Los Angeles County
Metropolitan Transportation Authority

West Santa Ana Branch Transit Corridor

Final Geotechnical, Subsurface, and Seismic Impact Analysis Report

Metro®

WEST SANTA ANA BRANCH TRANSIT CORRIDOR PROJECT

Final
Geotechnical, Subsurface, and Seismic Impact Analysis Report

Prepared for:

Metro

Los Angeles County
Metropolitan Transportation Authority

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ACRONYMS AND ABBREVIATIONS

Acronyms	Definitions
AA	Alternatives Analysis
AREMA	American Railway Engineering and Maintenance-of-Way Association
ARP	average return period
ASCE	American Society of Civil Engineers
bgs	below ground surface
Cal/OSHA	California Occupational Safety and Health Administration
Caltrans	California Department of Transportation
CBC	California Building Code
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CGS	California Geological Survey
CIDH	cast-in drilled-hole
EIS/EIR	environmental impact statement/environmental impact report
EPBT	Elysian Park Blind Thrust Fault
g	acceleration due to gravity
I-	Interstate
LA	Los Angeles
LAUS	Los Angeles Union Station
LAX	Los Angeles International Airport
LPA	Locally Preferred Alternative
LRFD	Load and Resistance Factor Design
LRT	light rail transit
LRTP	Long Range Transportation Plan
LRV	light rail vehicle
MDE	maximum design earthquake
Metro	Los Angeles County Metropolitan Transportation Authority
mm/yr	millimeters per year
MRDC	Metro Rail Design Criteria
MSF	maintenance and storage facility
NEPA	National Environmental Policy Act

Acronyms	Definitions
NOP	Notice of Preparation
OCS	overhead contact system
ODE	operating design earthquake
OH	overhead
PEROW	Pacific Electric Right-of-Way
PEROW/WSAB AA Report	*Pacific Electric Right-of-Way/West Santa Ana Branch Alternatives Analysis Report*
PGA	peak ground acceleration
PHBT	Puente Hills Blind Thrust Fault
Project	West Santa Ana Branch Transit Corridor Project
ROW	right-of-way
RTP/SCS	Regional Transportation Plan/Sustainable Communities Strategy
SCAG	Southern California Association of Governments
SDC	seismic design criteria
SR	State Route
TPSS	traction power substation
UP	underpass
UPRR	Union Pacific Railroad
US-101	U.S. Highway 101
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WSAB	West Santa Ana Branch

1 INTRODUCTION

1.1 Study Background

The West Santa Ana Branch (WSAB) Transit Corridor (Project) is a proposed light rail transit (LRT) line. In January 2022, the Los Angeles County Metropolitan Transportation Authority (Metro) Board of Directors identified the Locally Preferred Alternative (LPA), which will extend approximately 14.5 miles from the northern terminus in the City of Los Angeles/Florence-Firestone community of Los Angeles (LA) County to the southern terminus in the City of Artesia, traversing densely populated, low-income, and heavily transit-dependent communities. The Project will provide reliable, fixed-guideway transit service that will increase mobility and connectivity for historically underserved, transit-dependent, and environmental justice communities; reduce travel times on local and regional transportation networks; and accommodate substantial future employment and population growth.

1.2 Alternatives Evaluation, Screening, and Selection Process

A wide range of potential alternatives have been considered and screened through the alternatives analysis processes. In March 2010, the Southern California Association of Governments (SCAG) initiated the Pacific Electric Right-of-Way (PEROW)/WSAB Alternatives Analysis (AA) Study (SCAG 2013) in coordination with the relevant cities, the Orangeline Development Authority (renamed to Eco-Rapid Transit, which has since been dissolved), the Gateway Cities Council of Governments, Metro, the Orange County Transportation Authority, and the owners of the right-of-way (ROW)—Union Pacific Railroad (UPRR), BNSF Railway, and the Ports of Los Angeles and Long Beach. The AA Study evaluated a wide variety of transit connections and modes for a broader 34-mile corridor from Union Station in downtown Los Angeles to the City of Santa Ana in Orange County. In February 2013, SCAG completed the PEROW/WSAB Corridor Alternatives Analysis Report[1] and recommended two LRT alternatives for further study: West Bank 3 and the East Bank.

Following completion of the AA, Metro completed the *West Santa Ana Branch Transit Corridor Project Technical Refinement Study* (Metro 2015) in 2015 focusing on the design and feasibility of five key issue areas along the 19-mile portion of the WSAB Transit Corridor within LA County:

- Access to Union Station in downtown Los Angeles
- Northern Section options
- Huntington Park Alignment and Stations
- New C (Green) Line Station
- Southern Terminus at Pioneer Station in Artesia

In September 2016, Metro initiated the WSAB Transit Corridor Environmental Study (Environmental Study) with the goal of environmentally clearing the Project under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA).

[1] Initial concepts evaluated in the SCAG report included transit connections and modes for the 34-mile corridor from Union Station in downtown Los Angeles to the City of Santa Ana. Modes included low-speed magnetic levitation (maglev) heavy rail, light rail, and bus rapid transit.

Metro issued a Notice of Preparation (NOP) on May 25, 2017, with a revised NOP issued on June 14, 2017, extending the comment period to 60 days. In June 2017, Metro held public scoping meetings in the Cities of Bellflower, Los Angeles, South Gate, and Huntington Park. Metro provided project updates and information to stakeholders with the intent to receive comments and questions through a comment period that ended in August 2017. A total of 1,122 comments were received during the public scoping period from May through August 2017. The comments focused on concerns regarding the Northern Alignment options, with specific concerns related to potential impacts to Alameda Street with an aerial alignment. Given potential visual and construction issues raised through public scoping, additional Northern Alignment concepts were evaluated.

In February 2018, the Metro Board of Directors approved further study of the alignment in the Northern Section due to community input during the 2017 scoping meetings. A second alternatives screening process was initiated to evaluate the original four Northern Alignment options and four new Northern Alignment concepts. The *Final Northern Alignment Alternatives and Concepts Updated Screening Report* was completed in May 2018 (Metro 2018). The alternatives were further refined and, based on the findings of the second screening analysis and the input gathered from the public outreach meetings, the Metro Board of Directors approved Alternatives E and G for further evaluation.

On July 11, 2018, Metro issued a revised and recirculated CEQA NOP, thereby initiating a scoping comment period. The purpose of the revised NOP was to inform the public of the Metro Board's decision to carry forward Alternatives E and G into the Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR). During the scoping period, one agency and three public scoping meetings were held in the Cities of Los Angeles, Cudahy, and Bellflower. The meetings provided project updates and information to stakeholders with the intent to receive comments and questions to support the environmental process. The comment period for scoping ended on August 24, 2018; more than 250 comments were received.

Following the July 2018 scoping period, a number of project refinements were made to address comments received, including additional grade separations, removing certain stations with low ridership, and removing the Bloomfield extension option. The Metro Board adopted these project refinements at its November 2018 meeting.

1.3 Draft Environmental Impact Statement/Environmental Impact Report

The Draft EIS/EIR and corresponding technical studies included evaluation of a No Build Alternative, four Build Alternatives, two station design options, and two site options for a maintenance and storage facility (MSF):

- Alternative 1: Los Angeles Union Station to Pioneer Station
  - Design Option 1: Los Angeles Union Station – Metropolitan Water District
  - Design Option 2: Addition of Little Tokyo Station
- Alternative 2: 7th St/Metro Center to Pioneer Station
- Alternative 3: Slauson/A Line (Blue) to Pioneer Station
- Alternative 4: I-105/C Line (Green) to Pioneer Station

- Paramount MSF site option
- Bellflower MSF site option

Figure 1-1 illustrates the Build Alternatives evaluated in the Draft EIS/EIR.

Figure 1-1. Draft EIS/EIR Build Alternatives

Source: Metro 2020

The Draft EIS/EIR was released for public review and comment in July 2021 for 45 days, which was then extended to a 60-day public review period through September 28, 2021, to provide additional time for the public to respond. Notices of the Draft EIS/EIR release were done in accordance with CEQA and NEPA regulations and included two rounds of notices to announce details of the release of the Draft EIS/EIR, as well as to provide information on the public hearings and comment methods. The Notice of Availability was distributed to 261 agencies via USB drives, which included an electronic copy of the Draft EIS/EIR.

During the 60-day public review period, Metro hosted four virtual public hearings, four virtual community information sessions, and over 19 pop-up booths for in-person engagement at locations throughout the project corridor. In addition, Metro held approximately 20 briefings to key stakeholders, elected officials, corridor cities, and other agencies. In total, approximately 450 submissions were received during the public review and comment period. In January 2022, the Metro Board of Directors identified Alternative 3 as the LPA. The LPA extends from a northern terminus at the Slauson/A Line Station located in the City of Los Angeles/Florence-Firestone unincorporated area of LA County to a southern terminus at the Pioneer Station located in Artesia for a total of 14.5 miles. With identification of the LPA, the Metro Board also identified the MSF site option located in the City of Bellflower as a component of the LPA.

1.4 Report Purpose and Structure

The purpose of this Geotechnical, Subsurface, and Seismic Impact Analysis Report is to evaluate the existing geologic, soils, and seismic conditions present within the Affected Area and analyze potential impacts to the LPA. The Affected Area for geotechnical, subsurface, and seismic resources is defined as the area within 250 feet of the LPA. Specifically, the 250-foot buffer extends out from the anticipated area of work/disturbance, including the alignment, design option, MSF site, temporary (construction) areas, and permanent project areas. Considering that the Affected Area for geotechnical, subsurface, and seismic resources is relatively flat, the 250-foot width will cover potential impacts from the Project upon the geology and soils of the area.

The study included review and evaluation of previously published and unpublished geologic and hydrogeologic information developed within the Affected Area. The report is organized into nine sections:

- Section 1 – Introduction
- Section 2 – Project Description
- Section 3 – Regulatory Framework
- Section 4 – Affected Environment/Existing Conditions
- Section 5 – Environmental Consequences/Environmental Impacts
- Section 6 – CEQA Determination
- Section 7 – Construction Impacts
- Section 8 – Project Measures and Mitigation Measures
- Section 9 – References

1.5 Methodology

Existing geologic and geotechnical data were reviewed to assess the Affected Area for known geologic hazards and identify potential impacts. If stations or structures are proposed within or directly adjacent to known geologic hazard areas, the potential for an impact has been identified and assessed.

To satisfy CEQA requirements, geology and soils impacts are analyzed in accordance with Appendix G of the CEQA Guidelines and considered significant if the Project has the potential to result in the following:

a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:

    i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault. Refer to Division of Mines and Geology Special Publication 42.
    ii) Strong seismic ground shaking.
    iii) Seismic-related ground failure, including liquefaction.
    iv) Landslides.

b) Result in substantial soil erosion or the loss of topsoil.
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property.
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater.
f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

Part "f" of the Geology and Soils portion of the CEQA Appendix G checklist is addressed in the West Santa Ana Branch Transit Corridor Project Final Paleontological Resource Impact Analysis Report (Metro 2024a).

2 PROJECT DESCRIPTION

This section describes the No Build Alternative and the LPA studied in the WSAB Transit Corridor Final EIS/EIR, including station locations, and the MSF. The LPA was developed through a comprehensive alternatives analysis process and meets the purpose and need of the Project.

The No Build Alternative and LPA are generally defined as follows:

- **No Build Alternative:** Reflects the transportation network in the 2042 horizon year without the LPA. The No Build Alternative includes the existing transportation network along with planned transportation improvements that have been committed to and identified in the constrained *Metro 2009 Long Range Transportation Plan* (2009 LRTP) (Metro 2009) and SCAG's *2016-2040* RTP/SCS (SCAG 2016), as well as additional projects funded by Measure M that would be completed by 2042.
- **LPA:** The LPA consists of a 14.5-mile LRT line that will extend from the northern terminus in the City of Los Angeles/Florence-Firestone community of LA County to a southern terminus in the City of Artesia.

Figure 2-1 illustrates the LPA. The northern terminus of the LPA will be located just south of the intersection of Long Beach Avenue and Slauson Avenue, connecting to the current Slauson/A Line Station. South of Slauson Avenue, the LPA will follow the UPRR-owned La Habra Branch[2] ROW east along Randolph Street. At the Ports-owned San Pedro Subdivision ROW, the LPA will turn southeast to follow the San Pedro Subdivision ROW and then transition to the PEROW south of the I-105 freeway. The LPA will then follow the Metro-owned PEROW to the southern terminus at the Pioneer Station in Artesia. Figure 2-2 depicts the alignment sections that will require freight track relocation. The LPA will be grade separated where warranted, as indicated on Figure 2-1.

[2] The La Habra Branch may also be referred to as the La Habra Subdivision. La Habra Branch is used within this document.

Figure 2-1. Locally Preferred Alternative Alignment by Grade

Source: WSP and TAHA 2023

Figure 2-2. Existing Rail Right-of-Way Ownership

Source: WSP and TAHA 2023

2.1 No Build Alternative

For the NEPA evaluation, the No Build Alternative is evaluated in the context of the existing transportation facilities in the project corridor (the corridor extends approximately 2 miles from each side of the four alternatives evaluated in the Draft EIS/EIR) and other capital transportation improvements and/or transit and highway operational enhancements that are reasonably foreseeable. Because the No Build Alternative provides the background transportation network against which the LPA's impacts are identified and evaluated, the No Build Alternative does not include the Project.

The No Build Alternative reflects the transportation network in 2042 and includes the existing transportation network along with planned transportation improvements that have been committed to and identified in the constrained Metro 2009 LRTP and the SCAG 2016 RTP/SCS, as well as additional projects funded by Measure M, a sales tax initiative approved by voters in November 2016. The No Build Alternative includes Measure M projects that are scheduled to be completed by 2042.

The required environmental baseline socioeconomic growth projections, including the reasonably foreseeable transportation network in 2042, were established in July 2017 when the preparation of the Draft EIS/EIR began. The SCAG 2016-2040 RTP/SCS was the adopted current regional growth forecast at the time the Draft EIS/EIR baseline was established. Specifically, the baseline year 2017 and future year 2042 population, housing, and employment are derived from the Transportation Analysis Zone-level estimates from the SCAG 2016-2040 RTP/SCS.

Table 2.1 lists the existing transportation network and planned improvements included as part of the No Build Alternative based on the Metro 2009 LRTP and SCAG 2016 RTP/SCS.

Table 2.1. No Build Alternative – Existing Transportation Network and Planned Improvements

Project	To / From	Location Relative to Study Area
Rail (Existing)		
Metro Rail System (LRT and Heavy Rail Transit)	Various locations	Within Study Area
Metrolink (Southern California Regional Rail Authority) System	Various locations	Within Study Area
Rail (Under Construction/Planned)[1]		
Metro Westside D Line Extension	Wilshire/Western to Westwood/VA Hospital	Outside Study Area
Metro C Line Extension[2] to Torrance	96th Street Station to Torrance	Outside Study Area
Metro C Line Extension	Norwalk to Expo/Crenshaw	Outside Study Area
Metro East-West Line/Regional Connector/Eastside Phase 2	Santa Monica to Lambert Road Santa Monica to Peck Road	Within Study Area
Metro North-South Line/Regional Connector/Foothill Extension to Claremont Phase 2B	Long Beach to Claremont	Within Study Area
Metro Sepulveda Transit Corridor	Metro G Line to Metro E Line	Outside Study Area

Project	To / From	Location Relative to Study Area
Metro East San Fernando Valley Transit Corridor	Sylmar to Metro G Line	Outside Study Area
Los Angeles World Airport Automated People Mover	96th Street Station to LAX Terminals	Outside Study Area
Metrolink Capital Improvement Projects	Various projects	Within Study Area
California High-Speed Rail	Burbank to LA LA to Anaheim	Within Study Area
Link US[3]	LAUS	Within Study Area
Bus (Existing)		
Metro Bus System (including BRT, Express, and local)	Various locations	Within Study Area
Municipality Bus System[4]	Various locations	Within Study Area
Bus (Under Construction/Planned)		
Metro G Line (BRT)	Del Mar (Pasadena) to Chatsworth Del Mar (Pasadena) to Canoga Canoga to Chatsworth	Outside Study Area
Vermont Transit Corridor (BRT)	120th Street to Sunset Boulevard	Outside Study Area
North San Fernando Valley BRT	Chatsworth to North Hollywood	Outside Study Area
North Hollywood to Pasadena	North Hollywood to Pasadena	Outside Study Area
Highway (Existing)		
Highway System	Various locations	Within Study Area
Highway (Under Construction/Planned)		
High Desert Multi-Purpose Corridor	SR-14 to SR-18	Outside Study Area
I-5 North Capacity Enhancements	SR-14 to Lake Hughes Road	Outside Study Area
SR-71 Gap Closure	I-10 to Rio Rancho Road	Outside Study Area
Sepulveda Pass Express Lane	I-10 to US-101	Outside Study Area
SR-57/SR-60 Interchange Improvements	SR-57/SR-60	Outside Study Area
I-710 South Corridor Project (Phases 1 and 2)	Ports of Long Beach and LA to SR-60	Within Study Area
I-105 Express Lane	I-405 to I-605	Within Study Area
I-5 Corridor Improvements	I-605 to I-710	Outside Study Area

Source: Metro 2018, WSP 2019

Notes: [1] Where extensions are proposed for existing Metro rail lines, the origin/destination is defined for the operating scheme of the entire rail line following completion of the proposed extensions and not just the extension itself.

