Los Angeles County
Metropolitan Transportation Authority

Appendix G Geology, Soils, Seismicity and Paleontological Resources Impacts Report

GOLD LINE EASTSIDE TRANSIT CORRIDOR PHASE 2

Prepared for
Los Angeles Metropolitan
Transportation Authority
One Gateway Plaza
Los Angeles, CA 90012

June 2022

Metro

Appendix G

Geology, Soils, Seismicity, and Paleontological Resources Impacts Report

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Prepared for:
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Acronyms

2020 RTP/SCS	Connect SoCal 2020-2045 Regional Transportation Plan/Sustainable Communities Strategy
AASHTO	American Association of State Highway and Transportation Officials
AREMA	American Railway Engineering and Maintenance-of-Way Association
ARP	average return period
bgs	below ground surface
BMP	Best Management Practices
BNSF	Burlington Northern Santa Fe
Caltrans	California Department of Transportation
CBC	California Building Code
CDMG	California department of Conservation, Division of Mines and Geology
CEQA	California Environmental Quality Act
CGS	California Geological Survey
CIDH	cast-in-drilled-hold
DSA	detailed study area
DWQ	Division of Water Quality
EIR	Environmental Impact Report
g	gravity
GSA	general study area
FHWA	Federal Highway Administration
I	Interstate
IOS	Initial Operating Segment
LARWQCB	Los Angeles Regional Water Quality Control Board
LID	low impact development

LRFD	Load and Resistance Factor Design
LRT	light rail transit
LRTP	Long Range Transportation Plan
LRVs	light rail vehicles
MDE	Maximum Design Earthquake
Metro	Los Angeles County Metropolitan Transportation Authority
MRDC	Metro Rail Design Criteria
MS4s	municipal separate storm sewer systems
MSF	Maintenance and Storage Facility
MUTCD	Manual of Uniform Traffic Control Devices
N/A	not applicable
NAVD	North American Vertical Datum
NPDES	National Pollutant Discharge Elimination System
OCS	overhead catenary system
ODE	Operating Design Earthquake
OIIWDG	Operating Industries, Inc. Work Defendants Group
PGA	peak ground acceleration
PRC	Public Resources Code
Project	Eastside Transit Corridor Phase 2 Project
Qls	landslide deposits
Qw	wash deposits
Qof	old alluvial fan deposits
Qya	young deposits of axial valley floors
Qyf	young alluvial fan deposits
ROW	right-of-way

RTP	Regional Transportation Plan
SCAG	Southern California Association of Governments
SDC	Supplemental Seismic Design Criteria
SVP	Society of Vertebrate Paleontology
SWPPP	Stormwater Pollution Prevention Plan
TBM	tunnel boring machine
TPSS	traction power substation
Tsh	Tertiary shale and siltstone
Tss	Tertiary sandstone
UBC	Uniform Building Code
USGS	United States Geological Survey
VMT	vehicle miles traveled

1.0 INTRODUCTION

This impacts report discusses the Eastside Transit Corridor Phase 2 Project (Project) setting in relation to geology, soils, seismicity, and paleontological resources. It describes existing conditions, current applicable regulatory setting, and potential impacts from operation and construction of the Build Alternatives and the No Project Alternative. This study was conducted in compliance with the California Environmental Quality Act (CEQA) and the State CEQA Guidelines, California Code of Regulations Section 15000 et seq.

The Project would extend the Los Angeles County Metropolitan Transportation Authority (Metro) L (Gold) Line, a light rail transit (LRT) line, from its current terminus at the Atlantic Station in the unincorporated community of East Los Angeles to the city of Whittier. It would extend the existing Metro L (Gold) Line approximately 3.2 to 9.0 miles, depending on the Build Alternative.

The Project area of analysis includes a general study area (GSA) that is regional in scope and scale, and a detailed study area (DSA) that encompasses an approximately two-mile area from the Project alignment in eastern Los Angeles County. The study area for geology, soils, and paleontological resources is the GSA to provide a regional context of the geological conditions, and the DSA for specific context.

A diverse mix of land uses are located within the GSA and DSA, including single- and multi-family residences, commercial and retail uses, industrial development, parks and recreational, health and medical uses, educational institutions, and vacant land. The Project would traverse densely populated, low-income, and heavily transit-dependent communities with major activity centers within the Gateway Cities subregion of Los Angeles County.

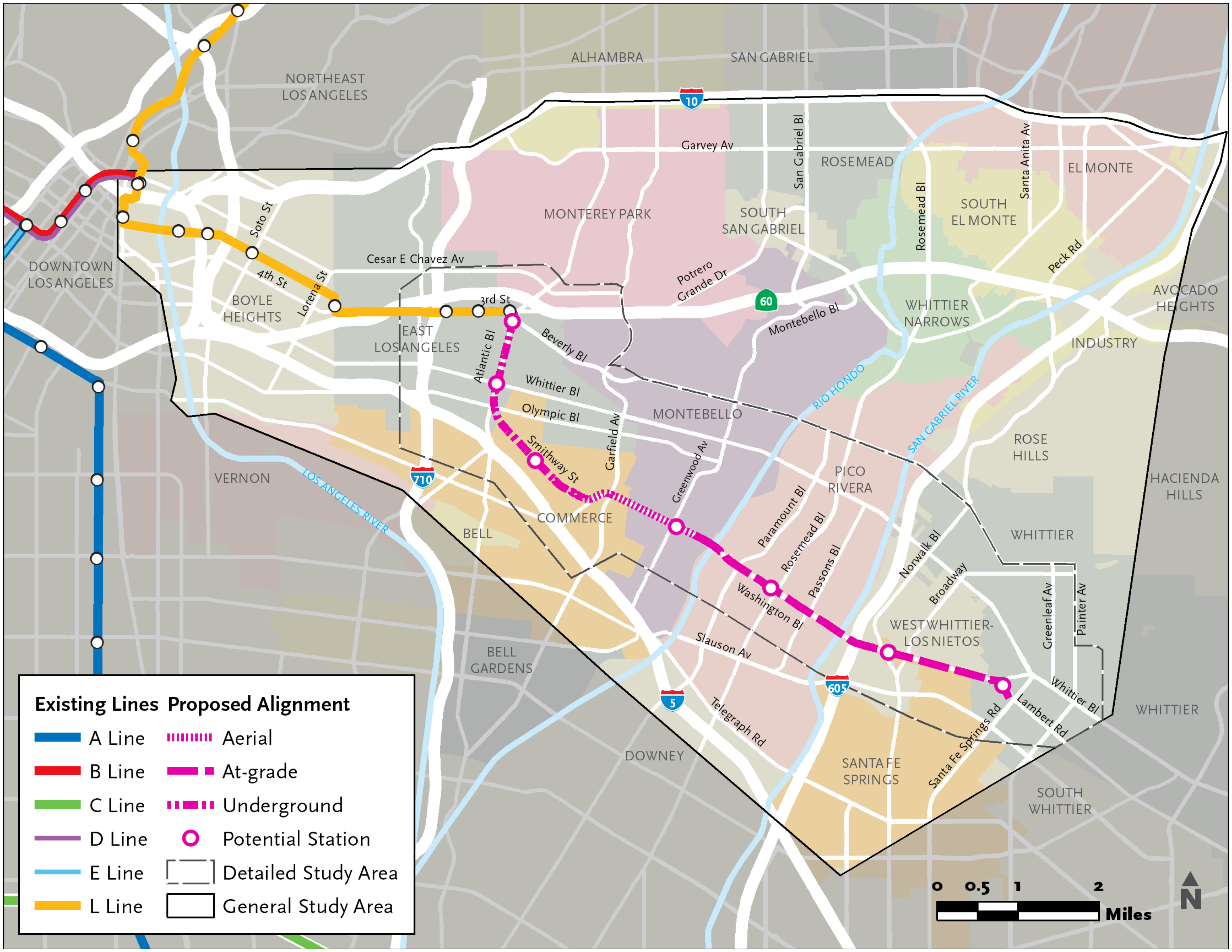
2.0 PROPOSED PROJECT AND ALTERNATIVES

2.1 Project Setting and Description

This impacts report evaluates potential environmental impacts of three Build Alternatives and a No Project Alternative. The Build Alternatives are: Alternative 1 Washington (Alternative 1), Alternative 2 Atlantic to Commerce/Citadel Initial Operating Segment (IOS) (Alternative 2), and Alternative 3 Atlantic to Greenwood IOS (Alternative 3).

For purposes of describing the Project, two study areas have been defined. The GSA is regional in scope and scale, whereas the DSA encompasses an approximately two-mile area from the Project alignment's centerline. The GSA is the same for all three of the Build Alternatives. The purpose of the GSA is to establish the study area for environmental resources that are regional in scope and scale, such as regional transportation, including vehicle miles traveled (VMT) and regional travel demands, population, housing, or employment. The GSA consists of several jurisdictions within Los Angeles County including the cities of Bell, Commerce, El Monte, Industry, Los Angeles, Montebello, Monterey Park, Pico Rivera, Rosemead, South El Monte, Santa Fe Springs, Whittier, unincorporated areas of Los Angeles County, which includes East Los Angeles and West Whittier-Los Nietos, and other cities within the San Gabriel Valley. It is generally bounded by Interstate (I) 10 to the north, Peck Road in South El Monte and Lambert Road in Whittier to the east, I-5 and Washington Boulevard to the south, and I-710 to the west. **Figure 2.1**, **Figure 2.2**, and **Figure 2.3** present the boundaries of the GSA for each of the three Build Alternatives.

The DSA establishes a study area to evaluate environmental resources that are more sensitive to the physical location of the Build Alternatives. The DSA for Alternative 1 Washington generally includes the area within a half-mile to two-mile distance from the guideway centerline, as shown in **Figure 2.1**. It encompasses five cities, Commerce, Montebello, Pico Rivera, Santa Fe Springs, and Whittier, and communities of unincorporated East Los Angeles and Whittier-Los Nietos. The DSA for Alternative 2 Atlantic to Commerce/Citadel IOS and Alternative 3 Atlantic to Greenwood IOS, does not extend as far to the east. As shown in **Figure 2.2** and **Figure 2.3** for Alternative 2 and Alternative 3 respectively, the DSA extends to the Rio Hondo and includes Commerce, Montebello, and unincorporated East Los Angeles.

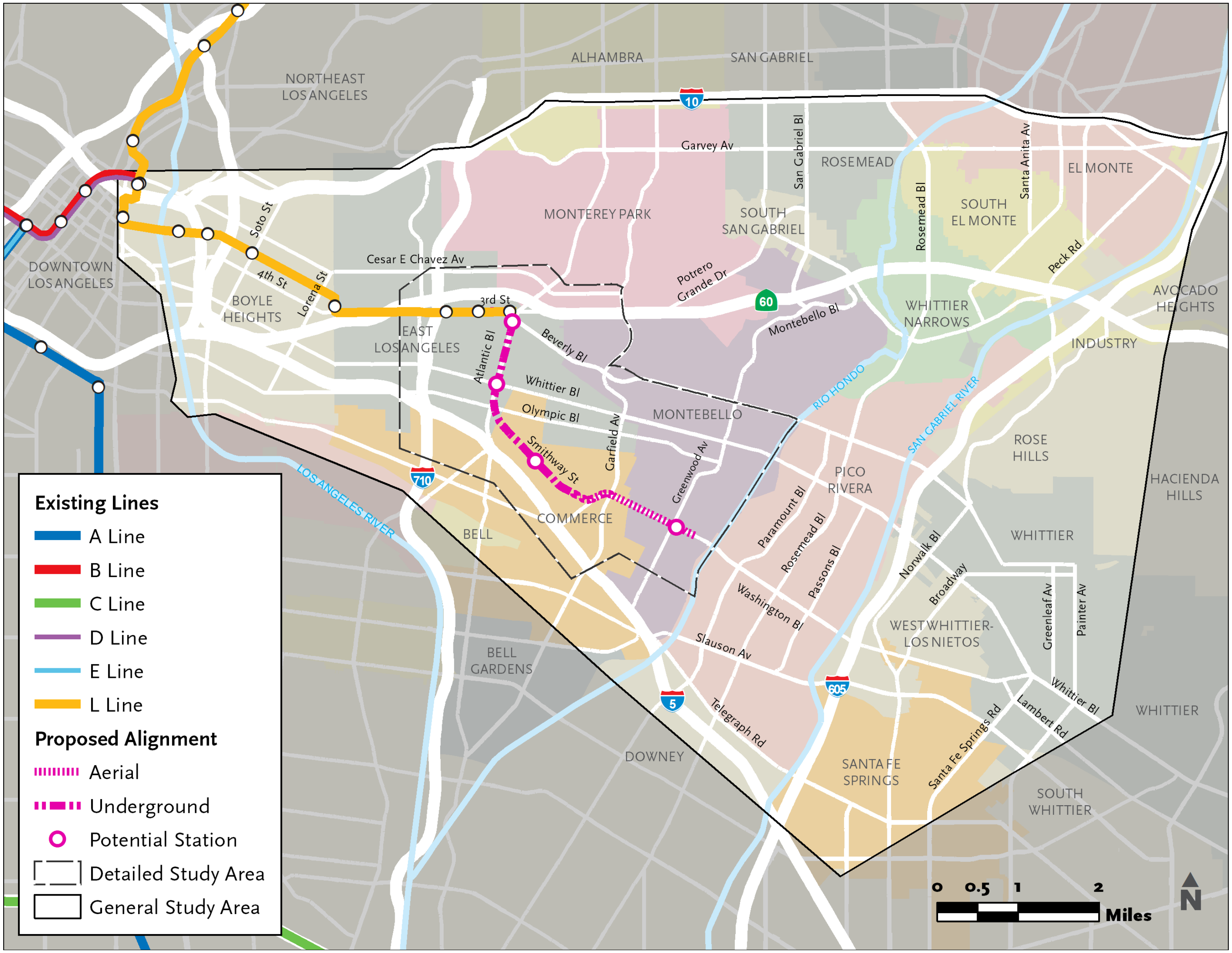


Source: Metro; CDM Smith/AECOM JV, 2021.

Figure 2.1. Alternative 1 Washington GSA and DSA

Source: Metro; CDM Smith/AECOM JV, 2021.

