrumentation and controls system to temporarily shut down the HSR operations in the event of an earthquake. In addition, train derailment containment devices would be installed in sections across hazardous fault zones as a track safety precaution.

6.3.1.3 Liquefaction and Other Types of Seismically Induced Ground Failure

Construction

The expected level of ground shaking along the HSR Build Alternative (including the early action projects) is high because they are near or crossed by faults that have large earthquake potential. However, for liquefaction to take place, groundwater must be present. The northern section of the project alignment from the Burbank Airport Station to SR 134 is designated as susceptible to liquefaction according to CGS (2010), as well as the southern segment of the RSA from 0.4 mile south of SR 2 to LAUS. The new crossings and bridges that would be located in the liquefaction areas include Sonora Avenue, Grandview Avenue, Flower Street, Verdugo Wash, Metrolink CMF Access Road, and Main Street. According to CGS historical high groundwater maps, there is shallow groundwater (less than 50 feet below ground surface) along the entire alignment except at the Burbank Airport Station, where groundwater is known to be at depths greater than 150 feet below ground surface. The actual depth of groundwater would be verified during geotechnical borings during the final design phases for the HSR Build Alternative and the early action projects. At locations where groundwater and soil foundation conditions are favorable with respect to development of strength loss from liquefaction, deep foundations are typically used to provide structural support through liquefied layers for bridges and building foundations, where required.

Due to the short duration of construction activities (i.e., estimated to be less than 10 years), the probability that a liquefaction or other seismically induced ground failure event would coincide with construction activities is low. The project includes several IAMFs to minimize the effects on people and structures in the event that liquefaction or other types of seismically induced ground failures occur during construction. Preparation of a CMP stating how the contractor will address geologic constraints (GEO-IAMF#1) and implementation of the guidelines and standards outlined in GEO-IAMF#10 would minimize risks associated with liquefaction and seismically induced slope failure. Detailed slope-stability evaluations would be conducted, and engineering measures such as ground improvement, use of retaining walls, or regrading of slopes would be implemented, as appropriate, to reduce the potential for seismically induced slope failures.

Operation

Similar to what was stated above, the project would not cause or accelerate the potential for liquefaction or other types of seismically induced ground failure during operation. Therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of liquefaction or other types of seismically induced ground failure during operation.

The project includes IAMFs to minimize the effects on people and structures, in the event that liquefaction or other seismically induced ground failures occur. The potential effects of liquefaction and IAMFs to address them are the same as discussed in Section 6.3.1.1. Under GEO-IAMF#2, during operation, slope monitoring should be performed at sites identified in the CMP where a potential for long-term instability exists from gravity or seismic loading.

6.3.1.4 Slope Failure Hazards Associated with Cut or Fill Slopes

Construction

Construction of the HSR Build Alternative includes several cut-and-fill areas. Construction of the proposed project on soft or loose soils could result in on- or off-site slumps, as well as instability to cut-and-fill slopes required for the HSR tracks or collapse of retaining structures used for retained fills or retained cuts. These potential slumps and slope failures could endanger people and structures if an earthquake were to occur during construction. The effects would be highly dependent on the size of the earthquake and the specific state of construction of various features at the moment the earthquake occurred. Due to the design recurrence intervals of seismic events (i.e., estimated recurrence period of 2,475 years) from Technical Memorandum 2.10.6 (Authority 2010b) and the short duration of construction activities (i.e., estimated to be less than 10 years) relative to recurrence intervals, the probability that a seismically induced slope failure event would coincide with construction activities is low.

However, implementation of GEO-IAMF#10 would minimize the effects on people and structures if a seismic event occurs during construction. GEO-IAMF#10 involves preparation of a technical memorandum documenting how specific guidelines have been incorporated into facility design and construction. For example, appropriate design standards, such as Section 1805.3 of the International Building Code, in addition to standard safety practices, would be implemented during construction, and cuts and fills would be designed in accordance with commonly accepted geotechnical engineering procedures, including consideration of seismic shaking forces and slope stability.

Although the proposed project would exacerbate slope failure hazards associated with cut-and-fill slopes during construction, implementation of the project IAMFs would minimize impacts. With the implementation of IAMFs, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of slope failure hazards associated with cut and fill during construction.

Operation

While a portion of the RSA near Elysian Park is within an area designated by CGS as a potential landslide hazard zone, there are no pre-existing landslides within or adjacent to the project footprint. The consequences of slope failure during operation of the HSR Build Alternative would be either loss of bearing support to the track facilities or increased load on structures that are in the path of the slope failure. The former represents the higher risk because of the flat topography along the HSR Build Alternative. Loss of bearing support would affect at-grade and retained-fill segments more than retained cuts and elevated structures, such as grade separations or railroad bridges, supported on deep foundations. These failures could endanger people and on- and off-site structures if the HSR track were damaged.

The HSR Build Alternative's design addresses slope stability by incorporating standard International Building Code and other engineering standards and criteria. Detailed slope stability evaluations would be conducted and impact avoidance measures, such as structural solutions (e.g., tie backs, soil nails, or retaining walls) or geotechnical solutions (e.g., ground improvement or regrading of slopes), would be implemented as appropriate to reduce the potential for future slumps and slope failures. Structural solutions would physically hold cuts in slopes in place with walls or other physical structures, while geotechnical solutions would improve the soils to increase stability or reduce slopes to eliminate slope failure. The sequential excavation method that will be employed to construct underneath Hollywood Burbank Airport will require the use of stiff pre-support, such as a grouted pipe canopy, and face support, such as face dowels and shotcrete, multiple drifts and short round lengths, and early installation of the center wall. These measures are to control ground loss ahead of the face and face stability. In the case of elevated structures, such as grade separations or railroad brides, the location of the foundation would occur during the design stages to avoid the area of slope failure. GEO-IAMF #2 will ensure that the Authority incorporates slope monitoring by a Registered Engineering Geologist into the construction procedures. Therefore, with implementation of IAMFs, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of slope failure hazards associated with cut-and-fill during operation.