[2] The Metro C Line extension to Torrance includes new construction from Redondo Beach to Torrance; however, the line will operate from Torrance to 96th Street.

[3] Link US rail walk times included only.

[4] The municipality bus network system is based on service patterns for Bellflower Bus, Cerritos on Wheels, Cudahy Area Rapid Transit, Get Around Town Express, Huntington Park Express, La Campana, Long Beach Transit, Los Angeles Department of Transportation, Norwalk Transit System, and the Orange County Transportation Authority.

BRT = bus rapid transit; LA = Los Angeles; LAUS = Los Angeles Union Station; LAX = Los Angeles International Airport; LRT = light rail transit; SR = State Route; VA = Veterans Affairs

2.2 Locally Preferred Alternative

2.2.1 Refinements to the Locally Preferred Alternative

The LPA evaluated in this report is Alternative 3 from the Draft EIS/EIR with refinements to address stakeholder coordination and comments on the Draft EIS/EIR. Refinements to the LPA include the following:

- Shift the Slauson/A Line aerial station platform south and add a second set of vertical circulation and pedestrian circulation elements between the Slauson/A Line Station and the existing A Line Station. Additionally, a set of stairs was added between the A Line station and street level.
- Swap the location of the freight and LRT tracks within the La Habra Branch ROW compared to the Draft EIS/EIR design. Freight tracks will be located on the north side of the ROW and LRT tracks on the south side to accommodate potential freight connectivity to an existing industrial track on the north side of the ROW.
- Open or close at-grade crossings and implement left-turn restrictions over the LRT tracks in the City of Huntington Park:
  - Open crossings previously proposed for closure at Albany Street and Rugby Boulevard
  - Close crossings previously proposed to remain open at Malabar Street and Arbutus Avenue
  - Implement left-turn restrictions at Santa Fe Avenue, Pacific Boulevard, Miles Avenue, and State Street
- Modify roadway design at the southeast corner of Florence Avenue and California Avenue to avoid partial acquisition of infrastructure related to a water well.
- Redesign a freight spur track connection north of Rayo Avenue on the west side of the freight tracks to avoid impacts to a spur track.
- Close the private at-grade crossing at Miller Way. The private business will be displaced by the Project.
- Extend the LRT viaduct north of Imperial Highway to avoid impacts to a spur track and full acquisition of a property.
- Reconfigure the I-105/C Line Station parking facility by removing dedicated transit parking on the west side of the freight tracks and expanding the parking facility on the east side of the freight tracks to the north; also add a new driveway entrance to the parking facility at Century Boulevard.
- Eliminate demolition and reconstruction of the Arthur Avenue and Façade Avenue bridges; modify Façade Avenue to an emergency exit only from the I-105/C Line infill station (rather than a station entrance and exit).
- Modify the replacement freight bridge at I-105 to a four-span structure, consistent with the current bridge, rather than the previously proposed two-span structure.
- Replace the proposed pedestrian undercrossing with a pedestrian bridge at Paramount High School that will span the entire rail ROW.
- Realign the MSF site entrance on Somerset Boulevard to align with Bayou Avenue to allow for a signalized pedestrian crossing of Somerset Boulevard.
- Add protected left turn and a traffic signal on Clark Avenue at Los Angeles Street to accommodate dedicated turning movements to the community.

- Modify alignment of the LRT tracks and soundwall at the Bellflower Mobile Home Park to minimize parking loss and provide replacement parking elsewhere on the property to maintain the existing number of parking spaces.
- Redesign retaining walls on the southeast side of the 183rd Street/Gridley Road crossing from retained fill to columns.
- Incorporate the Artesia Historic District Recreation Trails as an existing, rather than future, condition in the Final EIS/EIR plan set.
- Add a design option that will close 186th Street but keep 187th Street open to traffic in the City of Artesia, and turn Corby Avenue into a cul-de-sac with an access driveway for the existing business.
- Modify the entrance to the Pioneer Station parking structure to align with Solana Place and shift structure north to provide alley egress resulting in an additional level on the Pioneer parking structure to maintain the number of parking spaces identified in the Draft EIS/EIR.
- Extend the median located north of the LRT tracks at the Pioneer Boulevard grade crossing to prohibit left turns from a shopping center driveway along the east side.
- Incorporate Mitigation Measures NOI-4 (Crossing Signal Bell Shrouds) and NOI-5 (Gate-Down-Bell-Stop Variance), recommended in the Draft EIS/EIR to further reduce noise at grade crossings, as Project Measure NOI PM-1 and NOI PM-2 in the Final EIS/EIR to be implemented as part of the LPA.
- Add Project Measure VA PM-8 (Residential Screening for Aerial Structures), which requires privacy screening along portions of the aerial structure adjacent to the rear of residential properties in the Cities of Paramount, Bellflower, and Cerritos if the soundwall in those locations will not be sufficiently tall to provide similar privacy screening.
- Add Project Measures BIO PM-1 (Invasive Plant Species Best Management Practices) and BIO PM-2 (Prohibition of Invasive Plant Species in Landscape Plans) to provide options to minimize the spread of invasive species during construction and prohibit the inclusion of invasive species in landscape plans; add Project Measure BIO PM-3 (LA Metro Tree Policy) to require adherence to LA Metro Tree Policy, adopted by Metro in October 2022.
- Add Project Measure CR PM-1 (Secretary of the Interior Standards Design Review), which requires review and approval of the design of the new LRT bridge and C Line station that will be constructed within the Century Freeway-Transitway Historic District and extension of the Union Pacific LA River Rail Bridge's existing concrete piers by a professional who meets the Secretary of the Interior's Professional Qualification Standards in architectural history, history, or architecture.

Refinements also included the following modifications to construction laydown/staging areas:

- Relocate the construction laydown area near State Street and Randolph Street to east of State Street in the railroad ROW.
- Relocate the laydown area at the southeast corner of Imperial Highway and Garfield Place to north of Imperial Highway within the San Pedro Subdivision ROW.
- Locate a construction laydown/staging area on the east side of the ROW between Rayo Avenue and Southern Avenue.

Additionally, refinements included changes to traction power substations (TPSS) site locations:

- Relocate TPSS Site 14 from the northwest corner of Randolph Street and State Street to the east within railroad ROW.
- Eliminate optional TPSS Sites 16E and 12E in the City of Huntington Park.
- Add Optional TPSS Site 7E within the reconfigured parking facility east of the tracks at the I-105/C Line Station parking facility.
- Relocate the proposed TPSS Site 2 from the northwest side of the intersection of 183rd Street/Gridley Road to the southeast side.

2.2.2 Alignment Configuration

This section summarizes the LPA alignment. The general characteristics of the LPA are summarized in Table 2.2. Figure 2-3 illustrates the freeway crossings along the alignment. Additionally, the LPA will require relocation of existing freight rail tracks within the ROW to maintain existing operations where freight tracks will be in a shared corridor with the LRT tracks. Figure 2-2 depicts the alignment sections that will require freight track relocation.

Table 2.2. Summary of LPA Components

Component	Quantity
Alignment length	14.5 miles
Length of at-grade and aerial	12.1 miles at-grade; 2.4 miles aerial[1]
Station configurations	9 along WSAB alignment, 1 at-grade infill station along C Line 3 aerial; 6 at-grade
Parking facilities	5 total: 4 surface lots and 1 parking structure (approximately 2,800 spaces)
At-grade crossings	30
Elevated street crossings	15
Freight crossings	6
Freeway crossings	4 (1 aerial/overcrossing at I-105; 3 freeway undercrossings[2] at I-710, I-605, SR 91)
Freight realignment	8.7 miles
River crossings	3 (Rio Hondo, LA River and San Gabriel)
TPSS facilities	17
Maintenance and Storage Facility site	1 (City of Bellflower)

Source: WSP 2023
Notes: [1] Alignment configuration measurements count retained fill embankments as at-grade.
[2] The light rail tracks crossing beneath freeway structures.
LA = Los Angeles; TPSS = traction power substation; WSAB = West Santa Ana Branch

Figure 2-3. Freeway Crossings

Source: WSP 2023

The total alignment length of the LPA will be approximately 14.5 miles, consisting of approximately 12.1 miles of at-grade and 2.4 miles of aerial alignment. The LPA will include nine new LRT stations along the WSAB alignment, of which six will be at-grade and three will be aerial. Additionally, the Project will add one new infill station along the C Line at I-105 to allow transfers between the WSAB alignment and the C Line. Five of the stations will include parking facilities, providing a total of approximately 2,800 dedicated transit parking spaces. Four of the parking facilities will be surface lots and the fifth will be a parking structure. The alignment will include 30 at-grade crossings, 4 freeway crossings (3 freeway undercrossings and 1 aerial freeway crossing), 3 river crossings, 15 aerial road crossings, and 6 freight crossings. The following further describes the LPA along the alignment.

Northern terminus (City of Los Angeles/Florence-Firestone community of LA County): The northern terminus of the LPA will begin at the Slauson/A Line Station, which will serve as a transfer point to the Metro A Line. Transfers between the Slauson/A Line Station and the existing Metro A Line will be accommodated via two pedestrian bridges between the two station platforms. The pedestrian bridges will be located at the southern and northern ends of the platforms and will be accessed by stairs, escalators, and/or elevators. Stairs, escalators, and/or elevators will also connect with the street level on the north side of the station, while stairs will connect with the street level on the south side of the station. An additional set of stairs will be added to the existing A Line Station providing access to street level. Tail tracks[3] accommodating layover storage for a three-car train will extend approximately 1,000 feet north from the station.

La Habra Branch ROW[4] (City of Huntington Park): South of the Slauson/A Line Station, the alignment will turn east along the existing UPRR owned La Habra Branch ROW in the median of Randolph Street. The alignment will be on the south side of the La Habra Branch ROW, and the freight tracks will be realigned but remain in the northern portion of the ROW. The alignment will transition to an at-grade configuration west of Alameda Street and will proceed east along the Randolph Street median. Wilmington Avenue, Regent Street, and Malabar Street will be closed to traffic crossing the ROW, altering the intersection design to a right-in, right-out configuration. The Pacific/Randolph Station will be located just east of Pacific Boulevard. From the Pacific/Randolph Station, the alignment will continue east at-grade. Arbutus Avenue and Rita Avenue will be closed to traffic crossing the ROW, altering the intersection design to a right-in, right-out configuration.

San Pedro Subdivision ROW (Cities of Huntington Park, Bell, Cudahy, South Gate, Downey, and Paramount): At the San Pedro Subdivision ROW, the alignment will transition to an aerial configuration and turn south to cross over Randolph Street and the freight tracks, returning to an at-grade configuration north of Gage Avenue. The alignment will be located on the east side of the existing San Pedro Subdivision ROW freight tracks, and the existing track(s) will be relocated to the west side of the ROW. The alignment will continue at-grade within the San Pedro Subdivision ROW to the at-grade Florence/Salt Lake Station south of Florence Avenue.

[3] Tail tracks are additional tracks that extend beyond the end of the mainline tracks and can be used for temporarily parking, storing, or reversing the direction of trains. While the tracks are designed to allow for layover if needed, trains will not sit at the end of the line.

[4] The La Habra Branch may also be referred to as the La Habra Subdivision. La Habra Branch is used within this document.

The alignment will continue southeast from the at-grade Florence/Salt Lake Station within the San Pedro Subdivision ROW, crossing Otis Avenue, Santa Ana Street, and Ardine Street at-grade. The alignment will be located on the east side of the existing San Pedro Subdivision freight tracks, and the existing tracks will be relocated to the west side of the ROW. South of Ardine Street, the alignment will transition to an aerial structure to cross over the existing UPRR tracks and Atlantic Avenue. The Firestone Station will be located on an aerial structure between Atlantic Avenue and Firestone Boulevard. The Firestone Station will include a dedicated transit parking facility providing approximately 600 parking spaces with a vehicle underpass under the freight tracks to access the parking facility.

The alignment will then cross over Firestone Boulevard and transition back to an at-grade configuration prior to crossing Rayo Avenue at-grade. The alignment will continue south along the San Pedro Subdivision ROW, crossing Southern Avenue at-grade and continuing at-grade until it transitions to an aerial configuration to cross over the LA River. The LRT bridge will be constructed next to the existing freight bridge. South of the LA River, the alignment will transition to an at-grade configuration, then passing under the I-710 freeway through a new box tunnel structure. The alignment will then return to an aerial structure to cross over the Rio Hondo Channel. South of the Rio Hondo Channel, the alignment will transition to an aerial structure to cross over a realigned spur track, Imperial Highway and Garfield Avenue. South of Garfield Avenue, the alignment will transition to an at-grade configuration and serve the Gardendale Station north of Gardendale Street.

From the Gardendale Station, the alignment will continue south in an at-grade configuration, crossing Gardendale Street and Main Street to serve the I-105/C Line Station, which will be located at-grade north of Century Boulevard. The I-105/C Line Station will include a dedicated transit parking facility providing approximately 340 to 360 parking spaces, depending on the location of the TPSS. The alignment will continue at-grade, crossing Century Boulevard, then will cross over the I-105 freeway in an aerial configuration within the existing San Pedro Subdivision ROW bridge footprint. A new Metro C Line Station will be constructed in the median of the I-105 freeway. The I-105/C Line Station will be connected to the new infill C Line Station in the middle of the freeway via a pedestrian walkway on the new LRT bridge. Vertical pedestrian access will be provided from the LRT bridge to the new C Line Station platform via stairs, escalators, and/or elevators. Emergency egress from the C Line Station will also be provided at Façade Avenue via stairs and elevators. To accommodate construction of the new station platform, the existing Metro C Line tracks will be widened and, as part of the I-105 Express Lanes Project, the I-105 lanes will be reconfigured.

PEROW (Cities of Paramount, Bellflower, Cerritos, and Artesia): South of the I-105 freeway, the alignment will continue at-grade within the San Pedro Subdivision ROW. In order to maintain freight operations and allow for freight train crossings, the alignment will transition to an aerial configuration as it turns southeast and enter the PEROW. The existing freight track will cross beneath the aerial alignment and align on the north side of the PEROW east of the San Pedro Subdivision ROW. The Paramount/Rosecrans Station will be located in an aerial configuration west of Paramount Boulevard and north of Rosecrans Avenue. The existing freight track will be relocated to the northeast side of the alignment adjacent to the viaduct structure. The Paramount/Rosecrans Station will include a dedicated transit parking facility providing approximately 490 parking spaces located south of the alignment between Los Angeles Department of Water and Power property and Rosecrans Avenue.

The alignment will continue southeast in an aerial configuration over the Paramount Boulevard/Rosecrans Avenue intersection and descend to an at-grade configuration. The alignment will return to an aerial configuration to cross over Downey Avenue descending back to an at-grade configuration north of Somerset Boulevard. The existing Paramount High School pedestrian bridge will be reconstructed over the LPA and freight tracks to maintain the connection between Paramount High School and the athletics fields. One of the adjacent freight storage tracks at the World Energy facility will be relocated to accommodate the new LRT tracks and maintain storage capacity. There are no active freight tracks south of the World Energy facility (Somerset Boulevard).

The alignment will cross Somerset Boulevard at-grade. South of Somerset Boulevard, the at-grade alignment will parallel the existing Bellflower Bike Trail that is currently aligned on the south side of the PEROW. The alignment will continue at-grade crossing Lakewood Boulevard, Clark Avenue, and Alondra Boulevard. The at-grade Bellflower Station will be located west of Bellflower Boulevard. The Bellflower Station will include a dedicated transit parking facility providing approximately 260 parking spaces.

East of Bellflower Boulevard, the Bellflower Bike Trail will be realigned to the south side of the PEROW to accommodate an existing historic building located near the southeast corner of Bellflower Boulevard and the PEROW. The realigned bike trail will then match the existing bike trail east of the historic building near Bellflower Boulevard. The LRT alignment will continue southeast within the PEROW and transition to an aerial configuration near Cornuta Avenue, crossing over Flower Street and Woodruff Avenue. The alignment will return to an at-grade configuration south of Woodruff Avenue. South of Woodruff Avenue, the Bellflower Bike Trail will be realigned along the north side of the PEROW. Continuing southeast, the LRT alignment will cross under the SR-91 freeway in an existing undercrossing. The alignment will cross over the San Gabriel River on a new bridge, replacing the existing abandoned freight bridge. South of the San Gabriel River, the alignment will transition back to an at-grade configuration before crossing Artesia Boulevard at-grade.