Figure 2.2. Alternative 2 Atlantic to Commerce/Citadel IOS GSA and DSA



Source: Metro; CDM Smith/AECOM JV, 2021.

Figure 2.3. Alternative 3 Atlantic to Greenwood IOS GSA and DSA

2.2 Build Alternatives

This impacts report evaluates the potential environmental impacts of three Build Alternatives which have the same guideway alignment east of the existing terminus at Atlantic Station but vary in length. Alternative 1 has the longest alignment at approximately 9.0 miles with seven stations (one relocated/reconfigured and six new), two maintenance and storage facility (MSF) site options and would terminate at Lambert station on Lambert Road in the city of Whittier. Alternative 2 is approximately 3.2 miles in length with three stations, one MSF site option, and would terminate at the Commerce/Citadel station in the city of Commerce, with non-revenue lead tracks extending further into the city of Commerce to connect to the Commerce MSF site option. Alternative 3 is approximately 4.6 miles in length with four stations, two MSF site options, and would terminate at Greenwood station in the city of Montebello.

There are also design options under consideration for each of the three Build Alternatives that consist of a variation in the design of the relocated/reconfigured Atlantic Station (applicable to Alternatives 1, 2, and 3) and a variation in the station and alignment profile in Montebello (applicable to Alternatives 1 and 3). Construction and operation of one or both design options are considered and evaluated for Alternative 1 and Alternative 3.

To differentiate the impacts evaluation of a Build Alternative with or without the design option(s) incorporated, a Build Alternative without the design option(s) is referred to as the "base Alternative" (i.e., base Alternative 1). A Build Alternative with a design option incorporated is referred to by using the design option name (e.g., Alternative 1 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option). The three Build Alternatives and the design options are described in greater detail below.

2.2.1 Alternative 1 Washington

Alternative 1 would extend the Metro L (Gold) Line LRT approximately 9.0 miles east from the current at-grade station at Atlantic Boulevard to an at-grade terminus at Washington Boulevard/Lambert Road in the city of Whittier. This alternative would include a relocated/reconfigured Atlantic station in an underground configuration and six new stations: Atlantic/Whittier (underground), Commerce/Citadel (underground), Greenwood (aerial), Rosemead (at-grade), Norwalk (at-grade), and Lambert (at-grade). The base Alternative 1 alignment would transition from the existing at-grade alignment to an underground configuration and would transition to an aerial configuration in the city of Commerce before transitioning to at-grade at Montebello Boulevard. The alignment includes approximately 3.0 miles of tunnel, 1.5 miles of aerial, and 4.5 miles of at-grade alignment.

The Alternative 1 alignment crosses the Rio Hondo and San Gabriel River and the Rio Hondo Spreading Grounds. The existing San Gabriel River and Rio Hondo bridges would be replaced with new bridges designed to carry both the LRT facility and the four-lane roadway.

An MSF and other ancillary facilities would also be constructed as part of the Project, including overhead catenary system (OCS), cross passages, ventilation structures, traction power substation (TPSS) sites, crossovers, emergency generators, radio tower poles and equipment shelters, and other supporting facilities along the alignment.

Two design options for Alternative 1 are described below.

2.2.1.1 Guideway Alignment

Under Alternative 1, the guideway would begin at the eastern end of the existing East Los Angeles Civic Center Station, transitioning from at-grade to underground at the intersection of South La Verne Avenue and East 3rd Street. The guideway would turn south and run beneath Atlantic Boulevard to approximately Verona Street and Olympic Boulevard. The underground guideway would then curve southeast, running under Smithway Street near the Citadel Outlets in the city of Commerce. After crossing Saybrook Avenue, the guideway would daylight from underground to an aerial configuration. Depending on the MSF site option that is selected, the aerial guideway would continue parallel to Washington Boulevard, east of Garfield Avenue, and merge into the center median of Washington Boulevard (Commerce MSF site option) or merge into the center median of Washington Boulevard at Gayhart Street (Montebello MSF site option). The alignment would maintain an aerial configuration then transition to an at-grade configuration east of Carob Way and would remain at-grade in the center of Washington Boulevard. The at-grade alignment would terminate at Lambert station in the city of Whittier.

2.2.1.1.1 Design Options

The following design options are being considered for Alternative 1:

Atlantic/Pomona Station Option – The Atlantic/Pomona Station Option would relocate the existing Atlantic Station to a shallow open air underground station with two side platforms and a canopy (**Figure 2.4**). This station design option would be located beneath the existing triangular parcel bounded by Atlantic Boulevard, Pomona Boulevard, and Beverly Boulevard. The excavation depth of the station invert would be approximately 20 to 25 feet from the existing ground elevation.

This option would also impact the guideway alignment and location of the tunnel boring machine (TBM) extraction pit. The underground guideway would be located east of Atlantic Boulevard and require full property acquisitions at its footprint between Beverly Boulevard and 4th Street. The alignment would connect with the base Alternative 2 alignment just north of the proposed Atlantic/Whittier station. The TBM extraction pit would be east of Atlantic Boulevard between Repetto Street and 4th Street. Limits for the excavation would occur between the TBM extraction pit and the intersection of Pomona Boulevard and Beverly Boulevard.

Montebello At-Grade Option – This design option consists of approximately one mile of at-grade guideway along Washington Boulevard between Yates Avenue and Carob Way in the city of Montebello. In this design option, after crossing Saybrook Avenue, the LRT guideway would daylight from underground to an aerial configuration to avoid disrupting existing Burlington Northern Santa Fe (BNSF) Railway tracks. The aerial guideway would continue parallel to Washington Boulevard, then merge into the center median east of Garfield Avenue. At Yates Avenue, the guideway would transition from aerial to an at-grade configuration and remain at-grade until terminating near Lambert Road in the city of Whittier. This design option includes an at-grade Greenwood station located west of Greenwood Avenue. The lead tracks to the MSF site option would also be at-grade. Alternative 1 with the Montebello At-Grade Option would have approximately 3.0 miles of underground, 0.5 miles of aerial, and 5.5 miles of at-grade alignment.

Source: Metro; ACE Team, June 2022.

Figure 2.4. Atlantic/Pomona Station Option

2.2.2 Alternative 2 Atlantic to Commerce/Citadel IOS

Alternative 2 would extend the Metro L (Gold) Line approximately 3.2 miles from the current terminus at Atlantic Boulevard to an underground terminal station at the Commerce/Citadel station in the city of Commerce with lead tracks connecting to the Commerce MSF site option. Alternative 2 would include a relocated/reconfigured Atlantic station and two new stations: Atlantic/Whittier (underground), and Commerce/Citadel (underground). The base Alternative 2 alignment includes approximately 3.0 miles of underground, 0.1 miles of aerial, and 0.1 miles of at-grade alignment.

An MSF and other ancillary facilities would also be constructed as part of the Project, including OCS, tracks, cross passages, ventilation structures, TPSSs, track crossovers, emergency generators, radio tower poles and equipment shelters, and other facilities along the alignment.

2.2.2.1 Guideway Alignment

Under Alternative 2, the guideway would follow the same alignment as under Alternative 1. The guideway would begin at the eastern end of the existing East Los Angeles Civic Center Station, transitioning from at-grade to underground at the intersection of South La Verne Avenue and East 3rd Street. The guideway would turn south and run beneath Atlantic Boulevard to approximately Verona Street and Olympic Boulevard. The underground guideway would then curve southeast, running under Smithway Street near the Citadel Outlets in the city of Commerce. The alignment would terminate at the Commerce/Citadel station with non-revenue lead tracks connecting to the Commerce MSF site option.

2.2.2.1.1 Design Option

One design option, the Atlantic/Pomona Station Option described in **Section 2.2.1.1.1** and shown on **Figure 2.4** is being considered for Alternative 2.

2.2.3 Alternative 3 Atlantic to Greenwood IOS

Alternative 3 would extend the Metro L (Gold) Line approximately 4.6 miles east from the current terminus at Atlantic Boulevard to an aerial terminal station at the Greenwood station in the city of Montebello. This alternative would include a relocated/reconfigured Atlantic station and three new stations: Atlantic/Whittier (underground), Commerce/Citadel (underground), and Greenwood (aerial). The base Alternative 3 alignment includes approximately 3.0 miles of underground, 1.5 miles of aerial, and 0.1 miles of at-grade alignment.

An MSF and other ancillary facilities would also be constructed as part of the Project, including OCS, tracks, cross passages, ventilation structures, TPSSs, track crossovers, emergency generators, radio tower poles and equipment shelters, and other facilities along the alignment.

Two design options for Alternative 3 are described below.

2.2.3.1 Guideway Alignment

Under Alternative 3, the guideway would follow the same alignment as under Alternative 1. The guideway would begin at the eastern end of the existing East Los Angeles Civic Center Station, transitioning from at-grade to underground at the intersection of South La Verne Avenue and East 3rd Street. The guideway would then turn south and run beneath Atlantic Boulevard to approximately Verona Street and Olympic Boulevard. The underground guideway would then curve southeast, running under Smithway Street near the Citadel Outlets in the city of Commerce. After crossing Saybrook Avenue, the guideway would daylight from underground to an aerial configuration. Depending on the MSF site option that is selected, the aerial guideway would continue parallel to Washington Boulevard, east of Garfield Avenue, and merge into the center median of Washington Boulevard (Commerce MSF site option) or merge into the center media of Washington Boulevard at Gayhart Street (Montebello MSF site option). The aerial guideway would terminate at the Greenwood station in the city of Montebello.

2.2.3.1.1 Design Option

Two design options described in **Section 2.2.1.1.1**, the Atlantic/Pomona Station Option and the Montebello At-Grade Option are being considered for Alternative 3. Alternative 3 with the Montebello At-Grade Option would have approximately 3.0 miles of underground, 0.5 miles of aerial, and 1.1 miles of at-grade alignment.

2.3 Maintenance and Storage Facilities

The Project has two MSF site options: the Commerce MSF site option and the Montebello MSF site option. One MSF site option would be constructed. The MSF would provide equipment and facilities to clean, maintain, and repair rail cars, vehicles, tracks, and other components of the system. The MSF would enable storage of light rail vehicles (LRVs) that are not in service and would connect to the mainline with one lead track. The MSF would also provide office space for Metro rail operation staff, administrative staff, and communications support staff. The MSF would be the primary physical employment centers for rail operation employees, including train operators, maintenance workers, supervisors, administrative, security personnel and other roles.

The Commerce MSF site option is located in the city of Commerce, and the Montebello MSF site option is located in the city of Montebello. The Commerce MSF site option is located where it could support any of the three Build Alternatives. The Montebello MSF site option is located where it could support either Alternative 1 or Alternative 3.

2.3.1 Commerce MSF

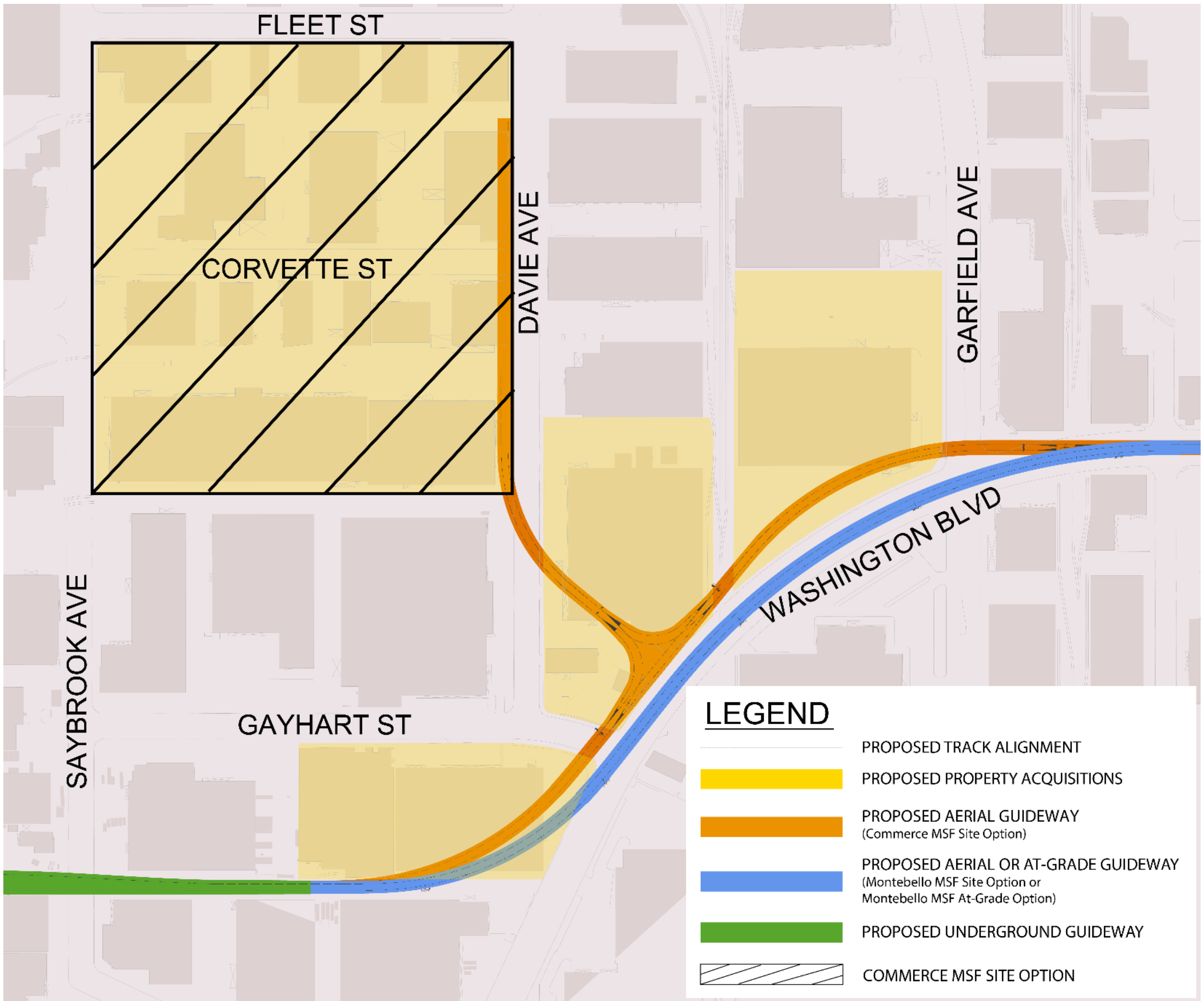
The Commerce MSF site option is located in the city of Commerce, west of Washington Boulevard and north of Gayhart Street. The site is approximately 24 acres and is bounded by Davie Avenue to the east, Fleet Street to the north, Saybrook Avenue to the west, and an unnamed street to the south. Additional acreage would be needed to accommodate the lead track and construction staging. As shown in a dashed line on **Figure 2.5**, the guideway alignment with the Commerce MSF site option would daylight from an underground to aerial configuration west of the intersection of Gayhart Street and Washington Boulevard and would run parallel to Washington Boulevard from Gayhart Street to Yates Avenue. The lead tracks to the Commerce MSF site option would be located northeast of the intersection of Gayhart Street and Washington Boulevard and extend in an aerial configuration and then would transition to at-grade within the MSF after crossing Davie Avenue. To construct and operate the Commerce MSF site option, Corvette Street would be permanently closed between Saybrook Avenue and Davie Avenue. Corvette Street is an undivided two-lane road and is functionally classified as a local street under the California Road System. The facility would accommodate storage for approximately 100 LRVs.