6.3.1.5 Slope Failure Hazards Associated with Pre-Existing Landslide, including Seismically Induced Landslides

Portions of the resource hazards RSA in the vicinity of Elysian Park and the Los Angeles River currently contain slopes. A portion of the resource hazards RSA near Elysian Park is within an area designated by CGS as a potential seismic landslide hazard zone, where an increased potential for slope failure exists. (Refer to Figure 5-7 for the areas mapped by CGS as landslide hazard zones.) No grading is currently proposed at the existing slopes identified in Section 5.2.1, and there are no pre-existing landslides within or adjacent to the project footprint. Therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of slope failure hazards associated with pre-existing landslides during construction or operation.

6.3.1.6 Tsunami and Seiche Hazards

Seismically induced flooding is caused by failure of water-retaining structures such as dams, reservoirs, levees, or large storage tanks during a seismic event or by seiche or tsunami waves during a seismic event. For the reasons discussed in previous sections, and because the project would not foresee excavations deeper than 150 feet (typically, bridges and building foundations may require cast-in-drill hole piles or similar deep foundation types generally less than 150 feet deep), unstable seismic conditions would not be triggered. Therefore, the project would not exacerbate seismic conditions and would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of seismically induced tsunamis and seiches during construction or operation.

6.3.1.7 Seismically Induced Dam Failure Hazards

Portions of the RSA are within the flood inundation zones of Hansen Dam and Eagle Rock Dam. As noted in Section 5.4.4, due to the distance to the nearest dam (5.9 miles) and nearest ocean (more than 14 miles), the risk of project exposure to flooding as a result of seismically induced dam failure during construction or operation is no greater than under existing conditions. The project would not expose people or structures to potential loss of life, injury, or destruction beyond what they are currently exposed to in the RSA. Construction and operation of the HSR Build Alternative would not change seismic conditions and would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction during construction or operation due to dam failure.

Seismically induced flooding is caused by failure of water-retaining structures such as dams, reservoirs, levees, or large storage tanks or by seiche or tsunami waves during a seismic event. As noted in Section 3.9.5.1, due to the distance to the nearest dam (5.9 miles) and nearest ocean (over 14 miles), the risk of flooding of the HSR Build Alternative (including the early action projects) from seiche or tsunami is low. Portions of the resource hazards RSA are within the flood inundation zones of Hansen Dam and Eagle Rock Dam, as well as several reservoirs within and near the resource hazards RSA.

Although seismically induced dam or reservoir failure is possible, due to the design recurrence intervals of seismic events (i.e., estimated recurrence period of 2,475 years) from Technical Memorandum 2.10.6 (Authority 2010b) and the short duration of construction activities (i.e., estimated to be less than 10 years) relative to recurrence intervals, the probability that a seismically induced dam failure event would coincide with construction activities is low. The statutes governing dam safety in California are included in Division 3 of the Water Code and place responsibility of dam safety under the jurisdiction of the California Water Resources Division of Safety of Dams. The risk of exposure to flooding of the HSR Build Alternative (including the early action projects) as a result of dam failure is no greater than existing conditions and would not expose people or structures to potential loss of life, injury, or destruction beyond what they are exposed to currently in the resource hazards RSA. However, in the event of seismically-induced flooding, implementation of the construction BMPs, guidelines, and standards outlined in GEO-IAMF#10 would minimize risks to people and structures during construction.

6.3.1.8 Ground Subsidence

Construction

Although oil extraction has occurred in the vicinity of the proposed alignment, substantial ground subsidence as a result of oil extraction is not known to have occurred (USGS 2016b). Additionally, dewatering groundwater during construction would not have an effect on existing groundwater levels or supplies, as discussed in the *Burbank to Los Angeles Hydrology and Water Resources Technical Report* (Authority 2018). Therefore, the project would not cause or accelerate the potential for ground subsidence. The project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of ground subsidence during construction.

Ground subsidence is a time-dependent process, and the likelihood of ground subsidence during construction is considered low because of the comparatively short duration of construction. The Authority addresses subsidence in its design and construction processes (GEO-IAMF#1). For the initial design, survey monuments were installed to establish a datum and to set an initial track profile. In the construction phase, the design-build contractors for track bed preparation conduct topographic surveys for preparation of final design. Because subsidence could have occurred since the original benchmarks (survey monuments) were established, the contractor's topographic surveys will be used to help determine whether subsidence has occurred. The updated topographic surveys will also be used to establish the top of rail elevations for final design where the HSR system is outside established floodplain areas and above water surface elevations. Where the HSR system is in floodplain areas susceptible to flooding, consideration is being given to overbuild the height of the rail bed in anticipation of future subsidence.

Operation

Similar to as stated above, the project would not cause or accelerate the potential for ground subsidence during operation. Therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of ground subsidence during operation.

The project includes IAMFs to minimize the effects on people and structures, in the event that liquefaction or other seismically induced ground failures occur during operation. GEO-IAMF#9 would include development of a stringent track monitoring program. If monitoring indicates that track tolerances are not met, trains would operate at reduced speed until track tolerances are restored. It is expected that conventional engineering design (e.g., as needed reballasting of the tracks) would be implemented at night, so any shutdowns would be less disturbing.

6.3.1.9 Expansive Soils

Construction

Localized areas underlain by expansive soils are likely to occur within the RSA given the regional geologic circumstances. A comprehensive geotechnical/geological investigation program conducted during final design would determine the locations of expansive soils as well as their deformation potential. The project would not cause or exacerbate the existing expansivity of soils. However, the project would be constructed in areas containing expansive soils, which would potentially expose people/structures to potential loss of life, injuries, or destruction as a result of expansive soil conditions during construction.

The project includes IAMFs to minimize the effects on people and structures in the event that expansive soils be found during geotechnical investigation. The effects are more critical to at-grade track segments than to elevated structures, such as grade separations or railroad bridges, on deep foundations, retained fill, or retained cuts. The earth loads associated with at-grade segments of the HSR Build Alternative may not be sufficient to overcome swell potential, and this swell would likely be variable along the alignment, leading to differential movement of the track system. Prior to construction, GEO-IAMF#1 would reduce the effects caused by shrink-swell soils through soil treatment or removal of soils that exhibit high shrink-swell potential, and replacement of the excavated soils with soils that do not exhibit these characteristics.