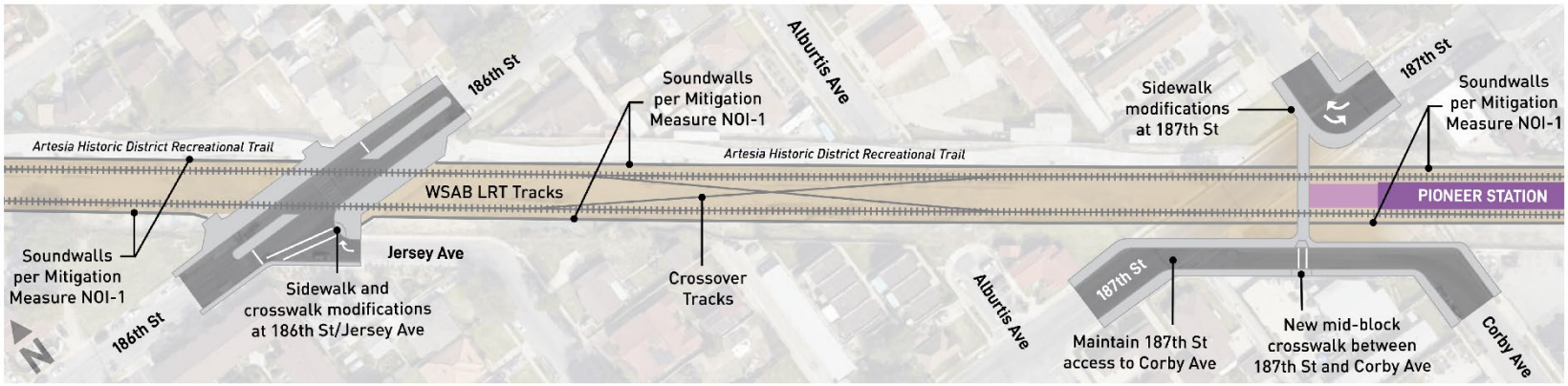
East of Artesia Boulevard, the alignment will cross beneath the I-605 freeway in an existing underpass. Southeast of the underpass, the alignment will continue at-grade, crossing Studebaker Road. North of Gridley Road, the alignment will transition to an aerial configuration to cross over 183rd Street and Gridley Road. The alignment will return to an at-grade configuration and cross 186th Street and 187th Street at-grade. The alignment will then pass through the Pioneer Station on the north side of Pioneer Boulevard at-grade. The Pioneer Station will include a dedicated transit parking facility providing approximately 1,100 parking spaces. Tail tracks accommodating layover storage for a three-car train will extend approximately 1,000 feet south from the station, crossing Pioneer Boulevard and terminating north of South Street.

2.2.3 Design Option – Close 186th Street

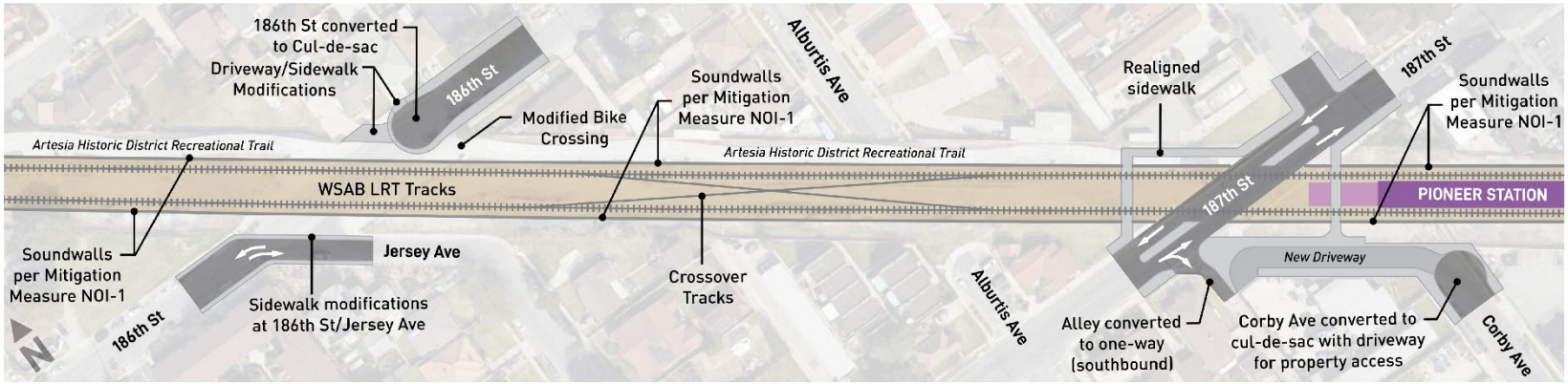
The LPA includes one design option:

- **Design Option:** Close 186th Street – The design option would close 186th Street but keep 187th Street open to traffic in the City of Artesia. Corby Avenue would become a cul-de-sac with an access driveway for the existing business (Figure 2-4).

Figure 2-4. Locally Preferred Alternative and Design Option: Close 186th Street



Locally Preferred Alternative



Design Option 1: Close 186th Street

Source: Cityworks Design and WSP 2023

2.2.4 Maintenance and Storage Facility

Generally, each LRT project requires an MSF facility to provide daily servicing and cleaning, inspection and repairs, and storage of light rail vehicles (LRVs). Activities may take place in the MSF throughout the day and night depending upon train schedules, workload, and the maintenance requirements.

In January 2022, the Metro Board identified the Bellflower MSF as the WSAB Project's MSF site. The MSF site is located in the City of Bellflower and is bounded by a mobile home community and industrial facilities to the west, Somerset Boulevard and apartment complexes to the north, residential homes to the east, and the PEROW and Bellflower Bike Trail to the south. Access to the site will be via a signalized driveway at Somerset Boulevard and Bayou Avenue (Figure 2-5). In total, the MSF site is approximately 21 acres and could accommodate up to 80 LRVs to serve the Project's operations plan.

The MSF will have storage tracks, each with sufficient length to store three-car train sets and a maintenance-of-way vehicle storage. The facility will include a main shop building with administrative offices, a cleaning platform, a TPSS, employee parking, a vehicle wash facility, a paint and body shop, and other facilities as needed. The east and west yard leads (i.e., the tracks leading from the mainline to the facility) will have sufficient length for a three-car train set.

Figure 2-5. Maintenance and Storage Facility Site

Source: WSP and TAHA 2023

3 REGULATORY FRAMEWORK

This section provides a summary of the federal, state, and local regulatory framework applicable to geologic hazards (including seismicity) in the Affected Area.

3.1 Federal

There are no federal policies or regulations directly applicable to the Project's geology and soils analysis. The LPA will cross three existing concrete-lined flood channels (Los Angeles River Channel, Rio Hondo Channel, and San Gabriel River) that are under the jurisdiction of the U.S. Army Corps of Engineers (USACE). LPA geotechnical design requirements for the channel crossings are discussed in the following subsections. In accordance with the WSAB Final Advanced Conceptual Engineering Report (Metro 2024g), coordination with the USACE will continue as design advances to confirm freeboard (clearance above flood waters), analyze and minimize impact to channel flood conveyance, and obtain agency approval for construction impacts (both temporary and permanent). See the West Santa Ana Branch Transit Corridor Project Final Water Resources Impact Analysis Report (Metro 2024c) for discussion on the USACE 404 and 408 permit requirements. Coordination with the USACE would address geotechnical, subsurface, and seismic issues as the coordination would be consistent with USACE geotechnical requirements for the flood channels during project implementation.

3.2 State

3.2.1 Alquist-Priolo Earthquake Fault Zoning Act

The California legislation protecting the population of California from the effects of fault-line ground surface rupture is the Alquist-Priolo Earthquake Fault Zoning Act[5] (Public Resources Code [PRC] 2621 *et seq.*). The Alquist-Priolo Act (California Geological Survey [CGS] 2018) is the state's principal guidance to prevent the construction of habitable structures on the surface trace of active earthquake faults. The Alquist-Priolo Act only addresses the hazard of surface fault rupture and does not consider other earthquake hazards.

3.2.2 Seismic Hazards Mapping Act

The California Seismic Hazards Mapping Act (PRC 2690-2699.6) became effective in 1991 to identify and map seismic hazard zones for the purpose of assisting cities and counties in preparing the safety elements of their general plans, and to encourage land use management policies and regulations that reduce seismic hazards. The recognized hazards include strong ground shaking, liquefaction, landslides, and other ground failure. The Act has resulted in the preparation of maps delineating liquefaction and earthquake-induced landslide Zones of Required Investigation. In addition, the CGS's Special Publication 117A, *Guidelines for Evaluating and Mitigating Seismic Hazards in California* (2008), provides guidance for the evaluation of earthquake-related hazards for projects in designated Zones of Required Investigations and for recommending mitigation measures as required by PRC Section 2695(a).

[5] The Alquist-Priolo Earthquake Fault Zoning Act was enacted in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. In accordance with this act, the State Geologist established regulatory zones, called "earthquake fault zones," around the surface traces of active faults and published maps showing these zones. Buildings for human occupancy are not permitted to be constructed across the surface trace of active faults.

3.2.3 Surface Mining and Reclamation Act

The State Surface Mining and Reclamation Act (PRC 2710 et seq.) became effective in 1975 to establish policy for the reclamation of mined lands and the conduct of surface mining operations. The Affected Area is not located on an existing or previously mined area and no local ordinances or regulations allow surface mining within the Affected Area; however, the issue of loss of mineral resources due to the Project is evaluated in this study.

3.2.4 California Building Code

In addition to the preceding state acts, California regulations protecting the public from geo-seismic hazards are contained in the California Code of Regulations (CCR), Title 24, Part 2 California Building Code (CBC). For surface structures other than guideways and bridges, the *Metro Rail Design Criteria* (MRDC) require conformance with the latest version of the LA County Building Code, which is based on the CBC. The CBC dictates the requirements for design of structures and includes requirements to perform site-specific geotechnical investigations and prepare design reports in accordance with the CBC-specified methodologies. These investigations and reports will be conducted as the project design advances and will address the hazards (for surface structures other than guideways and bridges) discussed in this report.

Chapter 16 of the CBC deals with structural design requirements governing seismically resistant construction (Section 1604), including, but not limited to, factors and coefficients used to establish seismic site class for the soil/rock at the building location and seismic occupancy category for the proposed building design (Sections 1613.3 through 1613.5). Chapter 18 includes, but is not limited to, the requirements for foundation and soil investigations (Section 1803); excavation, grading, and fill (Section 18/04); allowable load-bearing values of soils (Section 1806); and the design of footings, foundations, and slope clearances (Sections 1808 and 1809), retaining walls (Section 1807) and pier, pile, driven, and cast-in-place foundation support systems (Section 1810). Chapter 33 includes, but is not limited to, requirements for safeguards at work sites so that excavations and cut or fill slopes are stable (Section 3304). Appendix J of the CBC includes, but is not limited to, grading requirements for the design of excavations and fills (Sections J106 and J107) and for erosion control (Section J110).

3.2.5 California Division of Occupational Safety and Health

Construction activities associated with the LPA are subject to occupational safety standards for excavation, shoring, and trenching as specified in California Occupational Safety and Health Administration (Cal/OSHA) regulations (CCR, Title 8). This includes the Cal/OSHA normal ventilation requirements for underground work areas, which includes the following:

- Fresh air must be supplied to all underground work areas in sufficient amounts to prevent any dangerous or harmful accumulation of dusts, fumes, mists, vapors, or gases. If natural ventilation does not provide the necessary air quality through sufficient air volume and air flow, the employer must provide mechanical ventilation such that each employee working underground has at least 200 cubic feet of fresh air per minute.
- When performing work that is likely to produce dust, fumes, mists, vapors, or gases, the linear velocity of air flow in underground work areas must be at least 30 feet per minute. When such operations are complete, the ventilation systems must exhaust smoke and fumes to the outside atmosphere before resuming work.

3.3 Local

3.3.1 Los Angeles County Metropolitan Transportation Authority

The MRDC establish the design criteria for all Metro transit projects, including aboveground features of LRT projects. Section 5 of the MRDC, Structural/Geotechnical, indicates the following:

> The criteria and codes specified herein shall govern all matters pertaining to the design of Los Angeles County Metropolitan Transportation Authority (Metro) owned facilities including bridges, aerial guideways, cut-and-cover subway structures, tunnels, passenger stations, earth-retaining structures, surface buildings, miscellaneous structures such as culverts, sound walls, and equipment enclosures, and other non-structural and operationally critical components and facilities supported on or inside Metro structures. These criteria also establish the design parameters for temporary structures… The main reference document controlling the seismic design of Metro facilities under these criteria is the MRDC Section 5 Appendix, Metro Supplemental Seismic Design Criteria.

The MRDC provide guidance on the procedures and methods to be used during design of structures. Section 5 of the MRDC also provides detailed design requirements that address the geologic conditions and hazards discussed in this report. Specifically, MRDC Section 5.6, Geotechnical, requires subsurface investigation and laboratory testing, geotechnical reporting, and temporary excavation and detailed foundation design requirements that will address the hazards discussed in this report.

All new structures must be designed to resist the earthquake forces and ground displacement stipulated in the MRDC. The MRDC Section 5 Appendix, Metro Supplemental Seismic Design Criteria (SDC), dictates the required seismic performance criteria for structures. For structures other than aboveground and underground guideways and bridges, such as buildings and some retaining walls, the MRDC require conformance with the LA County Building Code, which is based on the CBC. For bridges and aerial structures, the MRDC require mandatory conformance with the latest version of the California Department of Transportation (Caltrans) *Bridge Design Specifications*, Caltrans SDC, and American Association of State Highway and Transportation Officials *LRFD [Load and Resistance Factor Design] Bridge Design Specifications*, or American Railway Engineering and Maintenance-of-Way Association (AREMA) specifications, as applicable, depending on the location of the structure. Retaining walls subject to LRT loading will also be designed in conformance with the American Association of State Highway and Transportation Officials with Caltrans Amendments, in accordance with MRDC Section 5.1.3.C.5. Underground structures will be designed to conform with Metro design specifications for underground guideways and structures.

The Metro Supplemental SDC will be used during design of the Project to provide seismic design recommendations for the LPA. In concert with these recommendations, Metro has a two-level design approach for both aerial and underground structures:

1. The Operating Design Earthquake (ODE), defined as an earthquake event likely to occur only once during the design life, where structures are designed to respond without significant structural damage. The ODE has a 150-year average return period (ARP).

2. The Maximum Design Earthquake (MDE), defined as an earthquake event with a low probability of occurring during the design life, where structures are designed to respond with repairable damage and to maintain life safety. The MDE has a 2,500-year ARP.

The Metro SDC also require the following:

- Bridge, aerial, and underground structures will be designed in accordance with the Metro MDE, which has a 2,500-year ARP.
- Surface structures not covered by the Caltrans SDC will be designed in accordance with the LA County Building Code. The LA County Building Code uses the maximum considered earthquake with a 2,500-year ARP.
- Bridges supporting railroads will be designed in accordance with the requirements of the MRDC, the applicable railroad, or the AREMA standards in lieu of specific railroad requirements. The ARP for AREMA-owned facilities varies, depending on the Structure Importance Classification and ranges from a 50- to 2,400-year ARP.

If a structure is governed by more than one set of SDC and conflict exists, the most critical set of requirements will apply to the design.

4 AFFECTED ENVIRONMENT/EXISTING CONDITIONS

The existing conditions of the Affected Area as they relate to geology, soils, and seismicity have been identified from a review of available published and unpublished geotechnical literature pertinent to the Project. These include, but are not limited to, the following:

- Safety elements of the general plans for the cities in the Affected Area and the County of LA
- Official Alquist-Priolo Earthquake Fault Zone maps
- Official seismic hazard zone maps and reports
- Geologic and topographic maps
- Other publications by the CGS, United States Geological Survey (USGS), and the California Department of Conservation, Division of Oil, Gas, and Geothermal Resources

4.1 General Discussion

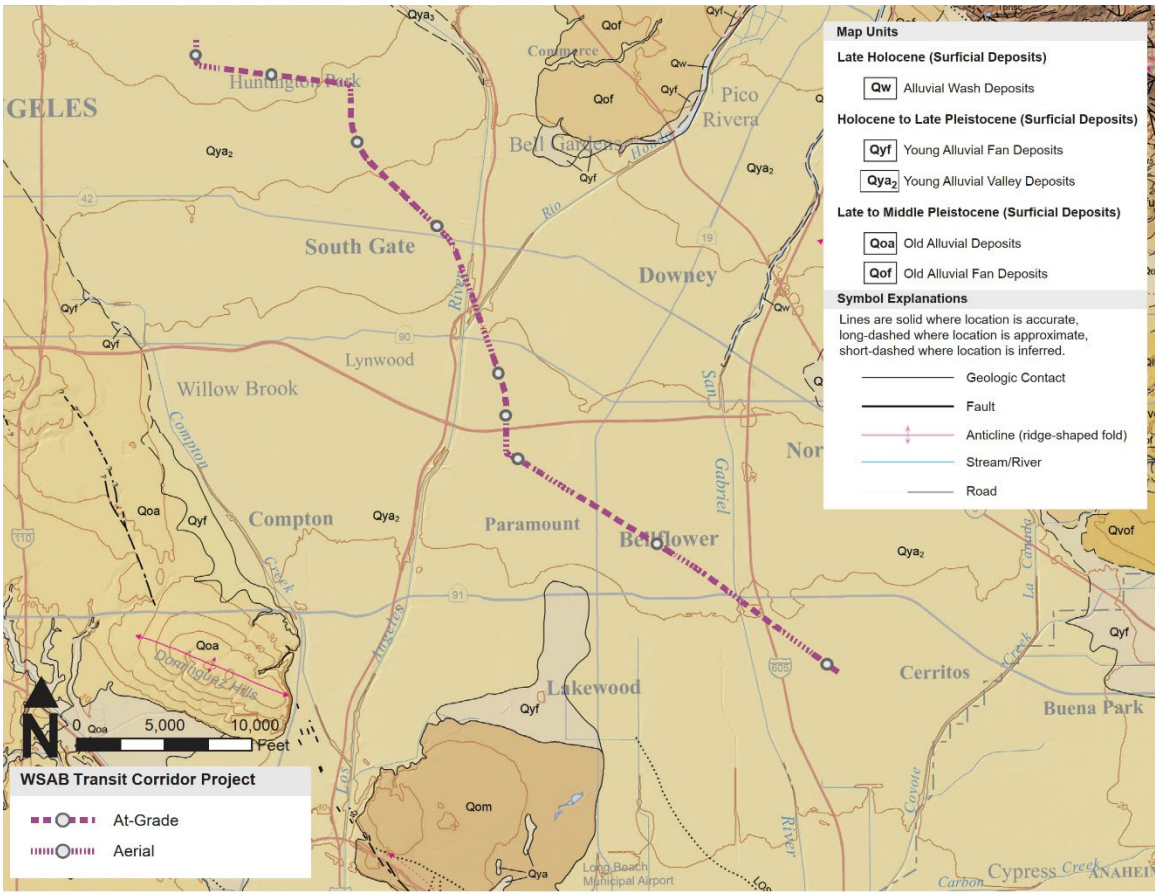
The Affected Area for geotechnical, subsurface, and seismic resources is defined as the area within 250 feet of the LPA. Specifically, the 250-foot buffer extends out from the anticipated area of work/disturbance, including the alignment, design option, MSF site, temporary (construction) areas, and permanent project areas. Considering that the Affected Area for geotechnical, subsurface, and seismic resources is relatively flat, the 250-foot width will cover potential impacts from the Project upon the geology and soils of the area.