2.3.2 Montebello MSF

The Montebello MSF site option is located in the city of Montebello, north of Washington Boulevard and south of Flotilla Street between Yates Avenue and S. Vail Avenue. The site is approximately 30 acres in size and is bounded by S. Vail Avenue to the east, a warehouse structure along the south side of Flotilla Street to the north, Yates Avenue to the west, and a warehouse rail line to the south. Additional acreage would be needed to accommodate the lead track and construction staging. As shown on in a solid line on **Figure 2.5**, as with the Commerce MSF site option, the guideway alignment with the Montebello MSF site option would daylight from an underground to an aerial configuration west of intersection of Gayhart Street and Washington Boulevard. The alignment would be located further east than the alignment with the Commerce MSF site option. The aerial guideway for the Montebello MSF site option would transition to the median of Washington Boulevard at Gayhart Street. Columns that would provide structural support for the aerial guideway would be installed in the median of Washington Boulevard and would require roadway reconfiguration and striping on Washington Boulevard.

The lead tracks would be in an aerial configuration from Washington Boulevard, parallel S. Vail Avenue, and then transition to at-grade as it approaches the MSF. The facility would accommodate storage for approximately 120 LRVs.

The Montebello MSF At-Grade Option includes an at-grade configuration for the lead tracks to the Montebello MSF. This design option would be necessary if the Montebello At-Grade Option is selected under Alternative 1 or Alternative 3. In this design option, the lead tracks would be in an at-grade configuration from Washington Boulevard, paralleling S. Vail Avenue and remain at-grade to connect to the Montebello MSF site option. For this design option, through access on Acco Street to Vail Avenue would be eliminated and cul-de-sacs would be provided on each side of the lead tracks to ensure that access to businesses in this area is maintained. Acco Street is an undivided two-lane road and is functionally classified as a local street under the California Road System.



Source: Metro; ACE Team, January 2022.

Figure 2.5. Montebello MSF S-Curve Alignment

2.4 Ancillary Facilities

The Build Alternatives would require a number of additional elements to support vehicle operations, including but not limited to the OCS, tracks, crossovers, cross passages, ventilation structures, TPSS, train control houses, electric power switches and auxiliary power rooms, communications rooms, radio tower poles and equipment shelters, and an MSF. Alternatives 1, 2, and 3 would have an underground alignment of approximately 3 miles in length between La Verne and Saybrook Avenue. Per Metro's Fire Life Safety Criteria, ventilation shafts and emergency fire exits would be installed along the tunnel portion of the alignment. These would be located at the underground stations or public right-of-way (ROW). The alignment for Alternative 1 and Alternative 3 would travel along the median of the roadway for most of the route. The precise location of ancillary facilities would be determined in a subsequent design phase.

2.5 Proposed Stations

The following stations would be constructed under Alternative 1:

- Atlantic (Relocated/Reconfigured) – The existing Atlantic Station would be relocated and reconfigured to an underground center platform station located beneath Atlantic Boulevard south of Beverly Boulevard in East Los Angeles. The existing parking structure located north of the 3rd Street and Atlantic Boulevard intersection would continue to serve this station.
    - Atlantic Pomona Station Option – The Atlantic/Pomona Station Option would relocate the existing Atlantic Station to a shallow underground open-air station with two side platforms and a canopy. This station design option would be located beneath the existing triangular parcel bounded by Atlantic Boulevard, Pomona Boulevard, and Beverly Boulevard. The existing parking structure located north of the 3rd Street and Atlantic Boulevard intersection would continue to serve this station.
- Atlantic/Whittier – This station would be underground with a center platform located beneath the intersection of Atlantic and Whittier Boulevards in East Los Angeles. Parking would not be provided at this station.
- Commerce/Citadel – This station would be underground with a center platform located beneath Smithway Street near the Citadel Outlets in the city of Commerce. Parking would not be provided at this station.
- Greenwood – This station would be aerial with a side platform located in the median of Washington Boulevard east of Greenwood Avenue in the city of Montebello. This station would provide a surface parking facility near the intersection of Greenwood Avenue and Washington Boulevard.
    - Under the Montebello At-Grade Option, Greenwood station would be an at-grade station located west of the intersection at Greenwood and Washington Boulevard.
- Rosemead – This station would be at-grade with a center platform located in the center of Washington Boulevard west of Rosemead Boulevard in the city of Pico Rivera. This station would provide a surface parking facility near the intersection of Rosemead and Washington Boulevards.
- Norwalk – This station would be at-grade with a center platform located in the median of Washington Boulevard east of Norwalk Boulevard in the city of Santa Fe Springs. This station would provide a surface parking facility near the intersection of Norwalk and Washington Boulevards.
- Lambert – This station would be at-grade with a center platform located south of Washington Boulevard just west of Lambert Road in the city of Whittier. This station would provide a surface parking facility near the intersection of Lambert Road and Washington Boulevard.

Alternative 2 would include Atlantic (Relocated/Reconfigured), Atlantic/Whittier, and Commerce/Citadel stations as described above.

Alternative 3 would include Atlantic (Relocated/Reconfigured), Atlantic/Whittier, Commerce/Citadel, and Greenwood stations as described above.

Station amenities would include items in the Metro Systemwide Station Standards Policy (Metro 2018) such as station pin signs, security cameras, bus shelters, benches, emergency/information telephones, stairs, map cases, fare collection, pedestrian and street lighting, hand railing, station landscaping, trash receptacles, bike racks and lockers, emergency generators, power boxes, fire hydrants, and artwork. Escalators and elevators would be located in aerial and underground stations. Station entry portals would be implemented at underground stations. Station access would be ADA-compliant and also have bicycle and pedestrian connections. Details regarding most of these items, including station area planning and urban design, would be determined at a later phase.

2.6 Description of Construction

Construction of the Project would include a combination of elements dependent upon the locally preferred alternative. The major construction activities include guideway construction (at-grade, aerial, underground); decking and tunnel boring for the underground guideway; station construction; demolition; utility relocation and installation work; street improvements including sidewalk reconstruction and traffic signal installation; retaining walls; LRT operating systems installation including TPSS and OCS; parking facilities; an MSF; and construction of other ancillary facilities. Alternative 1 would include construction of bridge replacements over the San Gabriel and Rio Hondo Rivers.

In addition to adhering to regulatory compliance, the development of the Project would employ conventional construction methods, techniques, and equipment. All work for development of the LRT system would conform to accepted industry specifications and standards, including Best Management Practices (BMP). Project engineering and construction would, at minimum, be completed in conformance with the regulations, guidelines, and criteria, including, but not limited to, Metro Rail Design Criteria (MRDC) (Metro 2018), California Building Code, Metro Operating Rules, and Metro Sustainability Principles.

The construction of the Project is expected to last approximately 60 to 84 months. Construction activities would shift along the corridor so that overall construction activities should be relatively short in duration at any one point. Most construction activities would occur during daytime hours. For specialized construction tasks, it may be necessary to work during nighttime hours to minimize traffic disruptions. Traffic control and pedestrian control during construction would follow local jurisdiction guidelines and the Manual of Uniform Traffic Control Devices (MUTCD) standards. Typical roadway construction traffic control methods and devices would be followed including the use of signage, roadway markings, flagging, and barricades to regulate, warn, or guide road users. Properties adjacent to the Project's alignment would be used for construction staging. The laydown and storage areas for construction equipment and materials would be established in the vicinity of the Project within parking facilities, and/or on parcels that would be acquired for the proposed stations and MSF site options. Construction staging areas would be used to store building materials, construction equipment, assemble the TBM, temporary storage of excavated materials, and serve as temporary field offices for the contractor.

2.7 Description of Operations

The operating hours and schedules for Alternatives 1, 2, and 3 would be comparable to the weekday, Saturday and Sunday, and holiday schedules for the Metro L (Gold) Line (effective 2019). It is anticipated that trains would operate every day from 4:00 am to 1:30 am. On weekdays, trains would operate approximately every 5 to 10 minutes during peak hours, every 10 minutes mid-day and until 8:00 pm, and every 15 minutes in the early morning and after 8:00 pm. On weekends, trains would operate every 10 minutes from 9:00 am to 6:30 pm, every 15 minutes from 7:00 am to 9:00 am and from 6:30 pm to 7:30 pm, and every 20 minutes before 7:00 am and after 7:30 pm. These operational headways are consistent with Metro design requirements for future rail services.

2.8 No Project Alternative

The No Project Alternative establishes impacts that would reasonably be expected to occur in the foreseeable future if the Project were not approved. The No Project Alternative would maintain existing transit service through the year 2042. No new transportation infrastructure would be built within the GSA aside from projects currently under construction or funded for construction and operation by 2042 via the 2008 Measure R or 2016 Measure M sales taxes. The No Project Alternative would include highway and transit projects identified for funding in Metro's 2020 Long Range Transportation Plan (LRTP) and Southern California Association of Governments (SCAG) *Connect SoCal 2020-2045 Regional Transportation Plan/Sustainable Communities Strategy* (2020 RTP/SCS). The No Project Alternative includes existing projects from the regional base year (2019) and planned regional projects in operation in the horizon year (2042).

3.0 REGULATORY FRAMEWORK

3.1 Federal

There are no specific federal regulations related to the geologic hazards of soils and seismicity.

3.2 State

3.2.1 Alquist-Priolo Act

The principal state guidance relating to geologic hazards is contained in the Alquist-Priolo Act (Public Resources Code [PRC] 2621 et seq.) and the Seismic Hazards Mapping Act of 1990 (PRC 2690-2699.6). The Alquist-Priolo Act prohibits the location of most types of structures for human occupancy across active traces of faults in earthquake fault zones, shown on maps prepared by the state geologist, and regulates construction in the corridors along active faults (earthquake fault zones). Earthquake fault zones are regulatory zones around active faults designated by the State. The zones vary in width, but average about one-quarter mile wide.

3.2.2 Seismic Hazards Mapping Act of 1990

The Seismic Hazards Mapping Act of 1990 focuses on hazards related to strong ground shaking, liquefaction, and seismically-induced landslides. Under its provisions, the state is charged with identifying and mapping areas at risk of strong ground shaking, liquefaction, landslides, and other corollary hazards. The maps are to be used by cities and counties in preparing their general plans and adopting land use policies to reduce and mitigate potential hazards to public health and safety.

3.2.3 California Building Code

The CBC codified in Title 24 California Code of Regulations encompasses a number of requirements related to geologic issues, including Part 2, Volume 2, Chapter 18, Soils and Foundations, which outlines the minimum standards for structural design and construction. The CBC augments and supersedes the Uniform Building Code (UBC) with stricter requirements to reduce the risks associated with building in seismic areas to the maximum extent practicable. The CBC is modeled after the International Building Code and sets standards for the investigation and mitigation of the site conditions related to fault movement, liquefaction, landslides, differential compaction/seismic settlement, ground rupture, ground shaking, and seismically-induced flooding. For surface structures other than guideways and bridges, the MRDC requires conformance with the Los Angeles County Building Code, which is based on the CBC. The MRDC is discussed further under **Section 3.4.1**.

Chapter 18, Soils and Foundations, of the CBC requires that geotechnical evaluations be conducted that include, among other requirements, a record of the soil profile, evaluation of active faults in the area, and recommendations for foundation type and design criteria that address issues as applicable such as (but not limited to) bearing capacity of soils, provision to address expansive soils and liquefaction, settlement and varying soil strength. If a building department, or other appropriate enforcement agency, determines that recommended action(s) presented in the geotechnical evaluations are likely to prevent structural damage, the approved recommended action(s) must be made a condition to the building permit (Section 1803.1.1.3 of Chapter 18).

The CBC provides standards for various aspects of construction, including but not limited to excavation, grading, and earthwork construction; preparation of the site prior to fill placement, specification on fill materials and fill compaction and field testing; retaining wall design and construction, foundation design and construction; and seismic requirements. Chapter 16 of the CBC provides structural design requirements governing seismically resistant construction (Section 1604), including 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). It includes provisions to address issues such as (but not limited to) construction on expansive soils, liquefaction potential, and soil strength loss. In accordance with California law, project design and construction would be required to comply with provisions of the CBC. The CBC sets seismic design requirements based on seismic risk categories, which are associated with a structure's occupancy category (i.e., structures that represent low hazard to human life, structures that represent substantial hazard to human life, structures designated as essential facilities based on the proposed use), and a structure's seismic risk category (i.e., severity of the design earthquake ground motion and specific soil properties at the site). Chapter 33 of the CBC includes, but is not limited to, requirements for excavation safeguards so that excavation 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).

3.2.4 California Public Resources Code

State requirements for paleontological resource management are included in PRC Section 5097.5 and Section 30244. These statutes prohibit the removal of any paleontological site or feature from public lands without permission of the jurisdictional agency, define the removal of paleontological sites or features as a misdemeanor, and require reasonable mitigation of adverse impacts to paleontological resources from developments on public (state, county, city, district) lands.