Operation

As stated above, the project would not cause or exacerbate the existing expansivity of soils. However, the project would be constructed in areas containing expansive soils, which would potentially expose people/structures to potential loss of life, injuries, or destruction as a result of expansive soil conditions during operation.

The potential for shrink-swell of expansive soils, if unchecked, represents a risk to structures and the operation of the track system and the track right-of-way for long-term operations, as well as the risk of injury or death of the people on or near the HSR Build Alternative if structures fall or the train derails. However, as GEO-IAMF#1 would have been applied during construction, the potential for effects due to expansive soils during project operation would be minimized.

6.3.1.10 Corrosive Soils

Construction

Soils mapped in the RSA have a low to high corrosivity to concrete and a moderate to high corrosivity to steel. The project would not cause or exacerbate the existing corrosivity of soils. However, the project would be constructed in areas containing corrosive soils, which would potentially expose people/structures to potential loss of life, injuries, or destruction as a result of corrosive soil conditions. A comprehensive geotechnical/geological investigation program conducted during final design would determine the locations of corrosive soils.

In locations where existing soils have a potential to be corrosive to steel and concrete, the implementation of GEO-IAMF#1 would ensure that the soils will be removed, buried structures will be designed for corrosive conditions, and corrosion-protected materials will be used in infrastructure.

Operation

For the reasons stated above, the project would not cause or exacerbate the existing corrosivity of soils. Therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of corrosive soil conditions beyond existing conditions during operation.

The potential for corrosion to uncoated steel and concrete represents a substantial risk to the operation of the track system and the track right-of-way for long-term operations. Consequences of corrosion could include eventual loss in the structural capacity of buried steel or concrete components. However, as GEO-IAMF#1 would have been applied during construction, the potential for corrosion to the project during operation would have been minimized.

6.3.1.11 Collapsible Soils

Soil types susceptible to collapse include loess and other fine-grained, windblown soils. These surficial deposits are likely loose and would require appropriate treatment to prevent potential collapse following construction. Potentially collapsible soils can be identified during a detailed geotechnical investigation.

Construction

Project construction could cause soil settlement if imposed loads cause compression of the underlying materials. This is most problematic at locations where coarse-grained soils exist and have not previously been consolidated by loads of the same levels as would be imposed by new construction. Such loads would be experienced at approach fills for embankments constructed to support track structural sections (for example, ballast and sub-ballast placed to meet track grade requirements).

Localized deposits of soft or loose soils could occur at various locations. Geotechnical explorations to be undertaken prior to final design and prior to construction would identify locations with the potential for settlement. In such locations, where subsurface conditions may not be capable of supporting the additional load induced by additional fill, engineering design features that address soft deposits of silty or clay soils would be incorporated, such as preloading to accelerate settlement or adding wick drains if applicable. Application of the engineering design features would reduce the potential for soil settlement.

Soil settlement could also occur on a local scale at locations where soft deposits of silty or clay soils are subjected to new earth loads, as might occur with approach fills for retained fill, or track subgrade and ballast materials that are placed to meet track grade requirements. A number of locations within the project footprint would require new earth fills. Some of these areas are potentially underlain by settlement-prone (loose or soft) soils. These specific locations would be identified during preconstruction and construction investigations, and engineered solutions would be implemented for site-specific conditions. Preparation of a CMP addressing how the contractor will address geologic constraints (GEO-IAMF#1) and implementation of the guidelines and standards outlined in GEO-IAMF#10 would minimize risks associated with collapsible soils.

Project IAMFs would minimize effects resulting from potentially unstable soils that may be present within the project footprint or from soils rendered unstable by heavy loads placed during construction. As a result, these IAMFs minimize the potential to expose people or structures to potential loss of life, injuries, or destruction.

Operation

As described above, the potential effects from collapsible soils would be addressed during construction. Therefore, with implementation of IAMFs, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of collapsible soils during operation.

While the project would implement IAMFs during construction to minimize the effects of collapsible soils, the proposed project design would also incorporate design features that consider the short- and long-term effects of unstable soils on the HSR Build Alternative and nearby facilities. Where appropriate, engineered ground improvements, including regrading or groundwater controls, would be implemented to avoid long-term adverse effects from unstable soils. The determination of the appropriate methods would be made during final design. The potential effects of soft or loose soils would be reduced with implementation of these design measures because loose and unstable soils would be improved, or foundations would be designed to avoid effects to structures from these conditions.

6.3.1.12 Soil Erosion

Construction

Because this is an urban area and topsoil is not present, the HSR Build Alternative would not result in a loss of topsoil. However, construction activities, such as grading and excavation, could cause or accelerate soil erosion. If exposed soils are not protected from wind or water erosion, such as when work areas are cleared of vegetation and materials are stockpiled, both the exposed work area and any stockpiles could erode and cause adverse effects on air and water quality. There is potential for increased stormwater runoff as a result of the construction of temporary, impermeable work surfaces. The implementation of GEO-IAMF#1, GEO-IAMF#10, and HYD-IAMF#3 would minimize the effects of soil erosion. HYD-IAMF#3 requires that the construction contractor comply with the State Water Resources Control Board Construction General Permit to prepare a Stormwater Pollution Prevention Plan (SWPPP), which would identify best management practices (BMP) to minimize soil erosion during construction. There are several methods for controlling water and wind erosion of soils. These include the use of mulches, revegetation, and covering areas with geotextiles. Where runoff velocity could be high, riprap and check dams could be used to reduce erosion. These methods will be implemented as appropriate and in coordination with other erosion, sediment, stormwater management and fugitive dust control. Additionally, standard construction practices, such as those listed in the Caltrans *Construction Site Best Management Practices (BMP) Manual* (Caltrans 2003b) and the *Construction Site Best Management Practice Field Manual and Troubleshooting Guide* (Caltrans 2003a), as outlined in GEO-IAMF#10, would be implemented to minimize the potential for erosion. These could include soil stabilization, watering for dust control, perimeter silt fences, and sediment basins.

With the implementation of project IAMFs, the project would minimize impacts of soil erosion during construction.

Operation

Soil erosion would occur primarily during the project’s construction phase due to the removal of vegetation and soil disturbance. During the project’s operational phase, no additional significant changes to vegetation cover or ground disturbance would take place. Therefore, operation of the HSR Build Alternative would not exacerbate exposure of unprotected soils to erosion.