The existing geologic conditions within the Affected Area include alluvial soils and sedimentary, igneous, and metamorphic bedrock; variable groundwater conditions; and the potential for ground shaking and liquefaction. The entire Affected Area is blanketed by alluvial soil, overlain locally by artificial fill soils. The topography is relatively flat and gently slopes to the south-southwest toward the Pacific Ocean. The existing geotechnical, geologic, and seismic conditions within the Affected Area are summarized below.

4.2 Regional Geologic Setting

The Affected Area is located within the LA Basin portion of the Peninsular Ranges geomorphic province of California. The Peninsular Ranges province is characterized by a series of northwest-trending mountains, valleys, and faults, all of which generally parallel the San Andreas Fault system. The Elysian Park-Repetto Hills, as well as the Newport-Inglewood Fault Zone, are prime examples of this northwest-trending regional structure. The LA Basin is a structural trough overlying bedrock formations between the Western Continental Shelf and the San Gabriel Mountains. Near the central part of the basin, this structural trough has been filled with nearly 30,000 feet of marine and alluvial deposits of the Quaternary (up to 2.6 million-year-old) and Tertiary (2.6 to 65 million-year-old) ages (Yerkes et al. 1965). These Quaternary and Tertiary units are underlain by Cretaceous-age crystalline bedrock. The geology of the Affected Area is shown on Figure 4-1; given the scale of the figure, the limits of the Affected Area for the conducted geotechnical analysis (250-foot buffer) are not illustrated.

Figure 4-1. Geologic Map



Sources: Jacobs 2023 (geologic base map from Saucedo et al. 2016)

4.3 Physiography and Topography

The Affected Area is on a gently sloping (relatively flat) alluvial surface (the inactive LA and San Gabriel River floodplains) within the LA Basin. Elevations along the Affected Area vary from approximately 175 feet above mean sea level on the northwestern end to 45 feet above mean sea level on the southeast end (USGS 1964a, 1964b, 1965, and 1966). Overall, the Affected Areas slope toward the south and southwest.

As shown on Figure 4-1, the Affected Area is transected by three river crossings: the concrete-lined LA River and Rio Hondo channels just west and east, respectively, of I-710, and the concrete-lined San Gabriel River channel just west of I-605.

4.4 Stratigraphy

The following discussion on the Affected Area geologic units is derived from a combination of regional geologic maps and their associated literature (Bedrossian et al. 2012 and Saucedo et al. 2016). The geologic units relevant to the Affected Area include alluvial soils. Sedimentary, igneous, and metamorphic bedrock are also present in the Affected Area at depths well below that of any of the improvements included in the LPA. Due to these depths, bedrock is not a geological concern for the Project. Figure 4-1 depicts the surficial geology of

the Affected Area. In addition to the mapped geologic units shown on Figure 4-1, artificial fill soils overlie the alluvial deposits locally within the Affected Area.

4.4.1 Artificial Fill Soil

Artificial fill soils are present locally within the Affected Area as the area is urban and developed. Historically, artificial fill soils have been placed during the construction of some past projects to generally raise the grade (ground level) at a site, or to replace soils that were considered detrimental to a proposed development. The depth and lateral extent of these fill soils depend on the original topography as well as urban development within the Affected Area. Fills on the order of 2 to 3 feet to 20 feet thick may be present throughout the Affected Area, although local areas may be underlain by thicker fills. The composition of the fill soils is variable, depending on the source.

4.4.2 Alluvial Soil

The alluvial soil unit (map unit Qya2 as shown on Figure 4-1) mapped along the Affected Area generally consists of interbedded lenses and/or discontinuous layers of fine-grained sediment (silt and clay) and coarse-grained sediment (sand, gravel, cobbles and boulders). From a geologic perspective, alluvial soils are considered unconsolidated because they lack cementation typically associated with rock formations. The contact between the alluvial materials and underlying bedrock is irregular because the alluvium has overlain landscapes developed by erosion into older deposits. The approximate depth to the alluvial soil/bedrock contact varies in the LA Basin. In the Affected Area, the alluvial sediments are expected to be present to depths greater than 1,000 feet below ground surface (bgs) (Yerkes et al. 1965).

4.5 Groundwater and Surface Water

4.5.1 Surface Water

The Affected Area is transected by three rivers: west to east, they are the concrete-lined LA River, Rio Hondo, and San Gabriel River. The Affected Area drains by sheet flow to these major drainages or to secondary drainages, which all ultimately drain into the Pacific Ocean.

4.5.2 Groundwater

Historically, the highest groundwater levels within the Affected Area range from approximately 40 feet bgs near Randolph Street to approximately 10 feet bgs or less from near Florence Avenue to the southeastern end of the Affected Area (CGS 1998a, 1998b, and 1998c).

Based on the available Caltrans as-built Log of Test Boring sheets, groundwater levels were noted at 5 feet bgs (in the 1950s) at I-710 and the LA River, 40 feet bgs (in the 1980s) at I-105 and the UPRR crossing, and 20 feet bgs (in the 1960s) at I-605 and Artesia Boulevard.

Based on experience with underground excavation projects in the downtown LA area (such as the Metro Regional Connector, B and D Lines), it is known that substantial amounts of groundwater inflows can be expected locally in alluvial deposits below the groundwater table. The groundwater levels used during design of the LPA structures will be based on site-specific geotechnical investigations.

4.6 Faulting and Seismicity

4.6.1 General Setting

Faults designated as active faults under the Alquist-Priolo Earthquake Fault Zoning Act have the potential for ground surface rupture during an earthquake event (CGS 2018). This designation indicates the faulting has resulted in surface offsets in Holocene time (~the last 12,000 years) and the fault's location is well defined. Potentially active faults may not be identified as active according to the Alquist-Priolo Act simply because their locations are not well defined and/or they have not been confirmed to have had surface ruptures in Holocene time. A potentially active fault is defined by the Alquist-Priolo Act as a fault that has experienced surface displacement within the Quaternary period (between approximately 12,000 years and 1.6 million years) but has not been confirmed to have younger Holocene displacements (CGS 2018).

No known active faults capable of ground rupture are mapped within the Affected Area, and the LPA is not located in an Alquist-Priolo Earthquake Fault Zone (CGS 2016a, 2016b, and 2016c). The Puente Hills active blind thrust fault system underlies the Affected Area. This fault system does not extend to the ground surface and is not considered capable of direct ground rupture during an earthquake. Known active and potentially active faults that are mapped within 5 miles of the Affected Area are summarized in Table 4.1 and are discussed in Sections 4.6.2 and 4.6.3, respectively. Nearby active and potentially active faults are shown on Figure 4-2.

Table 4.1. Summary of Nearby Active and Potentially Active Faults

Fault Name	Fault Type[1]	Slip Rate[1] (mm/yr)	Maximum Moment Magnitude (M_{max})[1]	Closest Distance to Affected Area (miles)[2]
Puente Hills Fault – LA Section	Blind Thrust	0.9	6.9	0
Puente Hills Fault – Santa Fe Springs Section	Blind Thrust	0.9	6.6	0.8
Lower Elysian Park Fault	Blind Thrust	0.1	6.7	1
Los Alamitos Fault	Uncertain	Uncertain	Uncertain	2.6
Puente Hills Fault – Coyote Hills Springs Section	Blind Thrust	0.9	6.8	3.1
Upper Elysian Park Fault	Blind Thrust	1.9	6.6	5
Newport-Inglewood-Rose Canyon Fault	Strike-Slip	1.0 to 5.0	7.2	4.9

Sources: Caltrans 2017; USGS and CGS 2006
Notes: [1] Caltrans 2017
[2] Blind thrust faults – Caltrans 2017 (distance tabulated is the vertical projection of the blind thrust fault to the surface)
Other faults – USGS and CGS 2006; see Figure 4-2.
mm/yr = millimeters per year; M_{max} = maximum moment magnitude

Figure 4-2. Fault Location Map

Sources: Jacobs 2023 (based on information from Caltrans 2017; USGS and CGS 2006)
Notes: Fault locations are approximate. A Historic fault is a fault that has ruptured in the last 150 years. A Holocene-Latest Pleistocene fault is a fault that has ruptured in the last 15,000 years. A Late Quaternary fault is a fault that has ruptured in the last 130,000 years.

In addition, numerous active faults are present in Southern California that also contribute to the ground shaking hazard for the Project. These faults are considered in the seismic analysis presented in Section 4.6.4.

4.6.2 Nearby Active Faults

4.6.2.1 Surface Faults

The closest active faults capable of ground rupture near the Affected Area are the Raymond, Hollywood, and Newport-Inglewood Faults. As shown on Figure 4-2, these faults are mapped over 5 miles from the Affected Area. These faults are considered in the seismic design for the LPA, as discussed in Section 4.6.4. The Raymond and Hollywood faults are generally north-dipping, east-west-trending faults with a slip rate between 1 and 5 millimeters per year (mm/yr) (USGS and CGS 2006). The Newport-Inglewood Fault Zone is a high-angle northwest-southeast trending right-lateral-strike-slip fault and also has a slip rate of between 1 and 5 mm/yr (USGS and CGS 2006).

4.6.2.2 Blind Thrust Faults

The Affected Area is underlain by the active Puente Hills Blind Thrust Fault (PHBT) (Shaw and Suppe 1996; Shaw et al. 2002). In addition, the Lower Elysian Park Blind Thrust Fault (EPBT) is mapped 1 mile north of the Affected Area. These blind thrust faults are not considered capable of direct ground rupture; however, the faults are considered in the seismic design for the LPA, as discussed in Section 4.6.4.

Puente Hills Blind Thrust Fault

The PHBT system is the name currently given to a series of northerly dipping, blind subsurface thrust faults extending approximately 25 to 28 miles along the eastern margin of the LA Basin. These faults form an en-echelon (parallel) arrangement from the northern LA Basin to the southern part of the Puente Hills.

A potential earthquake of maximum moment magnitude of 6.6 to 6.9 has been estimated for the individual PHBT segments (Caltrans 2017). Caltrans (2017) assumes a slip rate of 0.9 mm/yr for each of the various sections of the Puente Hills Fault. Although the Puente Hills Fault system might generate strong ground motion in the Affected Area, it is not considered capable of generating surface rupture. The projection of the PHBT LA Section to the ground surface intersects the Affected Area in the general vicinity of Florence Avenue (Bergen et al. 2017 and Rollins et al. 2018). As an example, the 1987 Whittier Narrows Earthquake occurred on the PHBT, and rupture of the PHBT did not break the ground surface (Hauksson et. al. 1988). The PHBT fault does not penetrate Quaternary aged sediments in the LA Basin; the fault tip is buried by the sediment, which is very broadly folded as a result of the fault (Rollins et al. 2018).

Lower Elysian Park Blind Thrust Fault

The northwest-southeast trending Lower EPBT is a thrust fault mapped generally from the mid-city area of LA to the Anaheim area of Orange County. The Lower EPBT is believed to be dipping to the northeast at between 15 to 30 degrees, and is assumed to have a slip rate of about 2 mm/yr. Estimated earthquake moment magnitudes associated with seismic events on the Lower EPBT could range from 6.6 to 6.9, with recurrence intervals in the range of 300 to 600 years (USGS and CGS 2006).

4.6.3 Nearby Potentially Active Faults

One potentially active fault is located within 5 miles of the Affected Area, the Los Alamitos Fault, mapped approximately 2.6 miles southwest of the Affected Area in the vicinity of the San Gabriel River (USGS and CGS 2006). The exact location, slip rate, and potential earthquake magnitude have not been established specifically for the Los Alamitos Fault as it is a relatively newly discovered fault. Yeats and Verdugo (2010) theorize that the Los Alamitos Fault is related to the LA Segment of the PHBT and the Newport-Inglewood Fault Zone, which is mapped farther southwest from the Los Alamitos, as shown on Figure 4-2. The Southern California Earthquake Data Center indicates that the Los Alamitos Fault may be a part of the larger Compton-Los Alamitos Fault, located farther south of the Project.

4.6.4 Seismic Shaking

The Affected Area is located within the seismically active region of Southern California and may be subject to seismic ground shaking over time. Preliminary seismic data research and review were conducted for the Affected Area using the USGS seismic design maps (American Society of Civil Engineers [ASCE] 2023). Considering the conceptual level of the Project, the MDE is used to provide a general frame of reference for the ground accelerations (the severity of ground shaking) that will be used in the design of the Project. Peak ground acceleration (PGA) is an estimation of maximum ground shaking a site can experience over a specified period of time. The period of time considered is termed the ARP. The ARP is dictated by the MRDC as discussed in Section 3.3 of this report. Based on available subsurface data from historical borings, soils within the upper 100 feet of the Affected Area can be generally classified as Site Class D for this conceptual level of study. Using the 2017 USGS Seismic Design Maps, PGA corrected for site effects (i.e., subsurface conditions) varies along the Affected Area, ranging from 0.82g (g = acceleration due to gravity) near the northern end (near Slauson Avenue) to 0.73g near the southern end (near South Street). The actual PGA that will be used during design of the LPA project structures will be developed as the project design progresses. The design PGA will use the site class developed from the geotechnical field investigation that will be performed for the LPA.

4.6.5 Other Seismic Hazards

A number of geologic hazards can occur in direct relation to a seismic event. The hazards range from liquefaction to tsunamis and seiches. The potential for these hazards to occur in the Affected Area in correlation with a seismic event is discussed below.

4.6.5.1 Liquefaction

Soil liquefaction occurs in the upper 50 to 75 feet bgs when saturated, loose soils lose their strength because of excess pore water pressure caused by earthquake ground shaking. Pore pressures develops when the space (pores) between the soil particles is completely filled with water, which exerts pressure on the soil particles, thereby influencing how tightly the soil particles are pressed together. Prior to an earthquake, the pore water pressure is static depending on the depth below the groundwater table; however, the shaking caused by an earthquake can increase the pore water pressure to a point where the soil loses strength and ground deformation can occur.

The primary factors affecting the possibility of liquefaction in a soil deposit are the intensity and duration of the earthquake shaking, the soil type, the relative density of the soil, the pressures of material above the soil, and the depth to groundwater. The types of soils most susceptible to liquefaction are clean, loose, uniformly graded, fine-grained sands; nonplastic silts that are saturated; and silty sands. When liquefaction occurs, the strength of the soil decreases, and the ability of the soil to support structures is reduced. The potential impacts of liquefaction may include settlement of the ground surface, additional forces pushing down on foundation piles as a result of soil settlement above the liquefied layers (downdrag), lateral spreading (similar to a landslide), and reduction of the shear strength of the liquefied soil, resulting in reduced load-carrying capacity. Liquefied soils can also exert additional dynamic pressures on retaining walls, which can cause them to tilt or slide. Liquefaction-induced ground failure has historically been a major cause of earthquake damage in Southern California. As shown on Figure 4-3, essentially all of the Affected Area is located in a Liquefaction Zone of Required Investigation (CGS 2016a through 2016c). Because of the scale of the figure, the limits of the Affected Area are not illustrated. Liquefaction Zones of Required Investigation are zones delineated by CGS in areas that have historically experienced liquefaction, or in areas where conditions favorable to liquefaction exist, including the presence of a shallow groundwater table and loose soils.

Figure 4-3. Seismic Hazard Zones Map

Sources: Jacobs 2023 (based on information from CGS 2016a through 2016c)

4.6.5.2 Seismically Induced Landslides

The potential for seismically induced landslides to occur depends on the steepness of the slope, strength and structure of the soil/rock, groundwater depth and extent, and level of ground shaking. The Affected Area is relatively flat, and no significant slopes are present. The Affected Area is not located in an Earthquake-induced Landslide Zone of Required Investigation (CGS 2016a through 2016c).

4.6.5.3 Seismically Induced Settlement

Loose, unsaturated granular soils are susceptible to settlement during an earthquake (as the earthquake shaking causes the soil grains to rearrange and densify). This settlement can result in structural distress as the ground settles. Seismically induced settlement occurs primarily within loose to moderately dense sandy soils due to volume reduction during or shortly after an earthquake event. The artificial fill soils present along the LPA alignment are expected to be undocumented and could include these loose soils. In addition, a portion of the alluvial soils along the LPA alignment is anticipated to be loose to medium dense. Within the entire Affected Area, unsaturated (above the groundwater table), undocumented fill soils and granular alluvial soils in the upper 50 to 75 feet bgs are potentially susceptible to seismically induced settlement.