Paleontological resources must be considered under CEQA. Appendix G of the CEQA Guidelines provides guidance relative to significant impacts on paleontological resources, indicating that a project would have a significant impact on paleontological resources if it disturbs or destroys a unique paleontological resource or site or unique geologic feature. Section 5097.5 of the California PRC specifies that any unauthorized removal of paleontological remains is a misdemeanor. Further, California Penal Code Section 622.5 sets the penalties for damage or removal of paleontological resources.

3.2.5 National Pollutant Discharge Elimination System

In accordance with Clean Water Act Section 402, which regulates stormwater discharges under the National Pollutant Discharge Elimination System (NPDES) program, California State Water Resources Control Board adopted a Construction General Permit. The Construction General Permit is applicable to all stormwater discharges associated with construction activity. The NPDES General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities (the Construction General Permit) was adopted on September 2, 2009. The provisions of the new Construction General Permit (Order #2009-0009-DWQ [State Water Resources Control Board Division of Water Quality] (DWQ)) became effective July 1, 2010 and was amended by Order # 2010-014-DWQ on February 14, 2011, and 2012-0006-DWQ on July 17, 2012. This Order has been administratively extended until a new order is adopted and becomes effective. Order #2009-0009-DWQ supersedes the previous Construction General Permit (Order #99-08-DWQ)(California State Water Resources Control Board 2012). The new Order has similar requirements to the current permit, but it specifies more minimum BMP that were previously only required as elements of the Stormwater Pollution Prevention Plan (SWPPP) or suggested by guidance.

The main objectives of the Construction General Permit are to:

- Reduce erosion from construction projects or activities
- Minimize or eliminate sediment in stormwater discharges from construction projects
- Prevent materials used at a construction site from contacting stormwater
- Implement a sampling and analysis program to monitor construction site runoff
- Eliminate unauthorized non-stormwater discharges from the construction sites
- Implement appropriate measures to reduce potential impacts on waterways both during and after construction projects
- Establish maintenance commitments on post-construction pollution control measures

The Construction General Permit requirements apply to any construction project that either results in the disturbance of at least one acre of land or is part of a larger common development plan. Additionally, the General Construction Permit is required for related construction or demolition activities, including clearing, grading, grubbing, or excavation, or any other activity that results in greater than one acre of land disturbance.

Metro would be responsible for compliance with this NPDES permit. Specific permitting requirements would be determined once construction plans and construction phasing are specified. NPDES permits and requirements are discussed more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report.

3.3 Regional

3.3.1 Los Angeles Regional Water Quality Control Board

Los Angeles Regional Water Quality Control Board (LARWQCB) is responsible for issuing the Los Angeles County Municipal Storm Water Permit (Order No. R4-2012-0175, NPDES No. CAS-004001, as amended by State Water Board Order WQ 2015-0075 on June 16, 2015 and Los Angeles Water Board Order R4-2012-0175-A01 on September 8, 2016, and as modified by LARWQCB on July 9, 2018). The existing permit covers the Los Angeles County Flood Control District, Los Angeles County, and 84 incorporated cities within the coastal watersheds of Los Angeles County. The permit covers the permittees for contributions to discharges of stormwater and urban runoff from municipal separate storm sewer systems (MS4s), also called storm drain systems. The discharges flow to water courses within the LACFCD and into receiving waters of the Los Angeles Region. This Order also serves as Waste Discharge Requirements pursuant to article 4, chapter 4, division 7 of the California Water Code (commencing with section 13260).

The current MS4 permit imposes basic programs, or minimum control measures, that mitigate stormwater quality issues. These programs include public information and participation, industrial/commercial inspection, planning and land development, development construction, public agency activities, and illicit connection/discharge abatement (Los Angeles County 2015). To illustrate, the implementation of temporary construction BMPs, such as erosion control and spill management and safe storage of fluids, are required under the development construction program. Post-construction stormwater BMPs are required for most public and private development under the planning and land development program.

3.3.2 Los Angeles County Metropolitan Transportation Authority

The MRDC establishes the design criteria for Metro transit projects, including LRT guideways and facilities. It was most recently updated with the 2018 adoption of the *Metro Systemwide Station Design Standards Policy*. Section 5 of the MRDC is the main reference for the seismic design of Metro facilities; this is supplemented by the MRDC Section 5 Appendix, Metro Supplemental Seismic Design Criteria.

The MRDC provides guidance on the procedures and methods to be used during design of structures. Section 5 of the MRDC also outlines design requirements that address geologic conditions and hazards. Section 5.6 of the MRDC requires subsurface investigation and laboratory testing, geotechnical reporting and temporary excavation, and detailed foundation design requirements that would address the hazards discussed in this report. All new structures must be designed to resist the earthquake forces and ground displacement defined in the MRDC. The MRDC Section 5 Appendix dictates the required seismic performance criteria for structures.

For structures other than bridges and aerial structures, MRDC requires conformance with the Los Angeles County Building Code (based on the CBC). For bridges and aerial structures, the MRDC requires mandatory conformance with the latest version of the California Department of Transportation (Caltrans) *Bridge Design Specifications* (2018), Caltrans *Seismic Design Criteria* (Caltrans 2019a), and American Association of State Highway and Transportation Officials (AASHTO) *Load and Resistance Factor Design* (LRFD) *Bridge Design Specifications* (AASHTO 2017 and Caltrans 2019b), or *American Railway Engineering and Maintenance-of-Way Association* (AREMA) *2019 specifications*, as applicable, depending on the location of the structure. Retaining walls subject to LRT loading will also be designed in conformance with the AASHTO with Caltrans Amendments, in accordance with MRDC Section 5.1.3.C.5. Underground structures would be designed to conform with Metro design specifications for underground guideways and structures.

The Metro Supplemental Seismic Design Criteria (SDC) (Metro 2017) would be used for the final design stage of the Project to provide seismic design recommendations for the selected Build Alternative. 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 structure 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 requires the following:

- Bridge, aerial, and underground structures would be designed in accordance with the Metro MDE, which has a 2,500-year ARP.

- Surface structures not covered by the Caltrans seismic design criteria would be designed in accordance with the Los Angeles County Building Code. The Los Angeles County Building Code uses the maximum considered earthquake with a 2,500-year ARP.

- Bridges supporting railroads would be designed in accordance with the requirements of 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, ranging from a 50- to 2,400-year ARP.

If a structure is governed by more than one set of seismic design criteria and conflict exists, the most stringent set of requirements would apply to the design.

3.4 Local

3.4.1 County of Los Angeles Municipal Code

The County of Los Angeles Municipal Code Section 22.44.1570 has set standards for the identification, protection, and remediation of cultural resources, including paleontological resources. Cultural resources within Los Angeles County include historic buildings, structures, artifacts and sites. They also include districts of historic, architectural, archaeological, or paleontological significance.

Recognized resources are important parts of the built and natural environments within Los Angeles County. County of Los Angeles Municipal Code Section 22.44.1570 (A) states the following: the intent of these provisions is to protect and preserve archaeological, historical, and paleontological resources from destruction, and avoid impacts to such resources where feasible. Where avoidance is not feasible, impacts to resources shall be minimized to the maximum extent feasible. Standards are also in place for the use of a 'qualified' archaeologist and paleontologist and qualified Native American monitor.

3.4.2 Los Angeles County General Plan

The *Los Angeles County 2035 General Plan* sets specific goals and policies in relation to seismic and geotechnical hazards in the Safety Element (Los Angeles County 2015). The following are some of the policies that apply to the Build Alternatives in unincorporated county areas. Incorporated areas are regulated by applicable city policies.

- Policy S 1.1: Discourage development in Seismic Hazard and Alquist-Priolo Earthquake Fault Zones.
- Policy S 1.2: Prohibit the construction of most structures for human occupancy adjacent to active faults until a comprehensive fault study that addresses the potential for fault rupture has been completed.

The general plan also sets goals and policies related to paleontological resources in the Conservation and Natural Resources Element. Relevant policies are described below and apply to unincorporated county areas:

- Policy C/NR 14.1: Mitigate all impacts from new development on or adjacent to historic, cultural, and paleontological resources to the greatest extent feasible.
- Policy C/NR 14.6: Ensure proper notification and recovery processes are carried out for development on or near historic, cultural, and paleontological resources.

3.4.3 Los Angeles County Low Impact Development Ordinance and Manual

Low impact development (LID) is a design strategy using naturalistic, on-site BMPs to lessen the impacts of development on stormwater quality and quantity. Los Angeles County's LID Standards Ordinance provides LID standards for infrastructure projects to lessen adverse impacts of stormwater runoff, minimize pollutant loadings, minimize erosion and hydrologic impacts on natural drainage systems (Los Angeles County 2008).

As of January 1, 2009, Los Angeles County instituted LID requirements for development occurring within unincorporated portions of the county. Los Angeles County prepared the 2014 *Low Impact Development Standards Manual* (Los Angeles County Department of Public Works 2014) to comply with the requirements of the 2012 MS4 Permit. The LID Standards Manual provides guidance for the implementation of stormwater quality control measures in new development and redevelopment projects in unincorporated areas of the county with the intention of improving water quality and mitigating potential water quality impacts from stormwater and non-stormwater discharges. One of the objectives of the LID Standards is to minimize erosion and other hydrologic impacts on natural drainage systems by requiring development projects to incorporate properly-designed, technically-appropriate hydromodification control development principles and technologies (Los Angeles County Department of Public Works 2014).

3.4.4 City of Commerce

The Safety Element of the *City of Commerce 2020 General Plan* (City of Commerce 2008) addresses seismicity amongst other natural and man-made hazards. The element identifies that the city would experience ground shaking in the event of an earthquake but would not likely be exposed to secondary seismic hazards such as ground settlement, landsliding, and tsunamis.

The Resource Management Element of the city's plan provides instruction in the event of the discovery of paleontological resources during excavation and grading.

The City of Commerce Municipal Code Chapter 19.33 provides requirements to lessen the water quality impacts of development by using smart growth practices and integrating LID design principles to mimic predevelopment hydrology through infiltration, evapotranspiration, and rainfall harvest and use (City of Commerce 2013).

3.4.5 City of Montebello

The *Montebello 1973 General Plan* was adopted in 1973 and was intended to guide development for 20 years. Although the city is built beyond the life of the general plan, Montebello is currently in the process of updating the plan, which is expected to be a 36-month process with the first draft released in early 2022. The existing plan includes a Seismic Safety Element that appraises seismic hazards within the city and a Safety Element that includes policies to prevent social and economic disruption and property damage from geological hazards. Relevant policies to the Project include (City of Montebello 1975):

- Continue to require engineering geologic investigations in hillside areas.
- Continue to review all land development proposals from the standpoint of minimizing hazards.

The city's General Plan does not address paleontological resources.

The City of Montebello's LID ordinance (Montebello Municipal Code Section 8.36.020) provides the legal framework implementing stormwater quality control measures for new development and redevelopment projects to improve water quality and mitigate potential water quality impacts from stormwater and non-stormwater discharges (City of Montebello 2002).

3.4.6 City of Pico Rivera

The city of Pico Rivera addresses goals and policies related to seismic and geologic hazards in the Safety Element of the city of Pico Rivera's *General Plan* (City of Pico Rivera 2014b). Applicable polices are outlined below.

- Policy 9.1-1 Safety Standards. Maintain enforcement of up-to-date seismic safety and structural design standards, including the California Building Standards Code for new and retrofitted buildings.
- Policy 9.1-2 Geotechnical Studies. Require that geotechnical studies be prepared for development in areas where geologic or seismic hazards may be present, such as liquefaction in the central portion of the city and in the Whittier Narrows Dam area.
- Policy 9.1-3 Infrastructure. Encourage property owners, Caltrans, the railroads, and local utility companies to regularly inspect and strengthen (as needed) infrastructure susceptible to failure during an earthquake.

The Environmental Resources Element recognizes that the city contains paleontological resources. Applicable polices are outlined below.

- Policy 8.7-1 Resource Preservation. Protect and preserve significant historic, archaeological, and paleontological resources, including those recognized at national, state, and local levels.
- Policy 8.7-3 Consultation. As part of the development review process, ensure that potential impact to historic, archaeological, and paleontological resources are minimized.
- Policy 8.7-4 Resource Assessment. Require new development necessitating discretionary approval that could potentially impact historic, archaeological, and/or paleontological resources to conduct a resource survey to ensure that potential sites are identified for avoidance or special treatment.

Title 16, Environment, Chapter 16.04, regulates stormwater and urban runoff pollution prevention within the city and requires new development and redevelopment to comply with LID structural and nonstructural BMPs (City of Pico Rivera 2014a).

3.4.7 City of Santa Fe Springs

The *Santa Fe Springs 2040 General Plan* (City of Santa Fe Springs 2021) includes goals and policies related to seismic hazards and soils. Applicable goals and policies from the Conservation and Open Space (COS) and Safety (S) Elements include:

- GOAL S-1: A COMMUNITY WELL PREPARED TO RESPOND EARTHQUAKES
- Policy S-1.1: Earthquake Preparation. Educate the community on actions to take before, during, and after a major earthquake, including establishing family emergency disaster plans to prepare for and after an earthquake event.
- Policy S-1.2: Training. Provide ongoing training to encourage preparedness and reduce the potential risk loss of life, property damage, and social and housing disruption resulting from an earthquake.
- Policy S-1.3: Agency Consultation. Consult emergency Preparedness with Federal, State, County, School Districts and other local agencies to prepare for response and recovery efforts in the event of an earthquake.
- Policy S-1.4: Minimize Property Damage. Encourage property owners to undertake seismic retrofit of structures vulnerable to moderate to severe ground shaking caused by earthquakes.
- Policy S-1.5: Seismic Standards. Ensure that all new development adheres to City and State seismic and geotechnical standards.
- Policy S-1.6: Earthquake Recovery Resiliency. Identify a plan of action and consult with different responsible agencies to respond to and recover from a major earthquake.
- Policy S-1.7: Infrastructure Resilience. Establish City plans and work with utility providers to ensure programs and systems are in place for continued functionality of water, sewer, electric power, natural gas, and communications infrastructure during and after a major earthquake.
- Policy S-1.8: Geotechnical Hazard Mitigation. Require that projects in areas susceptible to liquefaction and other geologic hazards demonstrate that all appropriate engineering and planning mitigations are implemented.
- Policy COS-4.2: Contaminated Soils. Coordinate with responsible agencies to avoid threats that contaminated soils pose to groundwater quality.