6.3.1.13 Difficult Excavation

Construction

The depth to bedrock within the resource hazards RSA ranges from outcrops near Elysian Park to hundreds of feet deep at the ends of the resource hazards RSA. A comprehensive geotechnical/geological investigation program to identify the locations and depths of the bedrock formations would be performed during the final design phase to identify areas of difficult excavation. The Authority would conform to the guidelines specified by relevant transportation and building agencies and codes (GEO-IAMF#10) requiring Authority contractors to account for geotechnical properties during HSR Build Alternative design and construction and would thus address risk factors associated with difficult excavation conditions. Methods in the Caltrans *Construction Site Best Management Practices (BMP) Manual* (Caltrans 2003b) and *Construction Site Best Management Practice Field Manual and Troubleshooting Guide* (Caltrans 2003a) related to difficult excavation conditions would be used per GEO-IAMF#10. Standard construction equipment is expected be used in excavations. With implementation of the GEO-IAMF#10 and standard safety practices as outlined in aforementioned manuals, there would not be an increased potential for injury or loss of life related to heavy equipment as discussed in Section 5.2.4.

Operation

There are no effects on operation related to areas of difficult excavation because excavations would only take place during construction.

6.3.1.14 Subsurface Gas Hazards

Construction

As discussed in Section 5.5.2, hazardous subsurface gases—including methane and hydrogen sulfide, which can occur naturally in soil, rock, or groundwater—may be found within the resource hazards RSA. For the below-grade alignment and the Burbank Airport Station, construction may increase the risk of exposure to subsurface gas hazards. Additionally, the early action projects include below-grade construction, which may also increase the risk of exposure to subsurface gas hazards. Additionally, the RSA's southern portion traverses oil fields that have a high probability of containing methane and other subsurface gases. The potential for encountering subsurface gases is considered high should any below-ground components be proposed in the oil fields in the southern portion of the RSA. Based on the review of DOGGR mapped sites, there appears to be no known active wells within the project footprint. The wells within or adjoining the HSR Build Alternative footprint were either plugged and abandoned or idle, where the area has been graded and developed for roadway, commercial, or residential purposes. However, the DOGGR records indicate that some of the abandoned or idle wells could not be identified in the field, as the information was missing. Therefore, a comprehensive geotechnical/geologic investigation program shall be required during future phases to determine if any idle or abandoned wells would cause significant risk to the public and environment. The implementation of GEO-IAMF#3 and SS-IAMF#4 would minimize these effects on people and structures.

Operation

The hazards related to the potential exposure to hazardous gases from natural sources or oil fields would be evaluated, and necessary actions would be taken as required during construction and prior to operation of the project. If hazardous gases were encountered during construction, then necessary precautions such as gas detection systems, installation of adequate venting system to prevent accumulation of vapors, gas collection systems at below-ground portions of the project should be considered during the operation phase. In addition, once the project construction is completed, the chance of subsurface gases encroaching on the project causing significant effects to human health and environment is unlikely. Therefore, operation of the HSR Build Alternative would not increase the risk of potential exposure to hazardous gases.

6.3.1.15 Mineral Resources

Construction

As stated in Section 5.5.1, the RSA south of San Fernando Road is predominantly zoned MRZ-2, whereas north of San Fernando is generally MRZ-3. Construction of the project might temporarily reduce access to existing mining facilities or potential zoned mineral resources depending on the proposed construction-related activities, including temporary construction zones.

With the implementation of standard design and construction protocols (See GEO-IAMF#4), potential issues related to the availability of access to zoned mineral resources during construction of the HSR Build Alternative would not increase beyond those that currently exist.

Operation

Operation of the HSR project would not reduce the availability of zoned mineral resources or hinder access to existing mining facilities.

6.4 Station Sites

The following section summarizes the impacts of the Burbank Airport relevant potential geology, soils, and seismicity impacts as a result of HSR construction and operation at the Burbank Airport Station and LAUS.

6.4.1 Burbank Airport Station

6.4.1.1 Surface Fault Rupture

The Burbank Airport Station would not be located on any known faults. The types of construction required for the project would not include mining operations, deep (greater than 150 feet) excavation into the earth, or boring of large areas creating unstable seismic conditions or stresses in the earth's crust. The project would not cause or accelerate the potential for surface fault rupture, and therefore the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of surface fault rupture during construction or operation at Burbank Airport Station.

6.4.1.2 Seismic Ground Shaking

See discussion under Section 6.3.1.2. The types of construction required for the project would not include mining operations, deep (greater than 150 feet) excavation into the earth, or boring of large areas creating unstable seismic conditions or stresses in the earth's crust. Therefore, the project would not cause or accelerate the potential for seismic ground shaking. The project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of seismic ground shaking during construction or operation at Burbank Airport Station.

If seismic ground shaking occurs, the IAMFs discussed under Section 6.3.1.2 would apply.

6.4.1.3 Liquefaction and Other Types of Seismically Induced Ground Failure

The area occupied by Burbank Airport Station is not designated as susceptible to liquefaction according to CGS (2010). The project would not cause or accelerate the potential for liquefaction or other types of seismically induced ground failure. Therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of liquefaction or other types of seismically induced ground failure during construction or operation at Burbank Airport Station.

In the event that liquefaction or other types of seismically induced ground failure occur, the IAMFs discussed under Section 6.3.1.3 would apply.

6.4.1.4 Slope Failure Hazards Associated with Cut or Fill Slopes

See discussion under Section 6.3.1.4. Cut and fill would be required to construct the underground Burbank Airport Station. Implementation of IAMFs would minimize effects resulting from potentially unstable soils. Therefore, with implementation of IAMFs, the project would not expose people or structures to potential loss of life, injuries, or destruction as a result of slope failure hazards associated with cut-and-fill during construction.

6.4.1.5 Slope Failure Hazards Associated with Pre-existing Landslide, Including Seismically Induced Landslides

While CGS identified landslide hazard zones within the RSA (Figure 5-7), there are no pre-existing landslides adjacent to Burbank Airport Station. Therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of slope failure hazards associated with pre-existing landslides during construction or operation at Burbank Airport Station.