4.6.5.4 Seismically Induced Inundation

Seismically induced inundation can occur when an earthquake causes catastrophic failure of a water-retaining structure such as a reservoir, dam, or levee, and subsequent flooding occurs due to the release of water from the structure. Based on a review of state inundation maps, floodwaters resulting from dam inundation are not expected to affect the LPA. The LPA alignment will be outside of the dam inundation areas identified by the California Dam Breach Inundation Maps produced by the California Department of Water Resources (2023).

4.6.5.5 Tsunamis and Seiches

Tsunamis are waves typically generated offshore or within large, open bodies of water primarily during subaqueous fault rupture or a subaqueous landslide event. Seiches are waves generated within a large, closed body of water, also caused either by subaqueous fault rupture or landslide events or by ground oscillations from distant earthquakes. At its closest point to the Affected Area, the Pacific Ocean is located over 8 miles to the southwest. There are no closed bodies of water within or adjacent to the Affected Area. Based on the distance to large bodies of water, the risk for tsunami or seiche in the Affected Area is negligible. In addition, the Affected Area is not located within a Tsunami Inundation Area according to LA County (2012).

4.7 Nonseismic Hazards

Potential nonseismic geologic hazards may exist within the Affected Area, as summarized in the following subsections. The *West Santa Ana Branch Transit Corridor Project Final Hazardous Materials Impact Analysis Report* (Metro 2024b) contains discussion regarding potential hazardous materials.

4.7.1 Slope Stability

The stability of a slope depends on the inclination, geology and geologic structure, soil and rock strength, and ground and surface water conditions within the slope. The Affected Area is relatively flat, and no significant slopes are present.

4.7.2 Expansive Soils

Expansive soils are clay-rich soils that swell and shrink with wetting and drying. The shrink-swell capacity of expansive soils can result in differential movement below or adjacent to a structure. This differential movement can result in significant damage to pavements, as well as foundations and associated structures. Clay-rich soils may exist locally within alluvial soils present in the Affected Area.

4.7.3 Ground Settlement and Collapsible Soils

Near the surface, ground settlement can occur when new loads are added to soil, or when a change in water levels results in a decrease in pore water pressures within compressible soils. Collapsible soils consist predominantly of sand- and silt-size particles arranged in a loose "honeycomb" structure. This loose structure is held together by small amounts of water-softening cementing agents, such as clay or calcium carbonate. When the soil becomes wet, these cementing agents soften, the honeycomb structure collapses and generates ground settlement. The alluvial soils within the entire Affected Area may be prone to collapse/ settlement, which can result in differential movement beneath foundations, potentially causing structural distress.

4.7.4 Regional Subsidence

Regional subsidence results from the withdrawal of groundwater and/or hydrocarbons from the subsurface. As the groundwater or hydrocarbons are pumped out of the ground, the resultant voids or pores are compressed under the pressures of the soils above. Accumulation of the compression results in subsidence of the ground surface. The California Department of Water Resources (2014) estimated the potential for future land subsidence within the Affected Area to be low because groundwater withdrawal is restricted and managed, and, where performed, is compensated for by reinjection of water in volumes similar to what is withdrawn. Regional subsidence is not considered to be a significant hazard to the Project.

4.7.5 Naturally Occurring Subsurface Gas

Naturally occurring oil and gas are not considered a major hazard in the Affected Area. The naturally occurring subterranean methane hazard recognized in parts of the City of LA (2004) has not been recognized in the Affected Area. Although not anticipated, if subsurface gases were to be encountered during excavations for the LPA viaduct foundations or other support structures, this could pose a fire/explosion hazard during construction. As detailed in the *West Santa Ana Branch Transit Corridor Project Final Hazardous Materials Impact Analysis Report* (Metro 2024b), one reportedly abandoned oil and gas well is known to exist in the Affected Area for geotechnical, subsurface, and seismic resources.

Radon gas is produced by the decay of uranium, which may be naturally present at varying levels in soil and rock. Once present, the gas moves through the ground and may enter structures through utility corridors, openings or cracks in foundations, and construction joints. Because radon gas is very dense, it may accumulate in basements or crawl spaces. Radon exposure has been linked to lung cancer. The U.S. Environmental Protection Agency (USEPA) action level for radon is above 4.0 picocuries per liter of air. The USEPA has mapped LA County as a Zone 2 radon area, which is defined as an area with a general indoor radon potential of between 2.0 and 4.0 picocuries per liter (USEPA 2019), thus, radon is not anticipated to be present at harmful concentrations in the Affected Area.

4.8 Mineral Resources

The Affected Area is situated atop alluvial soils, some of which could likely be used as construction aggregate. However, considering the highly urbanized nature of the Affected Area, mining of these materials is not economically viable and, therefore, there will be no loss of viable mineral resources.

5 ENVIRONMENTAL IMPACTS/ENVIRONMENTAL CONSEQUENCES

This section presents the environmental impacts and consequences of operation of the LPA as they relate to geology, soils, and seismicity. The following discussion is based on the existing conditions described in Section 4.

5.1 No Build Alternative

Under the No Build Alternative, no new transportation-related infrastructure would be constructed in the Affected Area except those projects identified in Metro's 2009 LRTP and SCAG's 2016 RTP/SCS, as well as additional projects funded by Measure M. These projects would be designed and operated to established standards, and adherence to those criteria and standards would minimize geologic and geotechnical-related impacts and avoid adverse effects.

5.2 Locally Preferred Alternative

Operation of the LPA will not have a significant impact on the geology and soils in the Affected Area. The LPA design features are not uncommon for the LA region. The modifications included in the LPA are shallow from a geologic perspective and will not exacerbate existing geologic conditions during operation. However, operation of the LPA could expose people and structures to the geologic hazards discussed in the sections that follow.

5.2.1 Seismic Shaking and Fault-Induced Ground Rupture

As discussed in Section 4.6, no known active faults capable of ground rupture are mapped within the Affected Area, and the LPA alignment is not located in an Alquist-Priolo Earthquake Fault Zone, in accordance with CGS Special Publication 42 (CGS 2018, and 2016a through 2016c). The closest active faults considered capable of ground rupture near the Affected Area are the Raymond, Hollywood, and Newport-Inglewood Faults. Each of these faults is mapped at least 4.5 miles away from the Affected Area. Considering the distance between these known faults and that no known active faults capable of ground rupture are mapped in the Affected Area, there is no potential for ground rupture due to known active faulting for the LPA.

Because the Affected Area is within the seismically active region of Southern California, operation of the LPA could subject people and structures to moderate to strong seismic ground shaking, which could result in human injury or death, or damage to structures.

Project Measure GEO PM-1 (Geotechnical Design [Operation]) (see Section 8.1.1) includes development of site-specific design parameters to account for the anticipated level of seismic ground shaking. The intensity of ground shaking at a given location depends primarily upon the earthquake magnitude, the distance from the source, and the site response characteristics. As indicated in Section 4.6.4, the conceptual PGA varies along the Affected Area, ranging from 0.82g near the northern end (near Slauson Avenue) to 0.73g near the southern end (near South Street) for the MDE. As discussed below, the estimated levels of ground shaking are integral parameters considered during the geotechnical and structural designs of the LPA.

The LPA will be designed in accordance with the MRDC (or equivalent) design standards, as discussed in Section 3.3. Structures included in the LPA will be designed to perform in accordance with the MDE and ODE thresholds indicated in Section 3.3. As also described in Section 3.3, the design criteria (MRDC, Caltrans SDC, LA County Building Code/CBC, or equivalents) dictate the ARP that will be used in the design. Above-grade and at-grade structures will be designed and will perform in accordance with the thresholds indicated in Section 3.3 for seismicity. Under NEPA, impacts to the LPA will be minimized, adverse effects will be avoided, and no mitigation measures will be required.

5.2.2 Liquefaction/Seismically Induced Settlement

As discussed in Section 4.6.5.1 and shown on Figure 4-3, the LPA alignment from the Pacific/Randolph Station south is located in a Liquefaction Zone of Required Investigation (CGS 2016a through 2016c). The alignment, from the Pacific/Randolph Station west, is not situated in a Liquefaction Zone of Required Investigation. Sites within a Liquefaction Zone of Required Investigation have historically experienced liquefaction and/or have conditions favorable to liquefaction. In addition, the alluvial soils located above the groundwater table within the Affected Area are susceptible to seismically induced settlement. As such, operation of the LPA could subject people and structures to the effects of liquefaction or seismically induced settlement, which could result in human injury or death, or damage to structures.

Project Measure GEO PM-1 (Geotechnical Design [Operation]) requires that the LPA be designed in accordance with design standards, including standards specific to liquefaction and seismic settlement, such as the MRDC Section 5, Structural; Metro's Supplemental SDC (2017); and the California Seismic Hazards Mapping Act. These design standards (included in Project Measure GEO PM-1) dictate that during project design, a geotechnical investigation will be conducted for the LPA, including detailed evaluation of these hazards. The investigation will be part of Metro's comprehensive geologic/geotechnical field investigation program that is being currently developed (Metro 2020a) and will include a detailed evaluation of these hazards. The design-level geotechnical investigations will provide information pertaining to the depths and areal extents of liquefaction and an estimate of the anticipated ground deformation associated with liquefaction, lateral spread, and seismically induced settlement.

Structures included as part of the LPA will be designed to perform in accordance with the MDE and ODE thresholds indicated in Section 3.3. During the design process, if it is determined that these hazards could result in an unacceptable soil or structural response (dependent on the type of structure), ground improvements such as stone columns, jet grouting, and cement deep soil mixing and compaction grouting will be implemented consistent with the design standards provided in Section 3.3. The required consistency with these design standards will reduce the potential deformation to acceptable levels. In lieu of ground improvements, structures and foundations may be designed to tolerate the estimated amount of displacements.

Design plans for the LPA will incorporate the design requirements mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]) and described in Section 3.3. Under NEPA, by implementing these mandatory design requirements, impacts to the LPA will be minimized, adverse effects will be avoided, and no mitigation measures will be required.

5.2.3 Seismically Induced Inundation

Seismically induced inundation can occur when an earthquake causes catastrophic failure of a water-retaining structure (such as a reservoir, dam, or levee, and subsequent flooding) occurs due to the release of water from the structure. Based on review of State inundation maps, floodwaters resulting from dam inundation are not expected to impact the LPA. The Affected Area is outside of the dam inundation areas identified by the California Dam Breach Inundation Maps produced by the California Department of Water Resources (2023). However, if seismically induced inundation were to impact the LPA, the inundation would be short-lived, and the water would be drained by the current and future drainage improvements. As part of the LPA, modifications to local storm drain systems will be required to discharge runoff from the project alignment. New drainage pipes under at-grade track will collect stormwater to earthen or concrete drainage swales running parallel to the track, which will discharge to the existing local stormwater infrastructure. Drainage systems within the portions of elevated track will similarly collect and discharge stormwater. Therefore, under NEPA, impacts to the LPA will be minimized, adverse effects will be avoided, and mitigation will not be required.

5.2.4 Expansive Soils

As discussed in Section 4.7.2, clay-rich soils may exist locally within alluvial soils present in the Affected Area that could swell and shrink with wetting and drying. The placement of structures on expansive soil could result in structural distress.

As such, operation of the above-grade and at-grade structures associated with the LPA could subject people and structures to the effects of expansive soils, which could result in damage to structures.

As part of Project Measure GEO PM-1 (Geotechnical Design [Operation]), the LPA will be designed and constructed in accordance with the recommendations to be included in the detailed geotechnical design reports. Expansive soil remediation could include soil removal and replacement, chemical treatment, or structural enhancements. Therefore, under NEPA, impacts to the LPA related to expansive soils will be minimized, adverse effects will be avoided, and no mitigation measures will be required.

5.2.5 Ground Settlement and Collapsible soils

As discussed in Section 4.7.3, the alluvial soils within the Affected Area may be prone to collapse/settlement, which can result in differential movement beneath foundations, potentially causing distress to above- and at-grade structures. As such, operation of the above- and at-grade structures associated with the LPA could subject people and structures to the effects of ground settlement, which could result in damage to structures.

Detrimental ground settlement from new structures or earth loads is typically alleviated by removal and replacement of the settlement-prone or collapse-prone soils. Also, implementation of ground improvement methods (similar to those indicated for liquefaction presented in Section 5.2.2) and structural support systems will minimize the potential for impacts related to collapse or settlement.

Additionally, and as part of Project Measure GEO PM-1 (Geotechnical Design [Operation]), the LPA will be designed in accordance with the recommendations to be included in the detailed geotechnical advance design reports. Recommendations specific to detrimental ground settlement from new structures or earth loads will be provided based on site-specific

geotechnical investigations. Therefore, under NEPA, potential impacts to the Affected Area related to settlement-prone/collapse-prone soils will be minimized, adverse effects will be avoided, and no mitigation measures will be required.

5.2.6 Naturally Occurring Oil and Gas

Foundation excavations for viaducts or other support structures may encounter hazardous gases resulting in a construction hazard. There are no oil or gas fields in the Affected Area for geotechnical, subsurface, and seismic resources. Therefore, under NEPA, naturally occurring oil and gas hazards are not anticipated to be a concern during operation of the LPA; therefore, there will be no adverse effects, and mitigation will not be required. Although not anticipated, and as discussed in Section 7.3.1.2, it is possible that subsurface gases could be encountered during excavations for the LPA viaduct foundations or other support structures. Construction effects are discussed in Section 7.3.1 of this report.

5.3 Design Option: Close 186th Street

The design option closes the 186th Street (at-grade) crossing of the LPA and maintains the 187th Street (at-grade) crossing. 186th and 187th streets are roughly 1,000 feet apart and are underlain by the same alluvial soil deposits as the overall LPA. The risks and effects related to seismic shaking and fault-induced ground rupture, liquefaction/seismically induced settlement and inundation, expansive soils, ground settlement, collapsible soils, and naturally occurring oil and gas at the location of the design option would be substantially similar to those effects identified for the LPA without the design option and discussed in Section 5.2.

As part of Project Measure GEO PM-1 (Geotechnical Design [Operation]), the LPA, including the design option if selected, would be designed in accordance with the recommendations to be included in the detailed geotechnical design report. Recommendations addressing seismic shaking and fault-induced ground rupture, liquefaction/seismically induced settlement and inundation, expansive soils, ground settlement, collapsible soils, and naturally occurring oil and gas would be provided based on site-specific geotechnical investigation. Therefore, under NEPA, impacts from the LPA with the design option related to these hazards would be minimized, adverse effects would be avoided, and mitigation would not be required.

5.4 Maintenance and Storage Facility

Evaluation of the MSF site considered seismic shaking and fault-induced ground rupture, liquefaction/seismically induced settlement, seismically induced inundation, expansive soils, ground settlement and collapsible soils, and naturally occurring oil and gas.

In addition to train storage tracks, the MSF will include a number of building structures. These design enhancements are similar to those that will be included as part of the LPA. Like the LPA, the Bellflower MSF site will be subject to the prescribed standards, requirements, and guidance related to the design and construction of the proposed building structures, including the requirements of the LA County Building Code. The Bellflower MSF site and the LPA have substantially similar geologic settings, potential geotechnical operational impacts, and effect determinations. The risks and effects related to seismic shaking and ground rupture, liquefaction/seismically induced settlement and inundation, expansive soils, ground settlement, and collapsible soils at the MSF site will be substantially similar to those effects identified for the LPA and discussed in Section 5.2.

As part of Project Measure GEO PM-1 (Geotechnical Design [Operation]), the LPA, including the Bellflower MSF site, will be designed in accordance with the recommendations to be included in the detailed geotechnical design report. Recommendations addressing seismic shaking and ground rupture, liquefaction/seismically induced settlement and inundation, expansive soils, ground settlement, and collapsible soils will be provided based on site-specific geotechnical investigation. Therefore, under NEPA, the Bellflower MSF site impacts related to these hazards will be minimized, adverse effects will be avoided, and mitigation will not be required.

5.5 U.S. Army Corps of Engineers Facilities

The LPA alignment will cross three USACE facilities: the concrete-lined LA River and Rio Hondo channels just west and east, respectively, of I-710, and the concrete-lined San Gabriel River channel just west of I-605. LPA plans indicate that the three facility crossings will consist of constructing new rail bridges adjacent to or along the same alignment as the existing rail bridges (the Freight/LA River Bridge [protect in place], the Freight/Rio Hondo Channel Bridge [protect in place], and the UPRR/San Gabriel River Bridge [to be demolished and replaced]). The new bridge crossings will result in footprints on the existing facilities that is very similar to the current footprints. Similar to the existing river crossing bridge foundations, the new bridge foundations will connect to the bridge columns through the channel bottom, resulting in a fully concrete-lined channel. At each of the river crossings, the new and existing structures are underlain by alluvial soil deposits that are common to the entire Affected Area (Unit Qya_2 on Figure 4-1). Accordingly, the impact determinations presented in Section 5.2 for the LPA are applicable to the three USACE facility crossings. In accordance with GEO PM 1 (Geotechnical Design [Operation]), site-specific geotechnical exploration will be performed to characterize the subsurface conditions for the LPA. With implementation of Project Measure GEO PM-1 (Geotechnical Design [Operation]), the geology and soils below the concrete-lined channels and adjacent areas will not be adversely impacted by operation of the LPA. Therefore, the LPA, from a geology and soils perspective, will not impact the USACE facilities during operation. Under NEPA, with implementation of the measures indicated in Section 8, no adverse effects will occur during operation of the LPA crossings of the USACE facilities.