The city's General Plan does not address paleontological resources.

Title V, Public Works, Chapter 52, Stormwater Management and Discharge Control Chapter 52 requires LID measures and BMPs that must be incorporated into design plans for development or redevelopment projects (City of Santa Fe Springs 2014).

3.4.8 City of Whittier

The city of Whittier formally adopted their new *2021-2040 Envision Whittier General Plan* in October 2021 (City of Whittier 2021). The 2021 general plan includes the following policies related to seismic hazards:

- PSNH-4.3: Ensure that all new development abides by current City and State seismic and geotechnical requirements.

- PSNH-4.5: Strive to ensure that all utility and infrastructure systems have continued functionality during and after a major earthquake.

- PSNH-4.6: Require that projects in areas susceptible to liquefaction, landslides, and other geologic hazards demonstrate that all appropriate engineering and planning mitigations are implemented.

The city's 2021 general plan addresses the protection of paleontological resources in the Historic Resources Element. The following policy is applicable to the Project:

- HR-3.2: Suspend development activity when archaeological and/or paleontological resources are discovered during construction.

3.5 Professional Standards

The Society of Vertebrate Paleontology (SVP), an international scientific organization of professional vertebrate paleontologists, has established standard guidelines (SVP, 2010) that outline acceptable professional practices for conducting paleontological resource assessments and surveys, monitoring and mitigation, data and fossil salvage, sampling procedures, and specimen preparation, identification, analysis, and curation. Most practicing professional paleontologists in the nation adhere closely to the SVP's assessment, mitigation, and monitoring requirements as specifically spelled out in its standard guidelines. The SVP's standard guidelines were approved by a consensus of professional paleontologists and are the standard against which all paleontological monitoring and mitigation programs are judged. Many federal and California state regulatory agencies have either formally or informally adopted the SVP's "standard guidelines" for the mitigation of construction-related adverse impacts on paleontological resources as a measure of professional practice.

4.0 METHODOLOGY

The following documentation was reviewed and evaluated in preparation of the discussion of the environmental setting and evaluation of geologic hazards and potential for paleontological resources to occur:

- Reports and data collected during previous geotechnical investigations of the GSA
- *Eastside Transit Corridor Phase 2 Washington Boulevard Alternative Preliminary Geotechnical Design Report* prepared by Diaz Yourman and Associates (2021)
- Available published and unpublished literature, and consultants' reports within the GSA for known geologic hazards. Documents reviewed included:
  - The safety elements of the general plans for Los Angeles County and cities of Commerce, Montebello, Pico Rivera, Santa Fe Springs, and Whittier
  - The official Alquist-Priolo Earthquake Fault Zone Maps; official Seismic Hazard Zone Maps, geologic and topographic maps, and other publications by the California Geological Survey (CGS), United States Geological Survey (USGS), and California Division of Oil and Gas)
  - The as-built drawings for the bridge crossings along the Rio Hondo and San Gabriel River along Washington Boulevard
- Paleontological records search report from the Natural History Museum of Los Angeles County
- Available published and unpublished literature, and consultants' reports within the GSA for known paleontological resources
- Available descriptions of details of construction of the Build Alternatives

Geologic and seismic impacts pertain to both construction and operational activities. The potential impacts during construction are generally related to failure of temporary structures and safety concerns related to soil stability. The potential for erosion and loss of topsoil is primarily related to the potential for soil disturbance during construction activities but can also be related to operations if soils are exposed following completion of construction. The potential impacts during operations are generally associated with the safety of built elements relative to geologic stability, including safety impacts resulting from an earthquake and exposure to secondary seismic hazards such as ground settlement or liquefication.

Paleontological impacts pertain to ground disturbance activities occurring in paleontologically sensitive geologic units and are therefore, primarily associated with construction activities. Generally, for project sites that are underlain by paleontologically sensitive geologic units, the greater the amount of ground disturbance associated with the project, the higher the potential for impacts to significant paleontological resources to occur. A significant paleontological resource includes any identifiable fossil that is unique, unusual, rare, uncommon, diagnostically or stratigraphically important, and/or those that add to an existing body of knowledge in specific areas – stratigraphically, taxonomically, and/or regionally. The SVP's (2010) asserts that any identifiable vertebrate fossil is a significant paleontological resource. Direct impacts to paleontological resources primarily concern the potential destruction of nonrenewable paleontological resources and the loss of information associated with these resources. This includes the unauthorized collection of fossil remains. If potentially fossiliferous bedrock or surficial sediments are disturbed, the disturbance could result in the destruction of paleontological resources and subsequent loss of information.

The threshold of significance for a significant impact to paleontological resources is defined under **Section 5.0**. The threshold would be reached when a project is determined to "directly or indirectly destroy a significant paleontological resource or unique geologic feature" (CEQA Guidelines Appendix G, Section VII, Part f).

5.0 THRESHOLDS OF SIGNIFICANCE

In accordance with Appendix G of the State CEQA Guidelines, a Build Alternative would have a significant impact related to geology and seismology under the following conditions:

Impact GEO-1: 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 (refer to Division of Mines and Geology Special Publication 42)
- Strong seismic ground shaking
- Seismic-related ground failure, including liquefaction
- Landslides

Impact GEO-2: Result in substantial soil erosion or the loss of topsoil.

Impact GEO-3: 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.

Impact GEO-4: Be located on expansive soil, as defined in Section 1803.5.3 of the CBC,[1] creating substantial direct or indirect risks to life or property.

Impact GEO-5: Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

Appendix G of the State CEQA Guidelines also includes a significance criterion for impacts relating to the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater. The Build Alternatives are in an urban area with an established sewer system. There are no existing or proposed septic tanks or other alternative wastewater disposal system associated with the Build Alternatives; therefore, this criterion is not applicable.

[1] Appendix G of the CEQA Guidelines refers to Table 18-1-B of the Uniform Building Code. That provision no longer exists. Instead, Section 1803.5.3 of the CBC describes the criteria for analyzing expansive soils.

6.0 EXISTING SETTING

6.1 Overview

This section provides an overview and general information for the GSA and DSA, including regional and local geology, faulting and seismicity, and paleontological resources.

6.2 Regional Setting

As described in **Section 1.0**, the Build Alternatives are located within the Gateway Cities area, near the northwest boundary of the Los Angeles Basin in the general vicinity of the Whittier Narrows, a prominent gap in the Puente Hills (see **Figure 2.1**). The Build Alternatives traverse the physiographic features known as the Montebello Plain and Montebello Hills, the Rio Hondo, and the San Gabriel River. Topography along the Garfield Avenue and Washington Boulevard corridor consists of gentle slopes along the side of the valley. A review of the USGS topographic maps of the Los Angeles, El Monte, and Whittier Quadrangles indicate that elevation ranges from 150 to 260 feet based on the North American Vertical Datum of 1988 (NAVD 88) along the Build Alternatives.

6.2.1 Topography and Drainage

The ground surface is generally flat along the Build Alternatives except where it crosses the Rio Hondo and San Gabriel River. Drainage along the Build Alternatives is typically controlled by curbside storm drains and gutters. The two major surface water drainages within the GSA are the Rio Hondo and the San Gabriel River. The Rio Hondo and the San Gabriel River are located in the DSA for Alternative 1 and would be crossed by the alignment. The Rio Hondo and San Gabriel River are not in the DSA for Alternative 2 or Alternative 3 and would not be crossed by the alignment for these two Build Alternatives.

6.2.2 Regional Geology

On a regional scale, the GSA lies within the Peninsular Ranges geomorphic province and adjacent to the Transverse Ranges geomorphic province. The Peninsular Range is bounded by the San Jacinto fault zone to the east, the Pacific Ocean coastline to the west, and the Transverse Ranges geomorphic province to the north. The Peninsular Ranges province is characterized by northwest-trending mountain ranges and hills separated by sub-parallel, sediment-filled valleys. The northwest structural trend manifests in regional structures within the province, such as the Whittier, Newport-Inglewood, and Elsinore fault zones and the northwest trending Elysian Park anticline.

The geologic history of the Peninsular Ranges is complex. In the Cretaceous Period, the Paleozoic to Mesozoic sedimentary and volcanic country rock was intruded by rocks of the California batholith. Uplift of the batholith resulted in the formation of mountain ranges followed by initial periods of nonmarine continental sedimentation and later periods of subsidence and marine and nonmarine sedimentation. Over 10,000 feet of marine sedimentary rocks were deposited in the Los Angeles Basin during subsidence and sedimentation between the middle Miocene and latest Pliocene (Norris and

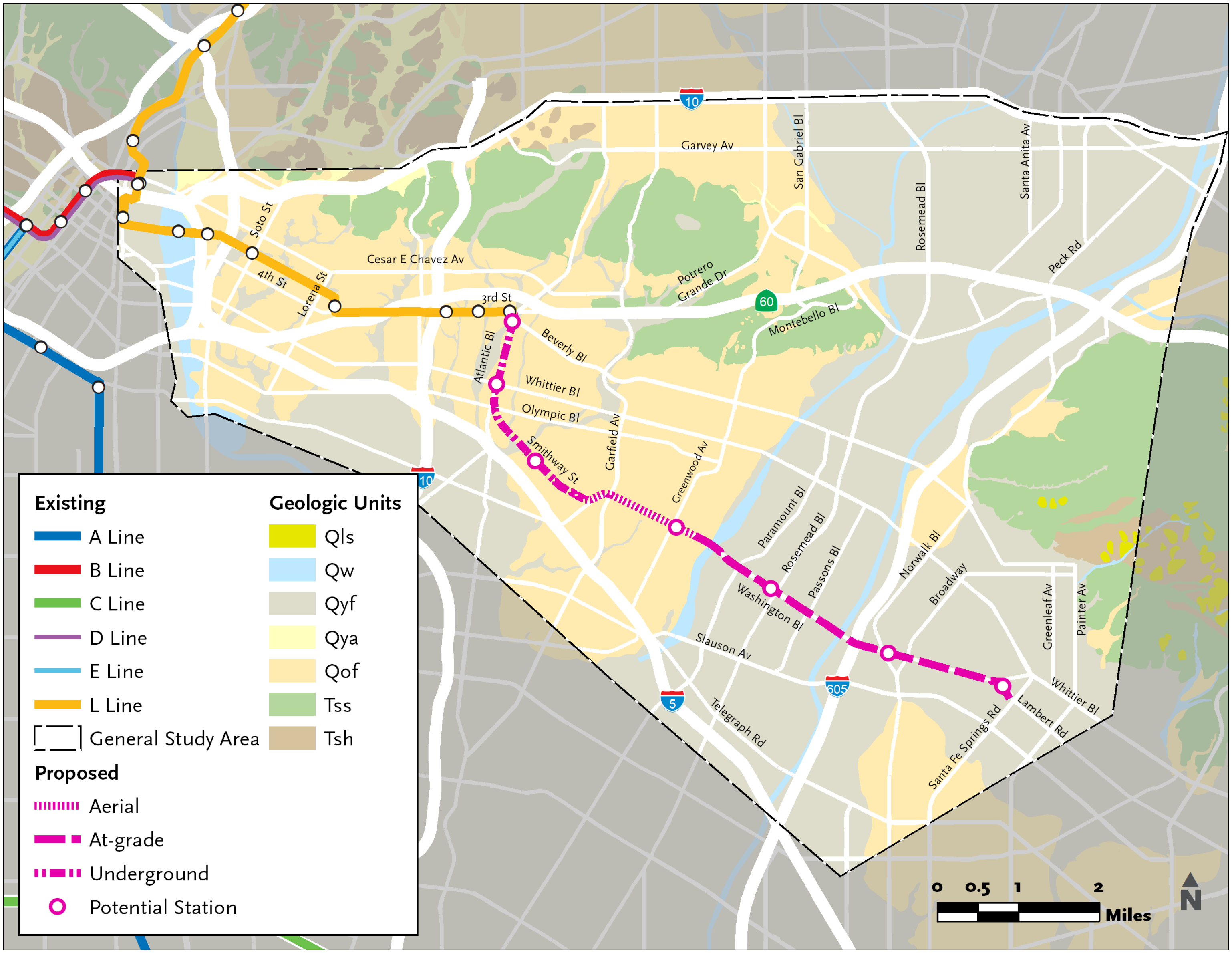
Webb 1990). Bedrock in the GSA consists of silty sandstone of the Pliocene Fernando Formation, one of the uppermost units of the marine sedimentary units filling the Los Angeles Basin. Based on the data review, bedrock is a few hundred to several hundred feet deep in the GSA and is unlikely to be encountered; no bedrock is exposed along the Project alignment. Bedrock is overlain by unconsolidated Quaternary alluvial fan and fluvial deposits. The regional geology in the GSA is shown on **Figure 6.1** (the GSA is the same for all three Build Alternatives, and the figure identifying the geology within the GSA that shows Alternative 1 is applicable to all three Build Alternatives).

The bedrock of the Fernando Formation in the GSA is folded into a series of east-west trending anticline and synclines with bedding striking east-west and shallow to moderately dipping to the south and north of the fold axis (Yerkes and Campbell 2005). The uplift of the Repetto and Puente Hills is quite recent. The San Gabriel River, being an antecedent stream, predates that uplift (Poland and Piper 1956).

There is historical high groundwater along the Build Alternatives, based on recent geotechnical investigations and available historic borehole data presented in the Seismic Hazard Evaluation Reports of the Los Angeles, El Monte, South Gate, and Whittier 7.5-Minute Quadrangles California Department of Conservation, Division of Mines (CDMG) (CDMG 1998a, 1998b, 1998c, 1998d). Historic high groundwater levels with the Project corridor range from approximately 110 feet below ground surface (bgs) on the northwest at Atlantic Boulevard, to 50 to 60 feet bgs at the end of Washington Boulevard. To the west of Montebello Boulevard, the historical high groundwater is generally deeper than 50 feet bgs. Groundwater becomes shallower, as shallow as approximately 15 feet bgs, in the vicinity of the Rio Hondo and the San Gabriel River, based on the *Eastside Transit Corridor Phase 2 Washington Boulevard Alternative Preliminary Geotechnical Design Report*, dated July 2021. It should be noted that fluctuations in the groundwater levels could occur due to changes in seasons, precipitation, irrigation, groundwater pumping in the vicinity, and other factors.