6.4.1.6 Tsunami and Seiche Hazards

See discussion under Section 6.3.1.6. Because the project would not exacerbate seismic conditions, as discussed above, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of seismically induced tsunami and seiches during construction or operation at Burbank Airport Station.

6.4.1.7 Seismically Induced Dam Failure Hazards

See discussion under Section 6.3.1.7. Because the project would not change seismic conditions, as discussed above, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction during construction or operation due to dam failure at Burbank Airport Station.

6.4.1.8 Ground Subsidence

See discussion under Section 6.3.1.8. The project would not cause or accelerate the potential for ground subsidence at Burbank Airport Station. Therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of ground subsidence during construction or operation at Burbank Airport Station.

If ground subsidence occurs, the IAMFs discussed under Section 6.3.1.8 would apply.

6.4.1.9 Expansive Soils

See discussion under Section 6.3.1.9. The project would not cause or exacerbate the existing expansivity of soils. Therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of expansive soil conditions during construction or operation at Burbank Airport Station.

In the event that expansive soils are found during geotechnical investigation, the IAMFs discussed under Section 6.3.1.9 would apply.

6.4.1.10 Corrosive Soils

See discussion under Section 6.3.1.10. The project would not cause or exacerbate the existing corrosivity of soils. Therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of corrosive soil conditions during construction or operation at Burbank Airport Station.

In locations where existing soils have a potential to be corrosive to steel and concrete, the IAMFs discussed under Section 6.3.1.10 would apply.

6.4.1.11 Collapsible Soils

See discussion under Section 6.3.1.11. The implementation of IAMFs as described in Section 6.3.1.11 would minimize effects resulting from potentially unstable soils at Burbank Airport Station. Therefore, with implementation of IAMFs, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of collapsible soils during construction or operation at Burbank Airport Station.

Of soil settlement occurs, the IAMFs discussed under Section 6.3.1.11 would apply.

6.4.1.12 Soil Erosion

See discussion under Section 6.3.1.12. The implementation of IAMFs as described in Section 6.3.1.12 would minimize effects of soil erosion at Burbank Airport Station during construction and operation.

6.4.1.13 Difficult Excavation

See discussion under Section 6.3.1.13, based on the review of available site-specific subsurface soil data, bedrock near the Burbank Airport Station is expected to be 100 feet or deeper. Due to the absence of shallow bedrock near Burbank Airport Station, it is anticipated that standard construction equipment would be used in excavations. Because the project would not require special equipment during construction, there would not be an increased potential for injury or loss of life. There would be no effect under operations.

6.4.1.14 Subsurface Gas Hazards

See discussion under Section 6.3.1.14. For the below-grade portion of the alignment in Burbank, construction may provide a route of exposure to subsurface gas hazards that would result in a risk or loss of life or destruction of property. If hazardous gases are encountered during construction, the implementation of GEO-IAMF#3 and SS-IAMF#4 including precautions such as gas detection systems, installation of an adequate venting system to prevent accumulation of vapors, and gas collection systems at below-ground portions of the project should be considered during the operation phase. In addition, once the project construction is completed, the chances of subsurface gases encroaching on the project causing significant effects to human health and environment are unlikely. Therefore, the operation of the HSR Build Alternative would not result in a risk of potential exposure to hazardous gases and would minimize the effects on people and structures.

6.4.1.15 Mineral Resources

See discussion under Section 6.3.1.15. The construction and operation of the project would not further reduce the availability of mineral resources or include provisions to extract known mineral resources at Burbank Airport Station.

6.4.2 Los Angeles Union Station

6.4.2.1 Surface Fault Rupture

LAUS is not located on any known faults. The types of construction at LAUS would not include mining operations, deep (greater than 150 feet) excavation into the earth, or boring of large areas creating unstable seismic conditions or stresses in the earth's crust. Therefore, the project would not cause or accelerate the potential for seismic ground shaking. The project would not cause or accelerate the potential for surface fault rupture; therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of surface fault rupture during construction or operation at LAUS.

6.4.2.2 Seismic Ground Shaking

See discussion under Section 6.3.1.2. The types of construction at LAUS would not include mining operations, deep (greater than 150 feet) excavation into the earth, or boring of large areas creating unstable seismic conditions or stresses in the earth's crust. Therefore, the project would not cause or accelerate the potential for seismic ground shaking. The project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of seismic ground shaking during construction or operation at LAUS.

If seismic ground shaking occurs, the IAMFs discussed under Section 6.3.1.2 would apply.

6.4.2.3 Liquefaction and Other Types of Seismically Induced Ground Failure

The area occupied by LAUS is designated as susceptible to liquefaction according to CGS (2010). However, the project would not cause or accelerate the potential for liquefaction or other types of seismically induced ground failure. Therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of liquefaction or other types of seismically induced ground failure during construction or operation at LAUS.

In the event that liquefaction or other types of seismically induced ground failure occur, the IAMFs discussed under Section 6.3.1.3 would apply.

6.4.2.4 Tsunami and Seiche Hazards

See discussion under Section 6.3.1.6. Because the project would not exacerbate seismic conditions, as discussed above, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of seismically induced tsunami and seiches during construction or operation at LAUS.

6.4.2.5 Seismically Induced Dam Failure Hazards

See discussion under Section 6.3.1.7. Because the project would not change seismic conditions, as discussed above, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction during construction or operation due to dam failure at LAUS.

6.4.2.6 Ground Subsidence

As discussed in Section 5.2.2, the RSA is not within areas of documented land subsidence (USGS 2016b). Additionally, the types of construction activities would not cause or accelerate the existing potential for ground subsidence at LAUS. Therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of ground subsidence during construction or operation at LAUS.

Should ground subsidence occur, the IAMFs discussed under Section 6.3.1.8 would apply.

6.4.2.7 Expansive Soils

See discussion under Section 6.3.1.9. The project would not cause or exacerbate the existing expansivity of soils. Therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of expansive soil conditions during construction or operation at LAUS.

In the event that expansive soils be found during geotechnical investigation, the IAMFs discussed under Section 6.3.1.9 would apply.