5.6 California Department of Transportation Facilities

The LPA alignment will transect Caltrans facilities as follows, from north to south:

- A new jacked-box tunnel will be installed below I-710. This new structure will be 35 feet wide, 21.5 feet tall, and embedded a minimum of 12 feet below I-710. The structure will be located parallel to and approximately 152 feet east of the current freight tunnel (I--710 Salt Lake Avenue Overhead [OH], Caltrans Bridge Number 53-0829). Similar to the Salt Lake Avenue OH, the new structure will be installed through the existing I-710 embankment fill.
- The current I-105 Century Boulevard Underpass (UP) (Caltrans Bridge Number 53-2427) freight structure will be demolished and replaced by a two-span LRT/pedestrian structure, and a new four-span freight structure will be constructed approximately 10 feet west of the current UP bridge. The replacement LRT/pedestrian structure and freight structure are both similar to the existing I-105 Century Boulevard UP and will span I-105 with supports at the abutments and in the median area of I-105. Access from the replacement LRT/pedestrian structure to the Metro C Line platform at-grade in the median area of I-105 is included as part of the LPA.

- The LPA will transect SR-91 using the existing East Bellflower OH (Caltrans Bridge Number 53-1257). No changes to SR-91 or the Bellflower OH are included as part of the LPA. However, an Overhead Contact System (OCS) pole founded on a cast-in-drilled-hole (CIDH) pile is planned between the two sets of LRT tracks to be laid below the OH. At the abutments and two bents, the OH structure is founded on concrete-driven piles with a pile cap. The proposed OCS pole will be placed between the center of the two bents. At the OH site, the LPA track modifications and OCS will be designed in accordance with the recommendations to be included in the detailed geotechnical design report. The report will be prepared per Project Measure GEO PM-1 (Geotechnical Design [Operation]), and the OH will not be adversely impacted by operation of the LPA.
- The LPA will transect I-605 using the existing Dairy Valley OH (Caltrans Bridge Number 53--1721). No changes to I-605 or the Dairy Valley OH are included as part of the LPA. However, an OCS pole founded on a CIDH pile is planned between the two sets of LRT tracks to be laid below the OH. At each abutment, the OH structure is founded on concrete-driven piles with a pile cap. The proposed OCS pole will be placed between the center of the abutments. At the OH site, the LPA track modifications and OCS will be designed in accordance with the recommendations to be included in the detailed geotechnical design report. The report will be prepared per Project Measure GEO PM-1 (Geotechnical Design [Operation]), and the OH will not be adversely impacted by operation of the LPA.

LPA improvements at the Caltrans facility crossings will result in a footprint on the existing facilities that is very similar to the current footprints. At each of the facility crossings, the new and existing structures are underlain by alluvial soil deposits common to the entire Affected Area (Unit Qya2 on Figure 4-1). Accordingly, the impacts determinations presented in Section 5.2 for the LPA are applicable to the Caltrans facility crossings. With implementation of Project Measure GEO PM-1 (Geotechnical Design [Operation]), the geology and soils below the Caltrans facilities will not be adversely impacted by operation of the LPA. Therefore, the LPA, from a geology and soils perspective, will not impact the Caltrans facilities during operation. Under NEPA, with implementation of the measures indicated in Section 8, no adverse effects will occur during operation of the LPA crossings of I-105, I-710, SR-91, or I-605.

6 CEQA DETERMINATION

To satisfy CEQA requirements, geology and soils operational impacts have been analyzed in accordance with Appendix G of the CEQA Guidelines. The CEQA determinations presented below are based on the existing conditions described in Section 4 of this report and the environmental impacts analysis presented in Section 5.

CEQA is only concerned with the effects of a project on the environment, not the effects of the environment on the Project. For informational purposes, however, the following analyzes the potential impacts of developing the LPA within the seismically active region of Southern California. The following analysis also considers whether the LPA might exacerbate geological, seismic, and related hazards (see State CEQA Guidelines, 14 CCR §15126.2(a)). The analysis is based on the questions presented in Appendix G of the State CEQA Guidelines.

6.1 Threshold GEO-1: Would the project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault?

6.1.1 No Project Alternative

Under the No Project Alternative, the LPA would not be constructed, and the Affected Area would remain unchanged. There would be no impact to the geology (including faulting) and soils in the Affected Area. Therefore, the operational-related impacts for the No Project Alternative would be less than significant, and no mitigation measures would be required.

6.1.1.1 Mitigation Measures

No mitigation measures are required.

6.1.1.2 Impacts Remaining after Mitigation

Less than significant impact.

6.1.2 Locally Preferred Alternative

The LPA is not underlain by a known active fault capable of ground rupture and is not located within an Earthquake Fault Zone established by the State of California Alquist-Priolo Earthquake Fault Zoning Act (CGS Special Publication 42). As such, operation of the LPA will not result in potentially significant impacts, including the risk of loss, injury, or death, from ground rupture of a known earthquake fault. There will be no impacts related to ground rupture along a known active earthquake fault, and no mitigation measures will be required.

6.1.2.1 Mitigation Measures

No mitigation measures are required.

6.1.2.2 Impacts Remaining after Mitigation

No impact.

6.1.3 Design Option: Close 186th Street

The LPA with the design option is substantially similar to the LPA without the design option in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.1.2 for the LPA without the design option is applicable to the LPA with the design option. There would be no impacts related to ground rupture along a known earthquake fault. No mitigation measures would be required.

6.1.3.1 Mitigation Measures

No mitigation measures are required.

6.1.3.2 Impacts Remaining after Mitigation

No impact.

6.1.4 Maintenance and Storage Facility

The Bellflower MSF is substantially similar to the LPA in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.1.2 for the LPA is applicable to the MSF. Impacts related to rupture along a known earthquake fault will be less than significant with design and construction performed per applicable design criteria. No mitigation measures will be required.

6.1.4.1 Mitigation Measures

No mitigation measures are required.

6.1.4.2 Impacts Remaining after Mitigation

Less than significant.

6.2 Threshold GEO-2: Would the project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking?

6.2.1 No Project Alternative

Under the No Project Alternative, the LPA would not be constructed, and the Affected Area would remain unchanged. There would be no impacts related to strong seismic ground shaking in the Affected Area. Therefore, the operational-related impacts for the No Project Alternative would be less than significant, and no mitigation measures would be required.

6.2.1.1 Mitigation Measures

No mitigation measures required.

6.2.1.2 Impacts Remaining after Mitigation

Less than significant impact.

6.2.2 Locally Preferred Alternative

As discussed in Section 5.2.1, the LPA could be exposed to strong seismic ground shaking. However, as discussed in Section 3.3, and as mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]), the LPA will be designed to accommodate the anticipated levels of ground shaking associated with a design seismic event, and structures will perform in accordance with the MRDC MDE and ODE thresholds discussed in Section 3.3.

The potential to experience substantial seismic ground shaking is a common hazard for every project in Southern California, and the hazard cannot be avoided. Structures (aerial and at-grade) have been and continue to be successfully designed and constructed based on mandatory design criteria. Considering the mandatory design requirements associated with seismic shaking, operation of the LPA will not result in substantial adverse effects, including the risk of loss, injury, or death, related to seismic shaking.

Operation of the LPA will not have an adverse effect on the geologic environment. The design features being considered are not uncommon for the LA region and will not exacerbate existing geologic conditions related to seismic shaking. Therefore, impacts related to seismic shaking will be less than significant with design and construction performed in accordance with applicable design criteria as mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]), and no mitigation measures will be required.

6.2.2.1 Mitigation Measures

No mitigation measures required.

6.2.2.2 Impacts Remaining after Mitigation

Less than significant impact.

6.2.3 Design Option: Close 186th Street

The design option closes the 186th Street (at-grade) crossing of the LPA and opens the 187th Street (at-grade) crossing. The LPA with the design option is substantially similar to the LPA without the design option in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.2.2 for the LPA without the design option is applicable to the LPA with the design option. Impacts related to seismic shaking would be less than significant with design and construction performed per applicable design criteria as mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]), and no mitigation measures would be required.

6.2.3.1 Mitigation Measures

No mitigation measures required.

6.2.3.2 Impacts Remaining after Mitigation

Less than significant impact.

6.2.4 Maintenance and Storage Facility

The Bellflower MSF is substantially similar to the LPA in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.2.2 for the LPA is applicable to the MSF. Impacts related to seismic shaking will be less than significant with design and construction performed per applicable design criteria as

mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]), and no mitigation measures will be required.

6.2.4.1 Mitigation Measures

No mitigation measures required.

6.2.4.2 Impacts Remaining after Mitigation

Less than significant impact.

6.3 Threshold GEO-3: Would the project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving Seismic-related ground failure, including liquefaction?

6.3.1 No Project Alternative

Under the No Project Alternative, the LPA would not be constructed, and the Affected Area would remain unchanged. There would be no impact to the geology and soils (including seismic-related ground failure and liquefaction potential) in the Affected Area. Therefore, the operational-related impacts for the No Project Alternative would be less than significant, and no mitigation measures would be required.

6.3.1.1 Mitigation Measures

No mitigation measures required.

6.3.1.2 Impacts Remaining after Mitigation

Less than significant impact.

6.3.2 Locally Preferred Alternative

As discussed in Section 5.2.2, the LPA could be exposed to seismic-related ground failure, including liquefaction, lateral spreading, and seismically induced settlement. However, as discussed in Sections 3.3 and 5.2.2, and as mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]), the LPA will be designed to accommodate the anticipated levels of deformation associated with a design seismic event, and structures will perform in accordance with the MRDC MDE and ODE thresholds discussed in Section 3.3.

The seismic-related ground failure hazard is a well-known hazard in Southern California and structures (aerial and at-grade) have been and continue to be successfully designed and constructed based on the referenced mandatory design criteria. Where warranted by site-specific subsurface conditions identified during the project geotechnical investigations, design enhancements (e.g., ground improvements or structural enhancements) can reduce potentially significant impacts to levels within the acceptable limits for the structure. Considering the mandatory design requirements associated with seismic-related ground failure, operation of the LPA will not result in significant impacts, including the risk of loss, injury, or death, involving seismic-related ground failure, including liquefaction. Therefore, impacts related to seismic-related ground failure will be less than significant with design and future operation performed per applicable design criteria, and no mitigation measures will be required.

6.3.2.1 Mitigation Measures

No mitigation measures required.

6.3.2.2 Impacts Remaining after Mitigation

Less than significant impact.

6.3.3 Design Option: Close 186th Street

The LPA with the design option is substantially similar to the LPA without the design option in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.3.2 for the LPA without the design option is applicable to the LPA with the design option. Impacts related to seismic-related ground failure would be less than significant with design and operation performed per applicable design criteria as mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]). No mitigation measures would be required.

6.3.3.1 Mitigation Measures

No mitigation measures required.

6.3.3.2 Impacts Remaining after Mitigation

Less than significant impact.

6.3.4 Maintenance and Storage Facility

The MSF is substantially similar to the LPA in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.3.2 for the LPA is applicable to the MSF. Impacts related to seismic-related ground failure will be less than significant with design and operation performed per applicable design criteria as mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]). No mitigation measures will be required.

6.3.4.1 Mitigation Measures

No mitigation measures required.

6.3.4.2 Impacts Remaining after Mitigation

Less than significant impact.

6.4 Threshold GEO-4: Would the project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving landslides?

6.4.1 No Project Alternative

Under the No Project Alternative, the LPA would not be constructed, and the Affected Area would remain unchanged. There would be no impact to the geology (including landslides) and soils in the Affected Area. Therefore, the operational-related impacts for the No Project Alternative would be less than significant, and no mitigation measures would be required.

6.4.1.1 Mitigation Measures

No mitigation measures required.

6.4.1.2 Impacts Remaining after Mitigation

Less than significant impact.

6.4.2 Locally Preferred Alternative

The landscape within the Affected Area is relatively flat, and no landslides have been mapped in the vicinity of the alignment. Natural landslides are not considered a hazard to the LPA; therefore, with design and operation performed per applicable design criteria as mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]), impacts will be less than significant, and no mitigation measures will be required. Temporary excavations, which could introduce the potential for construction-related landslides, are discussed in Section 7.

Operation of the LPA will not have a potentially significant impact on the geologic environment. The design features being considered are not uncommon for the LA region and will not exacerbate existing geologic conditions. Therefore, impacts will be less than significant, and no mitigation measures are required.

6.4.2.1 Mitigation Measures

No mitigation measures required.

6.4.2.2 Impacts Remaining after Mitigation

Less than significant impact.

6.4.3 Design Option: Close 186th Street

The LPA with the design option is substantially similar to the LPA without the design option in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.4.2 for the LPA without the design option is applicable to the LPA with the design option. Impacts related to landslides would be less than significant with design and operation performed per applicable design criteria as mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]). No mitigation measures would be required.

6.4.3.1 Mitigation Measures

No mitigation measures required.

6.4.3.2 Impacts Remaining after Mitigation

Less than significant impact.

6.4.4 Maintenance and Storage Facility

The MSF is substantially similar to the LPA in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.4.2 for the LPA is applicable to the MSF site. Impacts related to landslides will be less than significant with design and operation performed per applicable design criteria as mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]). No mitigation measures will be required.

6.4.4.1 Mitigation Measures

No mitigation measures required.

6.4.4.2 Impacts Remaining after Mitigation

Less than significant impact.

6.5 Threshold GEO-5: Would the project result in substantial soil erosion or the loss of topsoil?

6.5.1 No Project Alternative

Under the No Project Alternative, the LPA would not be constructed, and the Affected Area would remain unchanged. There would be no impact to the geology and soils (including loss and erosion) in the Affected Area. Therefore, the operational-related impacts for the No Project Alternative would be less than significant, and no mitigation measures would be required.

6.5.1.1 Mitigation Measures

No mitigation measures required.

6.5.1.2 Impacts Remaining after Mitigation

Less than significant impact.

6.5.2 Locally Preferred Alternative

The LPA is located in an urban setting and the topsoil layer in most of the Affected Area has been disturbed or concealed by previous human activities. The potential impacts will involve the loss of topsoil as an agricultural resource and loss of an erosional barrier. Post-construction operation of the LPA will not result in ground surface disturbance, site clearance, excavation, or grading that will otherwise create the potential for soil erosion to occur. The LPA will operate on designed and constructed facilities implemented in accordance with state and local guidelines regarding erosion. Additionally, a required Stormwater Pollution Prevention Plan and Water Quality Control Plan will be in place as part of operation, among other regulatory requirements, as detailed in the West Santa Ana Branch Transit Corridor Project Final Water Resources Impact Analysis Report (Metro 2024c).

The Affected Area is not used for agricultural purposes and the topsoil layer has already been disturbed or concealed by previous human activities. Considering the design requirements associated with erosion and mandatory best management practices detailed in the West Santa Ana Branch Transit Corridor Project Final Water Resources Impact Analysis Report, operation of the LPA will not result in substantial soil erosion or loss of topsoil. Therefore, impacts will be less than significant with design and construction performed per applicable design criteria, and no mitigation measures will be required.

6.5.2.1 Mitigation Measures

No mitigation measures required.

6.5.2.2 Impacts Remaining after Mitigation

Less than significant impact.

6.5.3 Design Option: Close 186th Street

The LPA with the design option is substantially similar to the LPA without the design option in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.5.2 for the LPA without the design option is applicable to the LPA with the design option. Impacts related to substantial soil erosion or loss of topsoil would be less than significant with design and operation performed per applicable design criteria, and no mitigation measures would be required.

6.5.3.1 Mitigation Measures

No mitigation measures required.

6.5.3.2 Impacts Remaining after Mitigation

Less than significant impact.

6.5.4 Maintenance and Storage Facility

The MSF is substantially similar to the LPA in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.5.2 for the LPA is applicable to the MSF. Impacts related to substantial soil erosion or loss of topsoil will be less than significant with design and operation performed per applicable design criteria, and no mitigation measures will be required.

6.5.4.1 Mitigation Measures

No mitigation measures required.

6.5.4.2 Impacts Remaining after Mitigation

Less than significant impact.

6.6 Threshold GEO-6: Would the project be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?

6.6.1 No Project Alternative

Under the No Project Alternative, the LPA would not be constructed, and the Affected Area would remain unchanged. There would be no impact to the geology and soils that would affect the potential for these hazards in the Affected Area. Therefore, the operational-related impacts for the No Project Alternative would be less than significant, and no mitigation measures would be required.

6.6.1.1 Mitigation Measures

No mitigation measures required.

6.6.1.2 Impacts Remaining after Mitigation

Less than significant impact.

6.6.2 Locally Preferred Alternative

Operational analysis and impact determinations for the LPA related to liquefaction, lateral spreading, and landslides are provided above. See Section 6.3 regarding the CEQA determination for ground failure (including liquefaction and lateral spreading), and Section 6.4 for the landslide hazard determination.

The Affected Area may be prone to collapse or settlement, which can result in differential movement beneath foundations potentially causing distress to above-grade and at-grade structures. As such, operation of the above- and at-grade structures associated with the LPA will potentially subject people and structures to the effects of ground settlement, which could result in damage to structures.