6.2.3 GSA Geologic Units

The main geologic units along the Build Alternatives are taken from the mapping of Bedrosian and Roffer (2012) and discussed below (refer to **Figure 6.1**). Geotechnical work for the Build Alternatives indicates bedrock is a few hundred to several hundred feet deep in the GSA and is unlikely to be encountered (Diaz-Yourman & Associates 2021).



Source: Metro; CDM Smith/AECOM JV, 2021.

Figure 6.1. GSA Geology Map

6.2.3.1 Landslide Deposits (Qls)

Landslide deposits (late Holocene) are slope-failure deposits that consist of displaced bedrock blocks and/or chaotically mixed rubbles. These deposits exist near the toe of hills the east boundary of the GSA. Most deposits are probably active or recently active.

6.2.3.2 Wash Deposits (Qw)

Wash deposits are associated with the action of active or recently active stream beds and include some debris flow deposits. Areas delineated by this unit are frequently exposed to episodes of bank-full stream flow and support heavy vegetation. The hydrologic actions of the streams or rivers result in deposits of unconsolidated gravel, sand, and silt which are present in active or recently active reaches. Wash deposits are anticipated in the immediate vicinity of the Rio Hondo and the San Gabriel River.

6.2.3.3 Young Alluvial Fan Deposits (Qyf)

Young alluvial fan deposits (Holocene and late Pleistocene) generally consist of unconsolidated to slightly consolidated boulder, cobble, gravel, sand, and silt deposits issued from a confined valley or canyon. These deposits include all soils in the project vicinity east of the Rio Hondo.

6.2.3.4 Young Deposits of Axial Valley Floors (Qya)

Young deposits of axial valley floors (Holocene and late Pleistocene) consist of slightly to moderately consolidated sand and pebble-cobble gravel. These deposits exist near the west portion of the northern boundary of the GSA in small areas.

6.2.3.5 Old Alluvial Fan Deposits, Undivided (Qof)

Old alluvial fan deposits (late to middle Pleistocene) consisting of slightly to moderately consolidated silt, sand, and gravel deposits. These deposits are anticipated along Washington Boulevard extending near Rio Hondo to the west and essentially covering the Build Alternatives west of Rio Hondo.

6.2.3.6 Tertiary Sandstone (Tss)

Tertiary sandstone, the bedrock represented by the Fernando Formation, exists in the portion of the Montebello Hills north of the Build Alternatives and in the portion of the Hacienda Hills east of the Build Alternatives. Based on the data review, bedrock is a few hundred to several hundred feet deep at the Build Alternatives and is unlikely to be encountered.

6.2.3.7 Tertiary Shale and Siltstone (Tsh)

Tertiary shale and siltstone, the bedrock also represented by the Fernando Formation, exist in the portion of the Hacienda Hills east of the Project alignment. The bedrock is deep near the Build Alternatives and is unlikely to be encountered.

6.2.4 GSA Geologic Conditions

Based on the review of the data available, the subsurface soils along the Build Alternatives mainly consist of layers or mixtures of sands, silts, and clays.

Collapsible soils are generally unsaturated soil that goes through a radical rearrangement of particles and great decrease in volume upon wetting, additional loading, or both. Based on review of the data currently available, there are no known collapsible soils along the Build Alternatives.

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 GSA.

Consolidation is the soil settlement due to expulsion of pore water in saturated clay resulting in rearrangement of soil particles. Consolidation settlement occurs in clay, especially in unconsolidated or normally consolidated soft clay when the soil is loaded. Although clay-rich soils may exist locally in the GSA, consolidation settlement may occur within the GSA.

A limited number of corrosion tests were performed from samples collected from the limited field exploration conducted for the design phase of the Project. The on-site soils at the site-specific boring locations do not pose a corrosive environment.

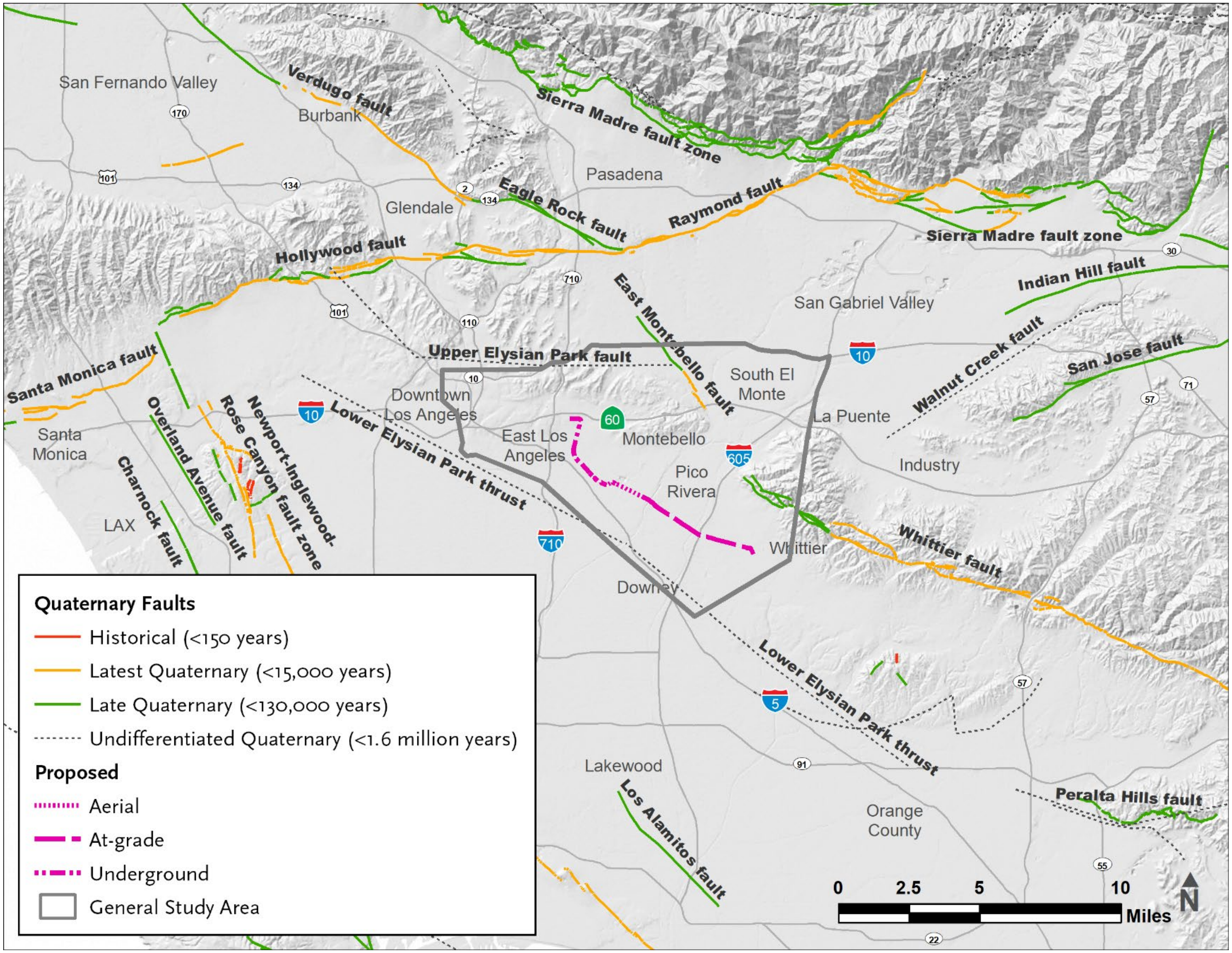
In California, most of the large area land subsidence is a result of excessive groundwater pumping. Based on the map illustrating areas of recorded subsidence — historical and current — across California, the Build Alternatives are not located within a subsidence area (USGS 2022).

6.3 Faulting and Seismicity

6.3.1 General Settings

The primary impacts that could result from faulting and seismicity are surface rupture of the earth along fault traces and damage to structures due to seismically-induced ground shaking. There are numerous faults in Southern California including active, potentially active, and inactive faults. The fault classification system is based on criteria adopted by the CGS for the Alquist-Priolo Earthquake Zoning Program. An active fault is one that has had surface displacement within Holocene time (about the last 11,000 years). A potentially active fault is a fault that has demonstrated surface displacement of Quaternary age deposits (last 1.6 million years). The Quaternary period began 2.6 million years ago and extends into the present. Inactive faults have not moved in the last 1.6 million years. Active faults that are located within 20 miles of the Build Alternatives are discussed below with respect to their known activity status and location relative to the closest point of the proposed alignment.

The location of the GSA and the Build Alternatives in relation to known regional fault systems is shown in **Figure 6.2**. There is one Alquist-Priolo Earthquake Fault zone within the GSA, which includes the East Montebello Fault approximately 4 miles northeast, as shown in **Figure 6.3**.



Source: Metro; CDM Smith/AECOM JV, 2021.

Figure 6.2. Regional Faults

Source: Metro; CDM Smith/AECOM JV, 2021.

Figure 6.3. Alquist-Priolo Earthquake Fault Zone for the East Montebello Fault

6.3.2 Active Faults

Holocene active faults within 20 miles from the closest point of the Build Alternatives are presented in **Table 6-1**. The Holocene active fault with surface expression closest to the Build Alternatives is the Whittier Fault, which is one of the two upper branches of the Elsinore fault zone, located within the GSA approximately 2.8 miles to the northeast of the eastern terminus of the Build Alternatives.

Active blind thrust faults in vicinity of the Build Alternatives are discussed separately in **Section 6.3.4**.

Table 6-1. Holocene Active Fault Distance (miles) from Proposed Alignment

Fault	Distance from Build Alternatives
East Montebello Fault (Alhambra Wash Fault)	4.0
Whittier Fault	2.8
Raymond Fault	6.0
San Jose Fault	9.5
Hollywood Fault	8.8
Verdugo Fault	9.3
Sierra Madre Fault	10.7
Clamshell-Sawpit Fault	12.0
Newport-Inglewood Fault	10.0
Santa Monica Fault	15.3
Palos Verdes Fault	20.0
San Andreas	>30

Source: Based on the *Eastside Transit Corridor Phase 2 Washington Boulevard Alternative Preliminary Geotechnical Design Report* prepared for Metro by Diaz-Yourman & Associates, July 2021.
Note:
Distances are given as distances from the nearest point along Alternative 1, Commerce MSF site option, or Montebello MSF site option.

6.3.3 Potentially Active Faults

The inferred trace of the MacArthur Park Fault is in the Los Angeles downtown area approximately 5 miles northwest of the western terminus of Build Alternatives. The fault has not been definitively proven to exist. It is inferred west of downtown Los Angeles and has been located based on south-facing scarps, truncated drainages, and other geomorphic features (Dolan and Sieh 1992). The Eagle Rock Fault, a late Pleistocene active fault, is located approximately 10 miles to the north of the Build Alternatives.

6.3.4 Blind Thrust Fault Zones

Blind thrust faults are faults that do not rupture all the way up to the Earth's surface and do not show evidence on the ground. They are buried under the uppermost layers of rock in the Earth's crust; consequently, they are typically characterized as fault zones or fault systems without designation of specific mapped fault lines. Several buried thrust faults, commonly referred to as blind thrusts, underlie the Los Angeles Basin at depth. These faults are not exposed at the ground surface and are typically identified at depths greater than 3 kilometers (1.86 miles). These faults do not present a potential surface fault rupture hazard; however, they are considered active and potential sources for future earthquakes. As is the case with many cities in the region, the Build Alternatives sit atop the Puente Hills blind thrust fault, which is the source of the 1987 Whittier Narrows earthquake. Previously defined as the Elysian Park Fold and Thrust Belt, the Elysian Park Thrust was thought to extend northwesterly from the Santa Ana Mountains to the Santa Monica Mountains, extending westerly to parallel the Santa Monica-Hollywood and Malibu Coast faults. The Elysian Park Thrust is now believed to be smaller, only underlying the central Los Angeles Basin and north of the State Route 60 Freeway.

Both the Puente Hill and the Elysian Park Thrusts are considered as active features capable of generating future earthquakes with associated significant ground shaking and possible deformation of the near surface materials.

6.3.5 Seismic Hazards

The potential to experience substantial seismic ground shaking is a common hazard for every project in Southern California. Structures (aerial, at-grade, and underground) have been and continue to be successfully designed and constructed based on mandatory design criteria. During a moderate to severe earthquake occurring on the nearby faults, strong ground shaking within the GSA would likely occur. In addition to ground shaking, effects of seismic activity on a project site may include surface fault rupture, soil liquefaction, and seismically induced differential settlement of structures, and landslides.

6.3.5.1 Ground Shaking

Seismic hazards that could affect the Build Alternatives include ground shaking from an earthquake along one of the several major active faults in the region. The magnitude of ground shaking is generally characterized by using the peak ground acceleration (PGA), measured as a percentage of gravity (g).

The design criteria used by Metro (MRDC, Section 5 Structural/Geotechnical, Rev 12, November 20, 2017) requires a two-level seismic evaluation approach to seismic design based on the ODE and MDE. The ODE is defined as the earthquake event with a 50 percent probability of exceedance in 100 years (recurrence interval of 150 years). Such event can reasonably be expected to occur during the 100-years design life of the Project. The MDE is defined as the earthquake event with a four percent probability of exceedance in 100 years, which corresponds to an average recurrence interval of 2,500 years. The two-level approach requires the design to provide a high-level of assurance that the overall system will continue to operate during and after an ODE. Operating procedures assume safe shut down and inspection before returning to operation. Furthermore, the system design will provide a high-level of assurance that public safety will be maintained during and after an MDE.

In comparison, the 2019 CBC uses two percent probability of exceedance in 50 years as the basis for seismic design requirements. In general, the PGA is lower for an event with a higher probability of occurrence under the same return period.