6.4.2.8 Corrosive Soils

See discussion under Section 6.3.1.10. The project would not cause or exacerbate the existing corrosivity of soils. Therefore, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of corrosive soil conditions during construction or operation at LAUS.

In locations where existing soils have a potential to be corrosive to steel and concrete, the IAMFs discussed under Section 6.3.1.10 would apply.

6.4.2.9 Collapsible Soils

See discussion under Section 6.3.1.11. The implementation of IAMFs as described in Section 6.3.1.11 would minimize effects resulting from potentially unstable soils at LAUS. Therefore, with implementation of IAMFs, the project would not increase the potential to expose people or structures to potential loss of life, injuries, or destruction as a result of collapsible soils during construction or operation at LAUS.

Should soil settlement occur, the IAMFs discussed under Section 6.3.1.11 would apply.

6.4.2.10 Soil Erosion

See discussion under Section 6.3.1.12. The implementation of IAMFs as described in Section 6.3.1.12 would minimize effects of soil erosion at LAUS during construction and operation.

6.4.2.11 Difficult Excavation

See discussion under Section 6.3.1.13. Due to the absence of shallow bedrock near LAUS, it is anticipated that standard construction equipment would be used in excavations. Because the project would not require special equipment during construction, there would not be an increased potential for injury or loss of life. There would be no effect under operations.

6.4.2.12 Subsurface Gases

LAUS would not include below-grade components. Therefore, construction and operation at LAUS would not provide a route of exposure to subsurface gas hazards that would result in a risk or loss of life or destruction of property.

6.5 Electric Power Utility Improvements

The Burbank to Los Angeles Project Section would not include the construction of a separate power source, although it would include the extension of power lines to a series of power substations positioned along the HSR corridor. In the event that the other project sections of the HSR system are not constructed, a standalone TPSS would be required within the Burbank to Los Angeles Project Section for purposes of independent utility. Any electrical interconnections between a potential future TPSS site and existing utility providers would have to be environmentally evaluated and cleared in subsequent documentation.

6.6 Maintenance Facilities

As described in Section 2.4, no maintenance facilities are proposed to be constructed within the Burbank to Los Angeles Project Section. The Burbank to Los Angeles Project Section would either use the HMF and LMF in other project sections, or maintenance would be handled through an independent contractor. Therefore, no further analysis of maintenance facilities is included in this technical report prepared for the Burbank to Los Angeles Project Section.

6.7 Cumulative Impacts

This section presents the potential cumulative impacts based on current knowledge of the project section. Subsequent to this technical report, the Authority has further refined the cumulative impacts described herein and presented the information in Section 3.19, Cumulative Impacts, of the Burbank to Los Angeles Project Section EIR/EIS.

The analysis of cumulative impacts for all resource areas, including geologic and soil resources, is based on the effects of past, present, and foreseeable future actions in the project area. The construction of one project does not alter the risk of geologic hazards to another project because all projects must be constructed in accordance with the Uniform Building Code. Therefore, the cumulative impact related to geologic hazards is less than significant.

Standard methods of soil erosion control would be utilized and local and state regulations regarding soil erosion (such as stormwater best management practices and temporary soil erosion guidelines) would be followed in the design and construction of the HSR Build Alternative. Therefore, no unusual adverse effects from soil erosion are anticipated.

It is not expected construction of the HSR Build Alternative would adversely impact existing mineral resources because the alignment would not have an adverse effect on existing mining operations and would be located in an urban environment where these resources are present.

Construction and operation of the HSR Build Alternative may not trigger a strong seismic wave that could induce dam failure. However, seismically induced dam failure (due to a naturally occurring, high-intensity earthquake) could result in flooding in large areas of the cities of Burbank, Glendale and Los Angeles from the Hansen Dam and Eagle Rock Dam (Section 5.4.4). The present and reasonably foreseeable future projects would increase the number of people exposed to this flood risk. The construction of the HSR Build Alternative would expose both people traveling on the train and HSR operations personnel to this flood risk. The contribution of the HSR Build Alternative to the exposure of people and facilities to seismically induced flood risk would be negligible relative to the urban population of the cities of Burbank, Glendale, and Los Angeles that is exposed to this risk.

7 GEOLOGIC RESOURCES IMPACT AVOIDANCE AND MINIMIZATION FEATURES

The HSR Build Alternative incorporates standardized HSR features to avoid and minimize impacts. These features are referred to as IAMFs. The Authority will implement these measures during project design and construction to avoid or reduce impacts.

The following IAMFs would be implemented to avoid and/or minimize adverse effects on geologic resources.

GEO-IAMF#1: Geologic Hazards

Prior to construction, the contractor shall prepare a construction management plan (CMP) addressing how the contractor will address geologic constraints and minimize or avoid impacts to geologic resources during construction. The CMP will be submitted to the Authority for review and approval. At a minimum, the CMP will address the following geotechnical constraints/resources:

a. **Groundwater Withdrawal.** Controlling the amount of groundwater withdrawal from the project by re-injecting groundwater at specific locations, if necessary, or using alternate foundation designs to offset the potential for settlement. This control is important for locations with retained cuts in areas where high groundwater exists, and where existing buildings are located near the depressed track section.

b. **Unstable Soils.** Employing various methods to mitigate for the risk of ground failure from unstable soils. If soft or loose soils are encountered at shallow depths, they can be excavated and replaced with competent soils. To limit the excavation depth, replacement materials can also be strengthened using geosynthetics. Where unsuitable soils are deeper, ground improvement methods such as stone columns, cement deep-soil-mixing, or jet-grouting can be used. Alternatively, if sufficient construction time is available, preloading (in combination with prefabricated vertical drains [wicks] and staged construction) can be used to gradually improve the strength of the soil without causing bearing-capacity failures.

c. **Subsidence.** The Authority addresses subsidence in its design and construction processes. For the initial design, survey monuments were installed to establish a datum and set an initial track profile. In the construction phase, the design-build contractors for track bed preparation conduct topographic surveys for preparation of final design. Because subsidence could have occurred since the original benchmarks (survey monuments) were established, the design-build contractor's topographic surveys will be used to help determine whether subsidence has occurred. The updated topographic surveys will also be used to establish the top of rail elevations for final design where the HSR system is outside established floodplain areas and above water surface elevations. Where the HSR system is in floodplain areas susceptible to flooding, consideration is being given to overbuild the height of the rail bed in anticipation of future subsidence.