Detrimental ground settlement from new structures or earth loads is typically alleviated by removal and replacement of the settlement/collapse-prone soils. Also, implementation of ground improvement methods (similar to those indicated for liquefaction) and structural support systems will minimize the potential for impacts related to collapse or settlement. As part of Project Measure GEO PM-1 (Geotechnical Design [Operation]), the LPA will be designed in accordance with the mandatory design requirements of the MRDC or equivalent, including design criteria identified in the geotechnical design reports from site-specific geotechnical investigations. The recommendations from the geotechnical reports will specifically address detrimental ground settlement from new LPA structures or earth loads. Based on the analysis presented above, operation of the LPA will not result in potentially significant impacts related to the risk of settlement or collapsible soil. Therefore, impacts related to settlement or collapsible soil will be less than significant with design and construction performed per applicable design criteria as mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]). No mitigation measures will be required.

Regional subsidence results from the withdrawal of groundwater and/or hydrocarbons from the subsurface. The California Department of Water Resources (2014) estimated the potential for future land subsidence within the Affected Area to be low because groundwater withdrawal is restricted and managed, and, where performed, it is compensated for by reinjection of water in volumes similar to what is withdrawn. Potential impacts related to regional subsidence will be a less than significant hazard to the Project, and no mitigation measures will be required.

Considering the mandatory design requirements in place for the subject hazards, operation of the LPA will not have an adverse effect on the geologic environment. The design features being considered are not uncommon for the LA region and will not exacerbate existing geologic conditions.

6.6.2.1 Mitigation Measures

No mitigation measures required.

6.6.2.2 Impacts Remaining after Mitigation

Less than significant impact.

6.6.3 Design Option: Close 186th Street

The LPA with the design option is substantially similar to the LPA without the design option in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.6.2 for the LPA without the design option is applicable to the LPA with the design option. Impacts related to collapse, settlement, and subsidence would be less than significant with design and operation performed per applicable design criteria mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]), and no mitigation measures would be required.

6.6.3.1 Mitigation Measures

No mitigation measures required.

6.6.3.2 Impacts Remaining after Mitigation

Less than significant impact.

6.6.4 Maintenance and Storage Facility

The MSF is substantially similar to the LPA in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.6.2 for the LPA is applicable to the MSF. Impacts related to collapse, settlement, and subsidence will be less than significant with design and operation performed per applicable design criteria mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]), and no mitigation measures will be required.

6.6.4.1 Mitigation Measures

No mitigation measures required.

6.6.4.2 Impacts Remaining after Mitigation

Less than significant impact.

6.7 Threshold GEO-7: Would the project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?

6.7.1 No Project Alternative

Under the No Project Alternative, the LPA would not be constructed, and the Affected Area would remain unchanged. There would be no impact to the geology and soils (including expansive soil potential) in the Affected Area. Therefore, the operational-related impacts for the No Project Alternative would be less than significant, and no mitigation measures would be required.

6.7.1.1 Mitigation Measures

No mitigation measures required.

6.7.1.2 Impacts Remaining after Mitigation

Less than significant impact.

6.7.2 Locally Preferred Alternative

As discussed in Section 4.7.2, clay-rich soils may exist locally within alluvial soils present in the Affected Area. The placement of structures on expansive soil could result in structural distress. Therefore, operation of the at-grade and above-grade structures associated with the LPA will potentially subject people and structures to the effects of expansive soils, which could result in damage to structures.

As mandated by GEO PM-1 (Geotechnical Design [Operation]), structures to be constructed as part of the LPA will be designed and constructed in accordance with MRDC and LA County Building Code standards (the Uniform Building Code is no longer applicable) or equivalent (see Section 3.3) specific to expansive soils. These required design standards will yield structures that will tolerate the effects of expansive soil or the expansive soils will be remediated. Expansive soil remediation could include soil removal and replacement, chemical treatment, or structural enhancements.

As part of Project Measure GEO PM-1 (Geotechnical Design [Operation]), the LPA will be designed in accordance with the recommendations to be included in the future detailed geotechnical design reports. Considering the mandatory design requirements associated with expansive soils, operation of the LPA will not result in significant impacts, including the risk of loss, injury, or death related to expansive soils. Therefore, impacts related to expansive soils will be less than significant with design and construction performed per applicable design criteria as mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]). No mitigation measures will be required.

6.7.2.1 Mitigation Measures

No mitigation measures required.

6.7.2.2 Impacts Remaining after Mitigation

Less than significant impact.

6.7.3 Design Option: Close 186th Street

The LPA with the design option is substantially similar to the LPA without the design option in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.7.2 for the LPA without the design option is applicable to the LPA with the design option. Impacts related to expansive soils would be less than significant with design and operation performed per applicable design criteria mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]). No mitigation measures would be required.

6.7.3.1 Mitigation Measures

No mitigation measures required.

6.7.3.2 Impacts Remaining after Mitigation

Less than significant impact.

6.7.4 Maintenance and Storage Facility

The MSF is substantially similar to the LPA in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.7.2 for the LPA is applicable to the MSF. Impacts related to expansive soils will be less than significant with design and operation performed per applicable design criteria mandated by Project Measure GEO PM-1 (Geotechnical Design [Operation]). No mitigation measures will be required.

6.7.4.1 Mitigation Measures

No mitigation measures required.

6.7.4.2 Impacts Remaining after Mitigation

Less than significant impact.

6.8 Threshold GEO-8: Would the project have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?

6.8.1 No Project Alternative

Under the No Project Alternative, the LPA would not be constructed, and the Affected Area would remain unchanged. The Affected Area is in a highly urbanized area served by existing municipal sewage systems. Therefore, the operational impacts for the No Project Alternative would be less than significant, and no mitigation measures would be required.

6.8.1.1 Mitigation Measures

No mitigation measures required.

6.8.1.2 Impacts Remaining after Mitigation

Less than significant impact.

6.8.2 Locally Preferred Alternative

The LPA is located in a highly urbanized area served by existing municipal sewage systems. The use of septic tanks or alternative wastewater systems is not anticipated under the LPA. Therefore, the LPA will not expose people or structures to significant impacts involving the adequacy of soils to support septic tanks or alternative waste disposal systems. No impacts will occur, and no mitigation measures will be required.

6.8.2.1 Mitigation Measures

No mitigation measures required.

6.8.2.2 Impacts Remaining after Mitigation

No impact.

6.8.3 Design Option: Close 186th Street

The LPA with the design option is substantially similar to the LPA without the design option in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.8.2 for the LPA without the design option is applicable to the LPA with the design option. The design option is located in a highly urbanized area served by existing municipal sewage systems. The use of septic tanks or alternative wastewater systems is not anticipated for the design option. Therefore, the design option would not expose people or structures to significant impacts involving the adequacy of soils to support septic tanks or alternative waste disposal systems. No impacts would occur, and no mitigation measures would be required.

6.8.3.1 Mitigation Measures

No mitigation measures required.

6.8.3.2 Impacts Remaining after Mitigation

No impact.

6.8.4 Maintenance and Storage Facility

The MSF is substantially similar to the LPA in regard to potential geotechnically related operational impacts and effect determinations. The determination provided in Section 6.8.2 for the LPA is applicable to the MSF. The Bellflower MSF is located in a highly urbanized area served by existing municipal sewage systems. The use of septic tanks or alternative wastewater systems is not anticipated for the MSF. Therefore, the MSF site will not expose people or structures to significant impacts involving the adequacy of soils to support septic tanks or alternative waste disposal systems. No impacts will occur, and no mitigation measures will be required.

6.8.4.1 Mitigation Measures

No mitigation measures required.

6.8.4.2 Impacts Remaining after Mitigation

No impact.

6.9 Threshold GEO-9: Would the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

See the West Santa Ana Branch Transit Corridor Project Final Paleontological Resource Impact Analysis Report (Metro 2024a) for determination.

7 CONSTRUCTION IMPACTS

7.1 Construction Activities

Construction activities associated with the LPA are detailed in the *West Santa Ana Branch Transit Corridor Project Construction Methods Report* (Metro 2024d).

7.2 Construction Methodology

The construction determinations presented below are based on the existing conditions described in Section 4 of this report and the environmental impacts analysis presented in Section 5.

7.3 Construction Impacts

This section describes the temporary construction impacts of the LPA, including the design option and MSF, on geotechnical, subsurface, and seismic resources. As summarized in this report, the Affected Area is underlain by alluvial soils with a potentially shallow groundwater table. Note that construction impacts associated with oil and gas wells, including environmental and health impacts, are discussed in the West Santa Ana Branch Transit Corridor Draft Hazardous Materials Impact Analysis Report (Metro 2024e).

During project construction, temporary conditions might arise that could result in potential impacts related to human injury and loss or damage to structures. Worker health and safety plans specific to each of the major tasks involved in development of the LPA (including the design option and MSF) will be prepared prior to the start of construction in accordance with Metro and Cal/OSHA requirements. Strict compliance with these worker health and safety plans will reduce the risks to workers, and no adverse effects will result. Information on the various construction techniques that may be used is included in the West Santa Ana Branch Transit Corridor Project Construction Methods Report (Metro 2024d).

Project Measures are defined in Section 8. As part of Project Measure GEO PM-2 (Geotechnical Design [Construction]), during design of the LPA, including the design option and MSF, a comprehensive geologic and geotechnical investigation will be conducted and a design-level geotechnical report will be prepared. The design-level geotechnical report will also provide detailed geotechnical construction recommendations, which will address the temporary conditions discussed below that may arise during construction. These recommendations will also comply with the standards discussed in Section 3.3.

7.3.1 Locally Preferred Alternative

7.3.1.1 Unconsolidated/Saturated Alluvial Soils

Construction of the LPA could result in an adverse effect related to unconsolidated/saturated alluvial soils if construction (deep excavations) directly or indirectly causes settlement resulting in distress to existing adjacent improvements. Unconsolidated or water-saturated alluvial soil deposits can be encountered during deep excavations, such as for viaduct foundation elements included in the LPA. Shoring, casing, or other ground-stabilization methods will be used to minimize impacts during excavations.

Temporary excavations will be required during construction of the LPA. Unsafe excavations could result in risk to life and property as a result of a temporary excavation failure. All temporary excavations will be performed in accordance with the safety requirements of Cal/OSHA. Shoring will be designed in accordance with the MRDC, as discussed in Section 3.3.

Soil types may necessitate various types/styles of bracing or excavation support. However, regardless of soil type, excavation depth and configuration drive the requirement of whether a temporary excavation requires support. Temporary excavation needs will be developed as the designs progress for the LPA.

Temporary excavation bracing will be designed to protect adjacent structures, traffic, utilities, and construction personnel. Suitable factors of safety will be used in the design of the temporary supports. Performance of the temporary construction must conform to the requirements stated in the MRDC.

Based on the above evaluation and application of the prescribed standards, requirements, and guidance as mandated by Project Measure GEO PM-2 (Geotechnical Design [Construction]), under NEPA, impacts to the LPA will be minimized. Adverse effects will be avoided, and no construction-related mitigation measures will be required.

7.3.1.2 Naturally Occurring Oil and Gas

If any oil wells are encountered during construction of the LPA, the wells will be abandoned in accordance with state guidelines. The West Santa Ana Branch Transit Corridor Project Final Hazardous Materials Impact Analysis Report (Metro 2024b) contains a discussion on oil wells in the Affected Area.

If subsurface gases were to be encountered during excavation for the LPA viaduct foundations or other support structures, this could pose a fire/explosion hazard during construction. Although not likely in the Affected Area, foundation excavations for viaducts or other support structures in hazardous areas may need to be considered "potentially gassy," and precautions such as forced-air circulation and air monitoring may need to be implemented during construction. In accordance with Project Measure GEO PM-2 (Geotechnical Design [Construction]), this potential hazard to the LPA will be further studied, and the recommendations from the detailed geotechnical design report will be incorporated into the project plans and specifications. Comprehensive geologic, geotechnical, and environmental investigations will be conducted as design advances, and design-level documents will be prepared for the LPA. These design-level reports will verify and document the hazardous subsurface conditions in the project area and support the design recommendations in compliance with the applicable regulations and standards for hazardous gases. By implementing these mandatory design requirements, under NEPA, impacts related to naturally occurring oil and gas will be minimized, adverse effects will be avoided, and no mitigation will be required.

7.3.2 Design Option: Close 186th Street

The LPA design option closes the 186th Street (at-grade) crossing of the LPA and opens the 187th Street (at-grade) crossing. 186th and 187th streets are roughly 1,000 feet apart and are underlain by the same alluvial soil deposits as the overall LPA. The determinations provided in Sections 7.3.1.1 and 7.3.1.2 for the LPA are applicable to the design option. Similar to the LPA, structures associated with the design option would be subject to associated prescribed

standards, requirements, and guidance related to temporary excavations, including Cal/OSHA requirements for temporary shoring and worker safety. As such, the discussion, analysis, and impact determinations presented for construction of the LPA are applicable to the design option. With the implementation of Project Measure GEO PM-2 (Geotechnical Design [Construction]), under NEPA, impacts to the design option site would be minimized, no adverse effects would occur, and no mitigation would be required.

7.3.3 Maintenance and Storage Facility

The MSF is substantially similar to the LPA in regard to potential geotechnically related construction impacts and effect determinations. The determinations provided in Sections 7.3.1.1 and 7.3.1.2 for the LPA are applicable to the MSF. Similar to the LPA, structures associated with the Bellflower MSF will be subject to associated prescribed standards, requirements, and guidance related to temporary excavations, including Cal/OSHA requirements for temporary shoring and worker safety. As such, the discussion, analysis, and impact determinations presented for construction of the LPA are applicable to the MSF site. With the implementation of Project Measure GEO PM-2 (Geotechnical Design [Construction]), under NEPA, impacts to the Bellflower MSF site will be minimized, no adverse effects will occur, and no mitigation will be required.

7.3.4 U.S. Army Corps of Engineers Facilities

The LPA alignment will cross three USACE facilities: the concrete-lined LA River and Rio Hondo channels just west and east, respectively, of I-710, and the concrete-lined San Gabriel River channel just west of I-605. LPA plans indicate that the three facility crossings will consist of constructing new rail bridges adjacent to or along the same alignment as the existing rail bridges (the Freight/LA River Bridge [protect in place], the Freight/Rio Hondo Channel Bridge [protect in place], and the UPRR/San Gabriel River Bridge [to be demolished and replaced]). The new bridge crossings will result in footprints on the existing facilities that are very similar to the current footprints. Similar to the existing river crossing bridge foundations, the new bridge foundations will connect to the bridge columns through the channel bottom, resulting in a fully concrete-lined channel. At each of the river crossings, the new and existing structures are underlain by alluvial soil deposits which are common to the entire Affected Area (Unit Qya2 on Figure 4-1). Accordingly, the impact determinations for unconsolidated/saturated alluvial soils and naturally occurring oil and gas during construction (Sections 7.3.1.1 and 7.3.1.2) are applicable to the three USACE facility crossings.

Similar to the LPA, structures associated with the USACE facilities will be subject to associated prescribed standards, requirements, and guidance related to temporary excavations, including Cal/OSHA requirements for temporary shoring and worker safety; and the geology and soils below the concrete-lined channels and adjacent areas will not be adversely impacted by construction of the LPA. As such, the discussion, analysis, and impact determinations presented for construction of the LPA are applicable to the USACE facility crossings. With the implementation of Project Measure GEO PM-2 (Geotechnical Design [Construction]), under NEPA, impacts to the USACE facility crossings will be minimized, no adverse effects will occur, and no mitigation will be required.

7.3.5 California Department of Transportation Facilities

The LPA alignment will transect Caltrans facilities as follows, from north to south:

- A new jacked-box tunnel will be installed below I-710. This new structure will be 35 feet wide, 21.5 feet tall, and embedded a minimum of 12 feet below I-710. The structure will be located parallel to and approximately 12 feet east of the current freight tunnel (I-710 Salt Lake Avenue OH, Caltrans Bridge Number 53-0829). Similar to the Salt Lake Avenue OH, the new structure will be installed through the existing I-710 embankment fill.
- The current I-105 Century Boulevard UP (Caltrans Bridge Number 53-2427) freight structure will be demolished and replaced by a two-span LRT/pedestrian structure, and a new four-span freight structure will be constructed approximately 10 feet west of the current UP bridge. The replacement LRT/pedestrian structure and freight structure are both similar to the existing I-105 Century Boulevard UP and will span I-105 with supports at the abutments and in the median area of I-105. Access from the replacement LRT/pedestrian structure to the Metro C Line platform at-grade in the median area of I-105 is included as part of the LPA.
- The LPA will transect SR-91 using the existing East Bellflower OH (Caltrans Bridge Number 53-1257). No changes to SR-91 or the Bellflower OH are included as part of the LPA. However, an OCS pole founded on a CIDH pile is planned between the two sets of LRT tracks to be laid below the OH. At the abutments and two bents, the OH structure is founded on concrete-driven piles with a pile cap. The proposed OCS pole will be placed between the two bents. At the OH site, the LPA track modifications and OCS will be designed in accordance with the recommendations to be included in the detailed geotechnical design report. The report will be prepared per Project Measure GEO PM-2 (Geotechnical Design [Construction]), and the OH will not be adversely impacted by construction of the LPA.
- The LPA will transect I-605 using the existing Dairy Valley OH (Caltrans Bridge Number 53-1721). No changes to I-605 or the Dairy Valley OH are included as part of the LPA. However, an OCS pole founded on a CIDH pile is planned between the two sets of LRT tracks to be laid below the OH. At each abutment, the OH structure is founded on concrete-driven piles with a pile cap. The proposed OCS pole will be placed between the abutments. At the OH site, the LPA track modifications and OCS will be designed in accordance with the recommendations to be included in the detailed geotechnical design report. The report will be prepared per Project Measure GEO PM-2 (Geotechnical Design [Construction]), and the OH will not be adversely impacted by construction of the LPA.