The PGA for the ODE and MDE were developed using the ground motions obtained from the 2019 edition of the USGS Earthquake Hazards Program Unified Hazard Tool with 5 percent damped acceleration response spectra. The average shear wave velocities over the upper 30 meters were determined from review of the local geology and limited available boring data in the general area. An average shear wave velocity of 300 meters per second was used for the evaluation. The results at selected locations along the Build Alternatives are presented in **Table 6-2**. Higher PGAs are associated with greater earthquake magnitude and stronger shaking.

Table 6-2. Potential Ground Motion Along Proposed Alignment, PGA (g)

Event	Atlantic Boulevard and Pomona Boulevard	Via Campo and Garfield Avenue	Garfield Avenue and Washington Boulevard	Washington Boulevard and Lambert Road
Operable Design Earthquake (ODE)	0.33	0.33	0.33	0.33
Maximum Design Earthquake (MDE)	1.07	1.07	1.07	1.07

Source: Based on the *Eastside Transit Corridor Phase 2 Washington Boulevard Alternative Preliminary Geotechnical Design Report* prepared for Metro by Diaz-Yourman & Associates, July 2021.

6.3.5.2 Liquefaction

Liquefaction-induced ground failure has historically been a major cause of earthquake damage in Southern California. Significant damage to roads, utilities, pipelines, and buildings during the 1971 San Fernando and 1994 Northridge earthquakes was caused by liquefaction-induced ground displacement. Localities most susceptible to liquefaction-induced ground displacement are underlain by loose, water-saturated, granular sediment within 50 feet of the ground surface. Liquefaction susceptibility generally decreases as the percentage of clay size particles in the soil increases and/or the coarse sand and gravel content increases.

In portions of the GSA, sediments susceptible to liquefaction comprise the young (Holocene to late Holocene age) alluvial fan deposits and the wash sediments. The older alluvial deposits are generally medium dense to dense and are considered by the CGS, previously CDMG (1998a, 1998b, 1998c, 1998d) to have a low liquefaction susceptibility.

The CGS has prepared seismic hazard maps for the Los Angeles Basin. The maps delineate liquefaction zones which have been defined by the CGS as areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacement such that mitigation would be required. The CGS uses criteria developed by the Seismic Hazard Mapping Act Advisory Committee in delineating liquefaction zones on the seismic hazard maps. In areas of limited or no geotechnical data, susceptibility zones are evaluated using a combination of geologic considerations. The CGS has rated the liquefaction susceptibility for the Holocene age sediments in the GSA as high, if saturated within 40 feet of the ground surface and, if not saturated, the susceptibility is rated as low. In contrast, the liquefaction susceptibility of older alluvial deposits is rated as low or not likely irrespective of groundwater levels.

CGS has identified Holocene sediments along Alternative 1 between South Bluff Road and the eastern terminus at Lambert Road to be within a potential liquefaction zone. The potential liquefaction zones are delineated on **Figure 6.4**. Alternative 2, Alternative 3, and the MSF site options are not within the liquefaction zone.

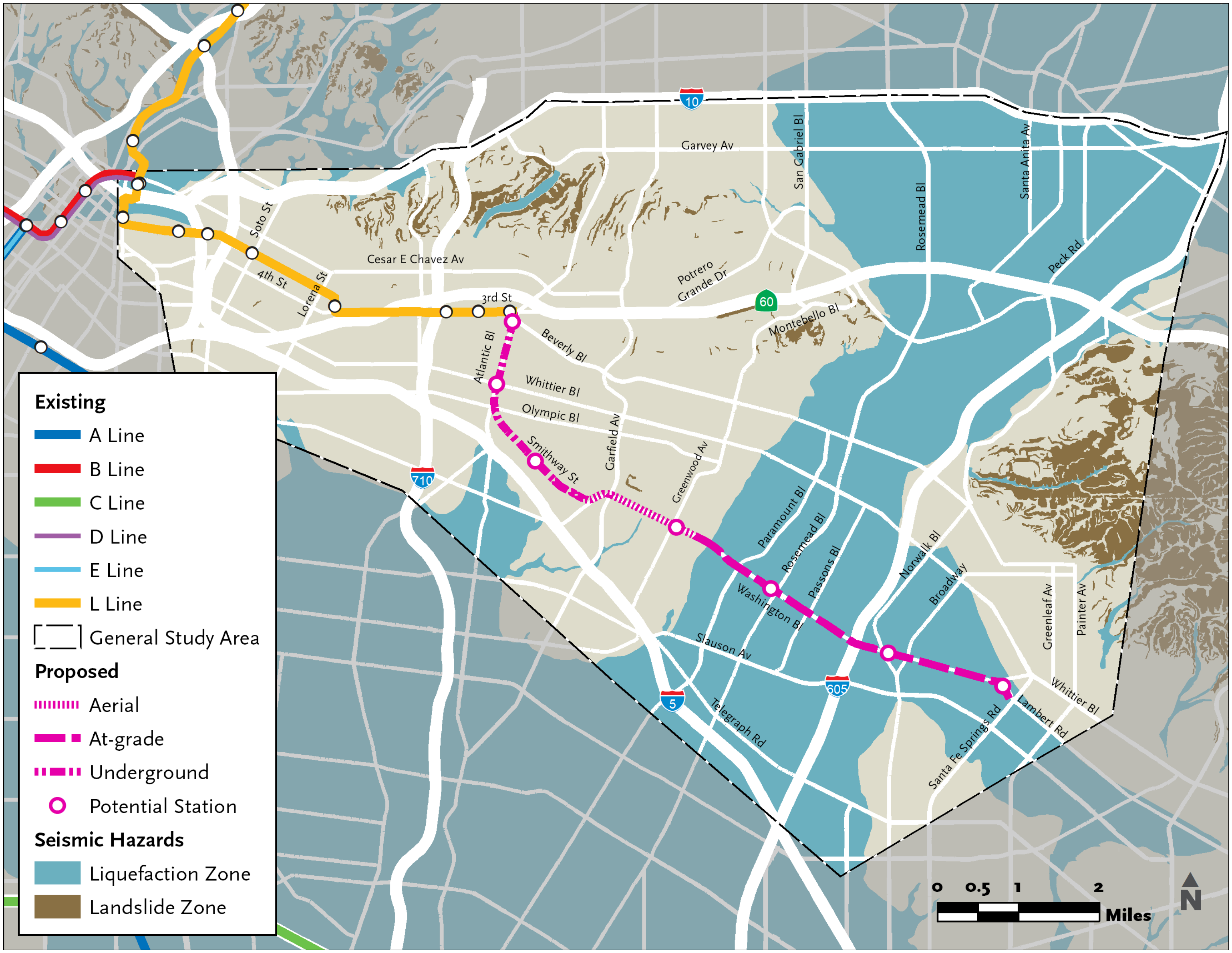
6.3.5.3 Settlement

Seismically-induced settlement consists of compression of the dry soils above groundwater and liquefaction-induced settlement of the liquefiable soils below groundwater. These settlements occur primarily within the loose to moderately dense sandy soils due to volume reduction during or shortly after an earthquake event. Such settlement can result in structural distress as the ground settles. Accordingly, the portion of Alternative 1 that is mapped within the liquefiable zone and underlain by wash deposits and the young alluvial fan deposits has the potential to experience seismically-induced settlement.

Additionally, the upper soils along the at-grade segment of Alternative 1 consist of predominately young alluvial fan deposits, which could be subject to settlement. Alternative 2 and Alternative 3 are not located in the area mapped to have the potential to experience liquefaction and seismically-induced settlement.

6.3.5.4 Landslides

The Build Alternatives are not located within a mapped earthquake-induced landslide zone as shown on **Figure 6.4**. In general, the Build Alternatives are located on relatively level ground and the potential for landslides to affect the Build Alternatives is low. However, for Alternative 1, the potential for lateral spread landslide may exist within the liquefaction-susceptible area nearby the Rio Hondo and San Gabriel River, as ground surfaces consist of gentle slopes at these two locations. Lateral spreading of the ground surface can occur during a seismic activity when potentially liquefiable soil is present in conjunction with a sloping ground surface and a "free" face (e.g., retaining wall, slope, or channel). When the soil undergoes a temporary loss of strength, and if the liquefiable soil is not contained laterally, it may result in deformation or translation of the slope. Lateral spread potential may also exist in the vicinity of open faces.



Source: Source: CDMG, Seismic Hazard Zone Maps for El Monte, Los Angeles, South Gate, and Whittier 7.5 Minute Quadrangles, Details below.

Figure 6.4. Liquefaction and Landslide Hazard Zone Map

6.4 Paleontological Resources

6.4.1 Paleontological Potential

Paleontological potential is defined by the SVP Uniform Guidelines rank geologic units according to Paleontological Potential (SVP 2010). Rock units are described as having (a) high, (b) undetermined, (c) low, or (d) no potential for containing significant paleontological resources. These ratings ultimately determine the degree of mitigation necessary to offset construction impact.

Only three geologic units occur along the Build Alternatives (**Figure 6.1**). These are old alluvial fan deposits, the young alluvial fan deposits, and wash sediments.

6.4.2 Paleontological Records Search

A paleontological records search was solicited from the Natural History Museum of Los Angeles County. Of the three most pertinent localities from that report, two are west and northwest of the Build Alternatives between Atlantic station (relocated/reconfigured) and Commerce/Citadel station. These are at a depth of 20 to 35 feet. Two localities are in the old alluvial fan deposits. They produced mastodon, horse, deer, sabertooth cat, and turkey fossils. The third locality is south-southwest of the Build Alternatives and lies in the young alluvial fan deposits. At a level of 30 feet bgs, it produced fish, snake, rodent, and rabbit fossils. The detection of bones of these small organisms indicates that these fossils were obtained by the screening of sediment samples. It should be noted that fish fossils in this deposit raise questions about the identification of the sediments as alluvial fan deposits. All fossils from these localities are of Pleistocene age.

6.4.3 Paleontological Literature Search

A search of paleontological literature yielded no published records of localities near the Build Alternatives. However, there was one recent unpublished report of a fossil bison just north of Beverly Boulevard on the west bank of the San Gabriel River (ESA 2020). It was found at 18 feet bgs. This site lies within the young alluvial fan deposits, north of the proposed Norwalk station.

6.4.4 Assignment of Paleontological Potential to Units

There have been relatively few projects in the GSA that were monitored for paleontological resources. Furthermore, the professional guidelines instructing screening of samples from fine-grained sediment has not been employed in many contexts where it should have been. When it is followed in ancient fine-grained sediments of the Los Angeles basin, it often produces microvertebrate fossils of fish, amphibians, reptiles, and small mammals such as rodents and rabbits. As mentioned in **Section 6.4.2**, one of the fossil localities in the young alluvial fan deposits produced such microbertebrate fossils as a result of sediment screening. Thus, the sparse localities which can be demonstrated to have produced significant paleontological resource in the GSA do not necessarily indicate that fossils are rare in the GSA.

6.4.4.1 Paleontological Potential by Geologic Unit

6.4.4.1.1 Alluvial Wash Deposits (Qw)

Alluvial wash deposits consist of unconsolidated sandy and gravelly sediments deposited in recently active channels of streams and rivers. The alluvial wash deposits are of Holocene age. These sediments are encountered only where Washington Boulevard crosses the Rio Hondo and San Gabriel River. There is no evidence of significant paleontological resources having been found in alluvial wash deposits. Therefore, even though SVP guidelines (SVP 2010) recognize early Holocene vertebrate fossils as significant paleontological resources, this area represents a low paleontological potential.

6.4.4.1.2 Young Alluvial Fan Deposits (Qyf)

As discussed under **Section 6.2.3.4**, the young alluvial fan deposits (Holocene and late Pleistocene) generally consist of unconsolidated gravel, sand, and silt; deposited primarily by flooding streams. These deposits include all soils in the project vicinity east of the Rio Hondo (with the exception of wash deposit sediments in the San Gabriel River). Paleontological potential would increase with depth (as depth approaches Pleistocene levels) as evidenced by the two young alluvial fan deposits localities identified in paleontological records search and literature search. One is at 30 feet, and one is at 18 feet bgs. Thus, this unit is assigned a low paleontological potential near the surface, but a high potential below 10 feet.

6.4.4.1.3 Old Alluvial Fan Deposits, Undivided (Qof)

As discussed under **Section 6.2.3.5**, old alluvial fan sediments (late to middle Pleistocene) generally consist of slightly to moderately consolidated silt, sand, and gravel deposits are anticipated along Garfield Avenue (including the tunnel section) and along Washington Boulevard extending from Garfield Avenue to South Bluff Road. The fossil from one of the two localities in this unit was found at depth of between 20 and 35 feet. The depth at which the fossils of the other locality were found is unknown, but even the near-surface sediments are of Pleistocene age. These findings confirm the assumption that the entire unit, including undisturbed sediments near the surface, should be assigned a high paleontological potential.

6.4.4.2 Potential by Project Section

The following describes the paleontological potential by sections of the Build Alternatives.

6.4.4.2.1 Atlantic to Citadel Section

As this section is entirely within old alluvial fan deposits, the section is ranked high sensitivity; this is especially true because this section would be subject to TBM use. The tunnel location is likely to be entirely within previously undisturbed sediments.

6.4.4.2.2 Citadel to Greenwood Avenue

This section is entirely within old alluvial fan deposits and is ranked high sensitivity.

6.4.4.2.3 Greenwood Avenue to Santa Fe Springs Road

The western portion of this section (from Greenwood Avenue to the Rio Hondo) lies within old alluvial fan deposits. This portion has high potential for paleontological resources. The remainder of this section, from the west bank of Rio Hondo to Santa Fe Springs Road, lies within young alluvial fan deposits sediments, and has low paleontological potential near the surface, increasing to high potential below a depth of 10 feet.

7.0 IMPACTS

This section provides an evaluation of impacts related to the identified potential geologic hazards and paleontological resources. Both construction and operational impacts are discussed. All impacts pertain primarily to construction activities. Only earthquakes (seismic hazards) concern operations.