d. **Water and Wind Erosion.** The Contractor will implement erosion control methods as appropriate from the various erosion control methods documented in the Construction Storm Water Pollution Prevention Plan (See HYD-IAMF#3), the Caltrans Construction Manuals, and the construction technical memorandum (see GEO-IAMF#6), and in coordination with other erosion, sediment, stormwater management and fugitive dust control efforts. Water and wind erosion control methods may include, but are not limited to, use of revegetation, stabilizers, mulches, and biodegradable geotextiles.

e. **Soils with Shrink-Swell Potential.** In locations where shrink-swell potential is marginally unacceptable, soil additives will be mixed with existing soil to reduce the shrink-swell potential. Construction specifications will be based on the decision whether to remove or treat the soil. This decision is based on the soils and their specific shrink-swell characteristics, the additional costs for treatment versus excavation and replacement, and the long-term performance characteristics of the treated soil.

f. **Soils with Corrosive Potential.** In locations where soils have a potential to be corrosive to steel and concrete, the soils will be removed, buried structures will be designed for corrosive conditions, and corrosion-protected materials will be used in infrastructure.

GEO-IAMF#2: Slope Monitoring

During operation and maintenance, the Authority shall incorporate slope monitoring by a Registered Engineering Geologist in the operation and maintenance procedures. The procedures shall be implemented at sites identified in the CMP where a potential for long-term instability exists from gravity or seismic loading (including, but not limited to, at-grade sections where slope failure could result in loss of track support, or where slope failure could result in additional earth loading to foundations supporting elevated structures such as grade separations or railroad bridges).

GEO-IAMF#3: Gas Monitoring

Prior to Construction, the Contractor shall prepare a Construction Management Plan (CMP) addressing how gas monitoring would be incorporated into construction best management practices. The CMP would be submitted to the Authority for review and approval. Hazards related to potential migration of hazardous gases due to the presence of oil fields, gas fields, or other subsurface sources can be reduced or eliminated by following strict federal and state Occupational Safety & Health Administration regulatory requirements for excavations, and by consulting with other agencies as appropriate regarding known areas of concern. These agencies include the DOGGR, and the California Environmental Protection Agency, Department of Toxic Substances Control.

Practices will include using safe and explosion-proof equipment during construction and testing for gases regularly at known or suspect areas where past or existing oil/gas extraction wells were located with no documented remediation. Installation of passive or active gas venting systems, gas collection systems, and active monitoring systems and alarms would be required in underground construction areas and facilities where subsurface gases are present. Gas barrier systems have been used effectively for subways in the Los Angeles area. Installing gas detection systems can monitor the effectiveness of these systems.

GEO-IAMF#4: Historic or Abandoned Mines

Prior to Construction, the Contractor shall prepare a Construction Management Plan (CMP) addressing how historic and abandoned mines would be incorporated into construction best management practices. The CMP would be submitted to the Authority for review and approval. Depending on the properties of an individual mine, mitigations to address historic or abandoned mines could include:

1. CERCLA Cleanup. Environmental cleanups at sites that are releasing or threatening to release hazardous substances such as heavy metals from acid mine drainage.
2. Non-CERCLA Cleanup. Cleanups of non-hazardous substance-related surface disturbance such as revegetation of disturbed areas, stabilization of mine tailings, reconstruction of stream channels and floodplains.
3. Safety Mitigation. Mitigation of physical safety hazards such as closure of adits and shafts and removal of dangerous structures.

GEO-IAMF#5: Hazardous Minerals

Prior to Construction, the Contractor shall prepare a Construction Management Plan (CMP) addressing how the contractor would minimize or avoid impacts related to hazardous minerals (i.e., radon, mercury, and naturally occurring asbestos (NOA)) during construction. The CMP would be submitted to the Authority for review and approval. The CMP shall include appropriate provisions for handling hazardous minerals including but limited to dust control, control of soil erosion and water runoff, and testing and proper disposal of excavated material.

GEO-IAMF#6: Ground Rupture Early Warning Systems

Prior to Construction, the Contractor shall document how the project design incorporates installation of early warning systems, triggered by strong ground motion association with ground rupture. Known nearly active fault would be monitored. Linear monitoring systems such as time domain reflectometers or similar technology shall be installed along rail lines in the zone of potential ground rupture. These devices emit electronic information that is processed in a centralized location and would be used to temporarily control trains, thus reducing accidents due to fault creep. Damage to infrastructure from fault creep can be mitigated with routine maintenance including minor realignment.

GEO-IAMF#7: Evaluate and Design for Large Seismic Ground Shaking

Prior to Construction, the Contractor shall document through preparation of a technical memorandum how all HSR components were evaluated and designed for large seismic ground shaking. Prior to final design, the Contractor would conduct additional seismic studies to establish up-to-date estimation of levels of ground motion. The most current Caltrans seismic design criteria at the time of design would be used in the design of any structures supported in or on the ground. These design procedures and features reduce to the greatest practical extent for potential movements, shear forces, and displacements that result from inertial response of the structure. In critical locations, pendulum base isolators may be used to reduce the levels of inertial forces. New composite materials may also be used to enhance seismic performance.

GEO-IAMF#8: Suspension of Operations During an Earthquake

Prior to Operation and Maintenance activities, the Contractor shall document in a technical memorandum how suspension of operations during or after an earthquake was addressed in project design. Motion-sensing instruments to provide ground motion data and a control system to shut down HSR operations temporarily during or after a potentially damaging earthquake would be incorporated into final design. Monitoring equipment would be installed at select locations where high ground motions could occur. The system would then be inspected for damage due to ground motion and/or ground deformation, and then returned to service when appropriate.