LPA improvements at the Caltrans facility crossings will result in a footprint on the existing facilities that is very similar to the current footprints. At each of the facility crossings, the new and existing structures are underlain by alluvial soil deposits common to the entire Affected Area (Unit Qya2 on Figure 4-1). Accordingly, the impacts determination presented in Sections 7.3.1.1 and 7.3.1.2 for the LPA are applicable to the Caltrans facility crossings.

Similar to the LPA, construction associated with the Caltrans facilities will be subject to associated prescribed standards, requirements, and guidance related to temporary excavations, including Cal/OSHA requirements for temporary shoring and worker safety; and the geology and soils below and adjacent to the facility crossings will not be adversely impacted by construction of the LPA. As such, the discussion, analysis, and impact

determinations presented for construction of the LPA are applicable to the Caltrans facility crossings. With the implementation of Project Measure GEO PM-2 (Geotechnical Design [Construction]), impacts to the Caltrans facility crossings will be minimized, no adverse effects will occur, and no mitigation will be required.

7.4 California Environmental Quality Act Determination

To satisfy CEQA requirements, the following subsections present Geology and Soils construction impacts analyzed in accordance with Appendix G of the CEQA Guidelines. CEQA is only concerned with the effects of a project on the environment, not the effects of the environment on the Project. As such, the following analysis considers whether construction of the Project might exacerbate geological, seismic, and related hazards (see State CEQA Guidelines, 14 CCR §15126.2(a)).

7.4.1 No Project Alternative

Under the No Project Alternative, project-related construction activities would not occur, no construction-related impacts would occur, and no mitigation measures would be required. As such, the No Project Alternative is not specifically addressed in the following subsections.

7.4.2 Threshold GEO-CON-1: Would the project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault?

7.4.2.1 Locally Preferred Alternative and Maintenance and Storage Facility

Construction of the LPA and MSF will not have a significant impact on the faults in the Affected Area. The design features being considered are not uncommon for the LA region. The improvements included in the LPA and MSF are shallow from a geologic perspective and will not exacerbate existing geologic conditions related to active faulting during construction. Therefore, impacts will be less than significant, and no mitigation measures will be required.

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

Less than significant impact.

7.4.2.2 Design Option: Close 186th Street

Similar to construction of the LPA without the design option, construction of the LPA with the design option would not have a significant impact on the faults in the Affected Area. The design features being considered are not uncommon for the LA region. The improvements included in the design option are shallow from a geologic perspective and would not exacerbate existing geologic conditions related to active faulting during construction. Therefore, impacts would be less than significant, and no mitigation measures would be required.

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

Less than significant impact.

7.4.3 Threshold GEO-CON-2: Would the project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving Strong seismic ground shaking?

7.4.3.1 Locally Preferred Alternative and Maintenance and Storage Facility

Construction of the LPA and MSF will not have significant impacts on the seismic potential of the Affected Area. The design features being considered are not uncommon for the LA region. The improvements included in the LPA and MSF are shallow from a geologic perspective and will not exacerbate existing geologic conditions related to seismic shaking. Therefore, impacts will be less than significant, and no mitigation measures will be required.

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

Less than significant impact.

7.4.3.2 Design Option: Close 186th Street

Similar to construction of the LPA without the design option, construction of the LPA with the design option would not have significant impacts on the seismic potential of the Affected Area. The design features being considered are not uncommon for the LA region. The improvements included in the design option are shallow from a geologic perspective and would not exacerbate existing geologic conditions related to seismic shaking. Therefore, impacts would be less than significant, and no mitigation measures would be required.

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

Less than significant impact.

7.4.4 Threshold GEO-CON-3: Would the project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving Seismic-related ground failure, including liquefaction?

7.4.4.1 Locally Preferred Alternative and Maintenance and Storage Facility

Construction of the LPA and MSF will not result in significant impacts on the geologic environment of the Affected Area. The design features being considered are not uncommon for the LA region and will not result in new liquefiable areas or exacerbate existing geologic conditions related to seismic-related ground failure, including liquefaction. Therefore, impacts will be less than significant, and no mitigation measures will be required.

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

Less than significant impact.

7.4.4.2 Design Option: Close 186th Street

Consistent with the LPA without the design option, construction of the LPA with the design option would not result in significant impacts on the geologic environment of the Affected Area. The design features being considered are not uncommon for the LA region and would not result in new liquefiable areas or exacerbate existing geologic conditions related to seismic-related ground failure, including liquefaction. Therefore, impacts would be less than significant, and no mitigation measures will be required.

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

Less than significant impact.

7.4.5 Threshold GEO-CON-4: Would the project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving landslides?

7.4.5.1 Locally Preferred Alternative and Maintenance and Storage Facility

The landscape within the Affected Area of the LPA and MSF is relatively flat, and no landslides have been mapped in the vicinity of the Affected Area.

Construction of LPA and MSF could result in adverse effects related to unconsolidated/saturated alluvial soils, if construction (deep excavations) will directly or indirectly cause settlement resulting in distress to existing adjacent improvements. Unconsolidated or water-saturated alluvial soil deposits can be encountered during deep excavations. Shoring, casing, or other ground-stabilization methods will be used to minimize impacts during excavations.

Temporary excavations will be required during construction of the LPA and MSF. Unsafe excavations could result in risk to life and property as a result of a temporary excavation failure. All temporary excavations will be performed in accordance with the safety requirements of Cal/OSHA. Shoring will be designed in accordance with the MRDC or equivalent, as discussed in Section 3.3.

Soil types may necessitate various types/styles of bracing or excavation support. However, regardless of soil type, excavation depth and configuration drive the requirement of whether a temporary excavation requires support. Temporary excavation needs will be developed as the designs progress for the LPA and MSF.

Temporary excavation bracing will be designed to protect adjacent structures, traffic, utilities, and construction personnel. Suitable factors of safety will be used in the design of the

temporary supports. Performance of the temporary construction must conform to the requirements stated in the MRDC or equivalent.

Based on the above discussions and application of the prescribed standards, requirements, and guidance as mandated by Project Measure GEO PM-2 (Geotechnical Design [Construction]), LPA and MSF impacts will be minimized, and adverse effects associated with unconsolidated/saturated alluvial soils will be avoided. Therefore, impacts will be less than significant, and no mitigation measures will be required. Additional information on the various construction techniques that may be used is included in the West Santa Ana Branch Transit Corridor Project Construction Methods Report (Metro 2024d).

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

Less than significant impact.

7.4.5.2 Design Option: Close 186th Street

The landscape within the Affected Area of the design option is relatively flat, and no landslides have been mapped in the vicinity of the Affected Area.

Consistent with the LPA without the design option, construction of the LPA with the design option could result in adverse effects related to unconsolidated/saturated alluvial soils if construction (deep excavations) would directly or indirectly cause settlement resulting in distress to existing adjacent improvements. Unconsolidated or water-saturated alluvial soil deposits can be encountered during deep excavations. Shoring, casing, or other ground-stabilization methods would be used to minimize impacts during excavations.

Temporary excavations would be required during construction. Unsafe excavations could result in risk to life and property as a result of a temporary excavation failure. All temporary excavations would be performed in accordance with the safety requirements of Cal/OSHA. Shoring would be designed in accordance with the MRDC or equivalent as discussed in Section 3.3.

Soil types may necessitate various types/styles of bracing or excavation support. However, regardless of soil type, excavation depth and configuration drive the requirement of whether a temporary excavation requires support. Temporary excavation needs would be developed as the design progresses.

Temporary excavation bracing would be designed to protect adjacent structures, traffic, utilities, and construction personnel. Suitable factors of safety would be used in the design of the temporary supports. Performance of the temporary construction must conform to the requirements stated in the MRDC or equivalent.

Based on the above discussions and application of the prescribed standards, requirements, and guidance as mandated by Project Measure GEO PM-2 (Geotechnical Design [Construction]), impacts from the LPA with the design option would be minimized, and adverse effects associated with unconsolidated/saturated alluvial soils would be avoided. Therefore, impacts would be less than significant, and no mitigation measures would be required. Additional information on the various construction techniques that may be used

are included in the *West Santa Ana Branch Transit Corridor Project Construction Methods Report* (Metro 2024d).

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

Less than significant impact.

7.4.6 Threshold GEO-CON-5: Would the project result in substantial soil erosion or the loss of topsoil?

7.4.6.1 Locally Preferred Alternative and Maintenance and Storage Facility

The LPA and MSF are located in an urban setting and the topsoil layer in most of the Affected Area has been disturbed or concealed by previous human activities. Construction of the LPA and MSF will result in ground surface disturbance during site clearance, excavation, and grading that could create the potential for soil erosion and loss of topsoil. The LPA and MSF will be designed and constructed in accordance with state and local guidelines regarding erosion control and management. The West Santa Ana Branch Transit Corridor Project Final Water Resources Impact Analysis Report (Metro 2024c) requires a Stormwater Pollution Prevention Plan and Water Quality Control Plan. These plans will limit potential impacts related to erosion. As such, the LPA and MSF will minimize significant impacts involving soil erosion or loss of topsoil. Therefore, impacts associated with soil erosion or loss of topsoil will be reduced to less than significant levels, and no mitigation measures will be required.

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

Less than significant impact.

7.4.6.2 Design Option: Close 186th Street

The design option is located in an urban setting and the topsoil layer in most of the Affected Area has been disturbed or concealed by previous human activities. Construction of the LPA with the design option would result in ground surface disturbance during site clearance, excavation, and grading that could create the potential for soil erosion and loss of topsoil. The LPA with the design option would be designed and constructed in accordance with state and local guidelines regarding erosion control and management. The *West Santa Ana Branch Transit Corridor Project Final Water Resources Impact Analysis Report* (Metro 2024c) requires a Stormwater Pollution Prevention Plan and Water Quality Control Plan. These plans would limit potential impacts related to erosion. As such, significant impacts involving soil erosion or loss of topsoil would be minimized. Therefore, impacts associated with soil erosion or loss of topsoil would be reduced to less than significant levels, and no mitigation measures would be required.

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

Less than significant impact.

7.4.7 Threshold GEO-CON-6: Would the project be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?

7.4.7.1 Locally Preferred Alternative and Maintenance and Storage Facility

Construction of the LPA and MSF will not generate new natural geologic hazard areas (landslide, lateral spreading, subsidence, liquefaction, or collapse), nor result in significant impacts on the geologic environment of the Affected Area. The design features being considered are not uncommon for the LA region and will not exacerbate existing geologic conditions related to potential on- or off-site lateral spreading, subsidence, liquefaction or collapse, or seismic-related ground failure, including liquefaction. Therefore, impacts will be less than significant, and no mitigation measures will be required. See Section 7.4.5.1 for discussion on temporary excavations for the LPA and MSF. Additional information on the various construction techniques that may be used is included in the West Santa Ana Branch Transit Corridor Project Construction Methods Report (Metro 2024d).

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

Less than significant impact.

7.4.7.2 Design Option: Close 186th Street

Consistent with the LPA without the design option, construction of the LPA with the design option would not generate new natural geologic hazard areas (landslide, lateral spreading, subsidence, liquefaction, or collapse), nor result in significant impacts on the geologic environment of the Affected Area. The design features being considered are not uncommon for the LA region and would not exacerbate existing geologic conditions related to potential on- or off-site lateral spreading, subsidence, liquefaction or collapse, or seismic-related ground failure, including liquefaction. Therefore, impacts would be less than significant, and no mitigation measures would be required. See Section 7.4.5.2 for discussion on temporary excavations for the design option. Additional information on the various construction techniques that may be used is included in the *West Santa Ana Branch Transit Corridor Project Construction Methods Report* (Metro 2024d).

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

Less than significant impact.

7.4.8 Threshold GEO-CON-7: Would the project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?

7.4.8.1 Locally Preferred Alternative and Maintenance and Storage Facility

Construction of the LPA and MSF will not have a significant impact on the expansive potential of soils in the Affected Area. The design features being considered are not uncommon for the LA region and will not exacerbate existing geologic conditions related to expansive soils during construction. Therefore, impacts will be less than significant, and no mitigation measures will be required.

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

Less than significant impact.

7.4.8.2 Design Option: Close 186th Street

Consistent with the LPA without the design option, construction of the LPA with the design option would not have a significant impact on the expansive potential of soils in the Affected Area. The design features being considered are not uncommon for the LA region and would not exacerbate existing geologic conditions related to expansive soils during construction. Therefore, impacts would be less than significant, and no mitigation measures would be required.

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

Less than significant impact.

7.4.9 Threshold GEO-CON-8: Would the project have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?

7.4.9.1 Locally Preferred Alternative and Maintenance and Storage Facility

Construction activities associated with the LPA and MSF will occur within highly urbanized areas served by existing municipal sewage systems. The use of septic tanks or alternative wastewater systems during construction is not anticipated for the LPA and MSF. No impacts will occur, and no mitigation measures will be required.

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

No impact.

7.4.9.2 Design Option: Close 186th Street

Consistent with the LPA without the design option, construction activities associated with the LPA with the design option would occur within highly urbanized areas served by existing municipal sewage systems. The use of septic tanks or alternative wastewater systems during construction is not anticipated for the LPA with the design option. No impacts would occur, and no mitigation measures would be required.

Mitigation Measures

No mitigation measures required.

Impacts Remaining after Mitigation

No impact.

7.4.10 Threshold GEO-CON-9: Would the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

See the West Santa Ana Branch Transit Corridor Project Final Paleontological Resource Impact Analysis Report (Metro 2024a) for determination.

8 PROJECT MEASURES AND MITIGATION MEASURES

As discussed in Sections 5.2 and 5.3, potential impacts associated with the design and operation of the LPA, design option, and MSF will be minimized through compliance with established design standards discussed in Section 3.3 and implemented through Project Measures GEO PM-1 (Geotechnical Design [Operation]) and GEO PM-2 (Geotechnical Design [Construction]). Mitigation measures are not required for the LPA, design option, and MSF.

8.1 Project Measures

Metro will verify that the following Project Measures (which were developed in accordance with the design requirements summarized in Section 2) are implemented to reduce geologic, soils, and seismicity-related impacts. These Project Measures are required and are part of the LPA.

8.1.1 GEO PM-1: Geotechnical Design (Operation)

A number of geotechnical design reports are required for the LPA, as detailed in the MRDC, Section 5.6, Geotechnical Investigations, Analysis and Design. Section 5.6 of the MRDC provides detailed requirements for the planning and conducting a geotechnical investigation, geotechnical design methodologies, and reporting. In addition, and as referenced in the MRDC, Caltrans and the County of LA Building Code have their own design requirements for bridges and aerial structures (Caltrans) and building structures (County of LA) that are also required.

In accordance with the MRDC, geotechnical report recommendations will be incorporated into the LPA plans and specifications. These recommendations will be a product of the LPA design process and will address the subsurface hazards identified in this report. Without these report recommendations, the LPA plans and specifications will not be approved, and the LPA will not be allowed to advance into the final design stage nor ultimately into construction. As a part of the Project, Metro has developed a comprehensive geotechnical field investigation and laboratory testing program (Metro 2020a) and is in the process of implementing the program. Findings from that program will be used to verify the information presented in the Final EIS/EIR.

8.1.2 GEO PM-2: Geotechnical Design (Construction)

A number of geotechnical design reports are required for the LPA, as detailed in the MRDC, Section 5.6, Geotechnical Investigations, Analysis and Design. Section 5.6 of the MRDC provides detailed requirements for the planning and conducting of a geotechnical investigation, geotechnical design methodologies, and reporting. In addition, and as referenced in the MRDC, Caltrans and the County of LA Building Code have their own design requirements for bridges and aerial structures (Caltrans) and building structures (County of LA) that are also required.

In accordance with the MRDC, geotechnical report recommendations will be incorporated into the LPA plans and specifications. These recommendations will be a product of the LPA design process and will address the subsurface hazards identified in this report. The design reports will also provide recommendations to be implemented during construction. The construction recommendations will address temporary excavations and ground settlement, and will include construction monitoring plans specific to the LPA. Implementation of the

recommendations and monitoring plans will be required, as applicable, for both on-site and off-site properties and existing improvements that could be affected by an excavation.

Without these construction recommendations, the LPA plans and specifications will not be approved, and the LPA will not be allowed to advance into the final design stage nor ultimately into construction. As a part of the Project, Metro has developed a comprehensive geotechnical field investigation and laboratory testing program and is in the process of implementing the program. Findings from that program will be used to verify the information presented in the Final EIS/EIR.

8.2 Mitigation Measures

As mandated by the Project Measures, hazards related to geology and soils will be investigated during design-level geotechnical studies that will be performed for the LPA. These studies will quantify the hazards and allow for appropriate geotechnical design recommendations to be incorporated into the plans for the LPA. Therefore, construction and operation of the LPA would not be significantly impacted by the potential geologic hazards, and geology and soils-related hazard mitigation measures are not required.

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