GEO-IAMF#9: Subsidence Monitoring

Prior to Operation and Maintenance, the Authority shall develop a stringent track monitoring program. Once tracks are operational, a remote monitoring program would be implemented to monitor the effects of ongoing subsidence. Track inspection systems would provide early warning of reduced track integrity. HSR train sets would be equipped with autonomous equipment for daily track surveys. This specification would be added to HSR train bid packages. If monitoring indicates that track tolerances are not met, trains would operate at reduced speed until track tolerances are restored. In addition, the contractor responsible for wayside maintenance would be required to implement a stringent program for track maintenance.

GEO-IAMF#10: Geology and Soils

Prior to Construction, the Contractor shall document through issuance of a technical memorandum how the following guidelines and standards have been incorporated into facility design and construction:

- 2015 American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Bridge Design Specifications and the 2015 AASHTO Guide Specifications for Load and Resistance Factor Seismic Bridge Design, or their most recent versions. These documents provide guidance for characterization of soils, as well as methods to be used in the design of bridge foundations and structures, retaining walls, and buried structures. These design specifications would provide minimum specifications for evaluating the seismic response of the soil and structures.
- Federal Highway Administration (FHWA) Circulars and Reference Manuals: These documents provide detailed guidance on the characterization of geotechnical conditions at sites, methods for performing foundation design, and recommendations on foundation

construction. These guidance documents include methods for designing retaining walls used for retained cuts and retained fills, foundations for elevated structures such as grade separations or railroad bridges, and at-grade segments. Some of the documents include guidance on methods of mitigating geologic hazards that are encountered during design.

- American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual: These guidelines deal with rail systems. Although they cover many of the same general topics as AASHTO, they are more focused on best practices for rail systems. The manual includes principles, data, specifications, plans, and economics pertaining to the engineering, design, and construction of railways.
- California Building Code: The code is based on 2015 International Building Code (IBC). This code contains general building design and construction requirements relating to fire and life safety, structural safety, and access compliance.
- IBC and American Society of Civil Engineers (ASCE)-7: These codes and standards provide minimum design loads for buildings and other structures. They would be used for the design of the maintenance facilities and stations. Sections in IBC and ASCE-7 provide minimum requirements for geotechnical investigations, levels of earthquake ground shaking, minimum standards for structural design, and inspection and testing requirements.
- Caltrans Design Standards: Caltrans has specific minimum design and construction standards for all aspects of transportation system design, ranging from geotechnical explorations to construction practices. These amendments provide specific guidance for the design of deep foundations that are used to support elevated structures, for design of mechanically stabilized earth (MSE) walls used for retained fills, and for design of various types of cantilever (e.g., soldier pile, secant pile, and tangent pile) and tie-back walls used for retained cuts.
- Caltrans Construction Manuals: Caltrans has a number of manuals including Field Guide to Construction Dewatering, Caltrans Construction Site BMPs Manual and Construction Site BMP Field Manual and Troubleshooting Guide. These provide guidance and best management practices for dewatering options and management, erosion control and soil stabilization, non-storm water management, and waste management at construction sites.
- American Society for Testing and Materials (ASTM): ASTM has developed standards and guidelines for all types of material testing- from soil compaction testing to concrete-strength testing. The ASTM standards also include minimum performance requirements for materials

HYD-IAMF#3: Prepare and Implement a Construction Stormwater Pollution Prevention Plan

Prior to Construction (any ground disturbing activities), the Contractor shall comply with the State Water Resources Control Board (SWRCB) Construction General Permit requiring preparation and implementation of a SWPPP. The Construction SWPPP would propose BMPs to minimize potential short-term increases in sediment transport caused by construction, including erosion control requirements, stormwater management, and channel dewatering for affected stream crossings. These BMPs would include measures to incorporate permeable surfaces into facility design plans where feasible, and how treated stormwater would be retained or detained on site. Other BMPs shall include strategies to manage the amount and quality of overall stormwater runoff. The Construction SWPPP would include measures to address, but are not limited to, the following:

- Hydromodification management to verify maintenance of pre-project hydrology by emphasizing on site retention of stormwater runoff using measures such as flow dispersion, infiltration, and evaporation (supplemented by detention where required). Additional flow control measures would be implemented where local regulations or drainage requirements dictate.
- Implementing practices to minimize the contact of construction materials, equipment, and maintenance supplies with stormwater.

- Limiting fueling and other activities using hazardous materials to areas distant from surface water, providing drip pans under equipment, and daily checks for vehicle condition.
- Implementing practices to reduce erosion of exposed soil, including soil stabilization, regular watering for dust control, perimeter siltation fences, and sediment catchment basins.
- Implementing practices to maintain current water quality, including siltation fencing, wattle barriers, stabilized construction entrances, grass buffer strips, ponding areas, organic mulch layers, inlet protection, storage tanks and sediment traps to arrest and settle sediment.
- Where feasible, avoiding areas that may have substantial erosion risk, including areas with erosive soils and steep slopes.
- Using diversion ditches to intercept surface runoff from off site.
- Where feasible, limiting construction to dry periods when flows in water bodies are low or absent.
- Implementing practices to capture and provide proper off-site disposal of concrete wash water, including isolation of runoff from fresh concrete during curing to prevent it from reaching the local drainage system, and possible treatments (e.g., dry ice).
- Developing and implementing a spill prevention and emergency response plan to handle potential fuel and/or hazardous material spills.

Implementation of a SWPPP would be performed by the construction contractors as directed by the contractor's Qualified SWPPP Practitioner or designee. As part of that responsibility, the effectiveness of construction BMPs must be monitored before, during and after storm events. Records of these inspections and monitoring results are submitted to the local regional water quality control board (RWQCB) as part of the annual report required by the Statewide Construction General Permit. The reports are available to the public online. The SWRCB and RWQCB would have the opportunity to review these documents.

SS-IAMF#4: Oil and Gas Wells

Prior to ground disturbing activities, the Contractor shall identify and inspect all active and abandoned oil and gas wells within 200 feet of the HSR tracks. Any active wells would be abandoned and relocated by the Contractor in accordance with the California Department of Conservation, Division of Oil, and Gas and Geothermal Resources (DOGGR) standards in coordination with the well owners. All abandoned wells within 200 feet of the HSR tracks would be inspected and re-abandoned, as necessary, in accordance with DOGGR standards and in coordination with the well owner. The Contractor would provide the Authority with documentation that the identification and inspection of the wells has occurred prior to construction.

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