7.1 Impact GEO-1: Exposure to Seismic Hazards

Impact GEO-1: Would a Build Alternative 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 (refer to Division of Mines and Geology Special Publication 42)
- Strong seismic ground shaking
- Seismic-related ground failure, including liquefaction
- Landslides

7.1.1 Alternative 1 Washington

7.1.1.1 Operational Impacts

Rupture of a Known Earthquake Fault and Seismic Shaking

As discussed in **Section 6.2,** Alternative 1 would does not cross any known Holocene active faults. The Whittier fault is the closest Holocene active fault with surface expression; it is approximately 2.8 miles northwest of the eastern terminus of the Alternative 1. The closest Alquist-Priolo Earthquake Fault zone is for the East Montebello Fault, approximately 4.0 miles to the northeast. Because there are no known active faults capable of ground rupture under the Project alignment, fault rupture would not present a risk, including the risk of loss, injury, or death.

Alternative 1 is located in a seismically active area, as is most of southern California and, thus, operation of Alternative 1 would potentially be subject to seismic ground shaking. Seismic shaking could result in damage to structures or human injury or death. For the Build Alternatives, seismic shaking could result in damage to aerial structures and stations, at-grade guideway and stations, and underground tunnel guideway sections and stations. Seismic shaking could also injure humans using the system from falls to the ground or structural collapse. The potential to experience substantial seismic ground shaking is a common hazard for every project in Southern California. Structures (aerial, at-grade, and underground) have been and continue to be successfully designed and constructed based on mandatory design criteria. Specifically, regarding the underground portion of the alignment, experience in California and worldwide shows that bored tunnels generally perform well during earthquake ground shaking, typically suffering less damage than surface structures. Because they are embedded in the ground, they move with the ground, and thus their motion is not magnified by the pendulum effect that occurs when an above-ground structure is shaken by an earthquake (Hashash et al. 2001).

To address potential seismic hazards, including development of site-specific design parameters to account for seismic shaking, Alternative 1 would be designed and constructed in conformance with the MRDC as set forth in PM GEO-1 identified in **Section 8.0.** Additionally, Alternative 1 would be designed and constructed in conformance with applicable portions of building and seismic code requirements including the most recent edition of the CBC, Metro's standard specifications, and industry standards. Consistent with MRDC and SDC requirements, Project structures would be designed to perform in accordance with the two-level seismic evaluation approach based on the MDE and ODE PGA identified in **Table 6-2**. Additionally, as described in **Section 3.4.1**, the design criteria (MRDC, Caltrans Seismic Design Criteria, Los Angeles County Building Code/CBC, or equivalents) dictate the ARP that would be used in the design. Aerial, at-grade, and underground structures would be designed and would perform in accordance with the thresholds indicated in **Section 3.4.1** for seismicity. Compliance with the latest earthquake-resistant building design standards would substantially reduce potential structural damage and the risk to public safety from seismic events.

Additionally, PM GEO-1 sets forth project compliance with MRDC Section 5, Structural; SDC (2017) which dictate that during final design, a geotechnical investigation must be conducted, including detailed and site-specific evaluation of geotechnical hazards. Structural engineering standards to address geological conditions are part of standard construction requirements and standard construction practices. The resulting final geotechnical engineering recommendations and any additional recommendations that come out of the review process would be incorporated into the final design plans consistent with standard practice to address any unstable geologic and related conditions present along the alignment. The project would be designed to perform in accordance with the MDE and ODE thresholds. As described, the design criteria (MRDC, Caltrans Seismic Design Criteria, Los Angeles County Building Code/CBC) provide the design framework, including the ARP and shaking intensity. Compliance with these requirements and industry standards would ensure that strong seismic ground shaking would not cause potential substantial adverse effects, including the risk of loss, injury, or death.

Seismic-Related Ground Failure, Liquefaction, and Landslides

As discussed in **Section 6.4.2**, there is also the potential for liquefaction in the portion of the proposed at-grade configuration underlain by young alluvial fan deposits from South Bluff Road to the eastern terminus of the alignment. In the portion of the alignment within a mapped liquefiable zone and younger alluvial fan deposits, including the proposed stations at Rosemead Boulevard, Norwalk Boulevard, and Lambert Road, and the associated parking facilities, there would be potential for adverse effects from liquefaction and seismically-induced settlement. This portion of the alignment would be at-grade. Seismic-related ground failure, liquefaction, and landslides could result in damage to structures and human injuries. Ground instability could impact structural stability which in turn could damage structures or injure humans occupying structures on unstable ground. The aerial portion and the underground portion of the alignment are predominately in the old alluvium where the potential for adverse impact due to liquefaction is considered low. Further, the aerial portion of the alignment would be supported on a deep foundation system to minimize risk. There would be potential for adverse effects from liquefaction and seismically-induced settlement along the at-grade configuration and stations underlain by young alluvial fan deposits from South Bluff Road to the eastern terminus of the alignment.

PM GEO-1 would be implemented. This project measure identifies that the Build Alternatives would be designed in accordance with design standards specific to ground stability. As set forth in PM GEO-1, a geotechnical investigation would be performed during final design; the required design-level geotechnical investigations would provide information pertaining to the depths and areal extents of potential liquefaction, lateral spread, and seismically induced settlement. During the design process, if it is determined that these hazards could result in an unacceptable soil or structural response (to be defined during final design and dependent on the type of structure), ground improvements such as dynamic compaction, stone columns, jet grouting, and cement deep soil mixing and compaction grouting or deep foundation support to account for liquefaction, lateral spread, or seismically induced settlement potential would be implemented consistent with the recommendations contained in the geotechnical investigation and design standards provided in **Section 3.4.1**.

While Alternative 1 is on relatively level ground with a low potential for landslides, lateral spread landslide potential may exist nearby the Rio Hondo and San Gabriel River where ground surfaces consist of gentle slopes. Lateral spreading would be further investigated during the design phase when site-specific data and final geometry of improvements are available consistent with requirements identified **Section 3.4.1**. The preliminary geotechnical design report has identified that shallow foundations would likely not be suitable at the site for the replacement of the Rio Hondo and San Gabriel River Bridges, and that similar to the existing bridges, the bridges would be supported on deep foundations (Diaz-Yourman & Associates 2021). The foundation types would be determined as part of the required geotechnical investigation conducted during the final design phase and would ensure that the potential for lateral spread landslide would not cause potential for substantial adverse effects, including the risk of loss, injury, or death. Foundation types may include deep foundation cast-in-drilled-hold (CIDH) concrete piles for drilled foundations and steel H-piles for driven piles for aerial structures, steel driven H-piles or CIDH for bridge supports, mat foundations with a 50- to 60-foot excavation for underground stations, embedded track on structure slab for track work, and CIDH concrete piles or other shallow foundation designs specific to the structure type for other miscellaneous structures.

Summary

As discussed above and identified in **Section 3.0**, Alternative 1 would be designed in compliance with regulatory requirements, industry standards, and the MRDC as identified in PM GEO-1; compliance with these regulatory and design requirements would reduce potential impacts by ensuring that development is designed to withstand seismic or other geologic hazards. Therefore, Alternative 1 would not indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure, including liquefaction, and landslides. The impact would be less than significant.

Design Options

Atlantic/Pomona Station Option

Alternative 1 with the Atlantic/Pomona Station Option would not have seismic risks that differ from the base Alternative 1. The Atlantic/Pomona Station Option would potentially be subject to seismic ground shaking, but it is not located within a liquefaction zone. As identified in PM GEO-1, the Atlantic/Pomona Station Option would be designed in compliance with regulatory requirements and the MRDC and would be the subject of a site-specific geotechnical evaluation during the final design phase that would include specific structural engineering recommendations. Because of compliance with these regulatory and design requirements and engineering standards, operation of Alternative 1 with the Atlantic/Pomona Station Option would not cause potential substantial adverse effects, including the risk of loss, injury, or death from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides. Therefore, the impact would be less than significant.

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the operational impacts from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure, including liquefaction, and landslides would be similar to those described under the base Alternative 1 with an aerial configuration at this location. Alternative 1 with the Montebello At-Grade Option would be potentially subject to seismic ground shaking, but it is not located within a liquefaction zone. As identified in PM GEO-1, the Montebello At-Grade Option would be designed in compliance with regulatory requirements and the MRDC and would be the subject of a site-specific geotechnical evaluation during the final design phase that would include specific structural engineering recommendations. As with the base Alternative 1 with an aerial configuration at this location; because of compliance with these regulatory and design requirements and engineering standards, Alternative 1 with the Montebello At-Grade Option would have less than significant operational impacts relative to known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides.

7.1.1.2 Construction Impacts

Rupture of a Known Earthquake Fault and Seismic Shaking

Construction activities for Alternative 1 would involve temporary excavation shoring, foundation support installation and earthwork along the alignment. Additionally, cut-and-cover excavation, roadway decking, temporary shoring, mass excavation, and underground construction would occur along Smithway Street at the TBM launching pit and then the TBM receiving pit west of Atlantic Boulevard and south of Pomona Boulevard. Alternative 1 would not cross any known active faults. The Whittier fault is the Holocene active fault with surface expression that is closest to the Build Alternatives; it is approximately 2.8 miles northwest of the eastern terminus of Alternative 1.

Alternative 1 is located in a seismically active area, thus, construction of Alternative 1 would potentially be subject to seismic ground shaking which could result in damage to structures and human injury. To address potential seismic hazards, Alternative 1 would be constructed in compliance with the MRCD as identified in PM GEO-1, applicable portions of building and seismic code requirements including the most recent edition of the CBC, Metro's standard specifications, and industry standards. These requirements include development of site-specific design parameters to account for seismic shaking. Adherence with the latest seismic safety parameters would substantially reduce potential structural damage and the risk to public safety from seismic events.

Seismic-Related Ground Failure, Liquefaction, and Landslides

In the portion of the proposed alignment within a mapped liquefiable zone, including the proposed stations at Rosemead Boulevard, Norwalk Boulevard, and Lambert Road, there would be potential for adverse effects from liquefaction and seismically-induced settlement. Additionally, lateral spread landslide potential may exist nearby the Rio Hondo and San Gabriel River where ground surfaces consist of gentle slopes. Consequently, construction of the Build Alternatives could subject people and structures to unstable ground which would result in damage to structures or human injury.

PM GEO-1 identifies that the Build Alternatives would be designed and constructed in accordance with design standards and the regulatory requirements defined in **Section 3.0**, including state regulations and the MRDC, to account for the potential effects of liquefaction and seismic settlement.

As identified in the PM GEO-1, a geotechnical investigation would be performed during final design in compliance with the MRDC; the geotechnical investigation to be conducted during final design, as discussed in **Section 7.1.1.1**, would include structural engineering standards and recommendations for temporary construction activities to address geological conditions, including recommendations on sloping or shoring to ensure stability of temporary excavations. The investigation would provide information pertaining to the depths and extent of liquefaction and an estimate of the anticipated ground deformation associated with liquefaction, lateral spread, and induced settlement. Depending on the findings of the investigation, various ground improvements would be implemented to minimize risks consistent with design standards, including dynamic compaction, stone columns, jet grouting, cement deep-soil mixing, and compaction grouting. The results of the geotechnical investigation would inform the design parameters for structural integrity and ground stability and thereby minimize risks associated seismic-related ground failure, liquefaction, and landslides.

Summary

Compliance with requirements and industry standards as described in PM GEO-1 would ensure that Alternative 1 would not cause potential substantial adverse effects, including the risk of loss, injury, or death during construction. Construction of Alternative 1 would not cause potential substantial adverse effects, including the risk of loss, injury, or death from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides. Therefore, the impact would be less than significant.

Design Options

Atlantic/Pomona Station Option

Alternative 1 with the Atlantic/Pomona Station Option would not have seismic risks that differ from the base Alternative 1. The Atlantic/Pomona Station Option would be potentially subject to seismic ground shaking, but it is not located within a liquefaction zone. The Atlantic/Pomona Station Option would be designed and constructed in compliance with regulatory requirements, industry standards and the MRDC, and would be the subject of a site-specific geotechnical evaluation during the final design phase that would include specific structural engineering recommendations. Compliance with regulatory and design requirements as identified in PM GEO-1 and described under the base Alternative 1, would reduce potential impacts by ensuring that development is designed to withstand seismic or other geologic hazards. Construction of Alternative 1 with the Atlantic/Pomona Station Option would not cause potential substantial adverse effects, including the risk of loss, injury, or death from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides. Therefore, the impact would be less than significant.

Montebello At-Grade Option

Alternative 1 with the Montebello At-Grade Option would not have seismic risks that differ from the base Alternative 1. Alternative 1 with the Montebello At-Grade Option would be potentially subject to seismic ground shaking, but it is not located within a liquefaction zone. The Montebello At-Grade Option would be designed and constructed in compliance with regulatory requirements, industry standards and the MRDC, and would be the subject of a site-specific geotechnical evaluation during the final design phase that would include specific structural engineering recommendations. Compliance with regulatory and design requirements as identified in PM GEO-1 and described under the base Alternative 1, would reduce potential impacts by ensuring that development is designed to withstand seismic or other geologic hazards. Construction of Alternative 1 with the Montebello At-Grade Option would not cause potential substantial adverse effects, including the risk of loss, injury, or death from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides. Therefore, the impact would be less than significant.

7.1.2 Alternative 2 Atlantic to Citadel IOS

7.1.2.1 Operational Impacts

Rupture of a Known Earthquake Fault and Seismic Shaking

Alternative 2 does not cross any known faults capable of ground rupture. The closest Alquist-Priolo Earthquake Fault zone is for the East Montebello Fault, located approximately 4 miles northeast from Alternative 2. Because there are no known active faults capable of ground rupture under the Project alignment, there is no potential for ground rupture due to known active faulting for Alternative 2.

Alternative 2 is located in a seismically active area, thus, operation would potentially be subject to seismic ground shaking. Seismic shaking could result in damage to structures or human injury or death. As identified in PM GEO-1, to address potential risks associated with seismic hazards, Alternative 2 would be designed and constructed in conformance with the MRDC**,** applicable portions of building and seismic code requirements including the most recent edition of the CBC, Metro's standard specifications, and industry standards. Additionally, as further identified in PM GEO-1, during final design, a geotechnical investigation would be conducted, including detailed and site-specific evaluation of geotechnical hazards. The resulting final geotechnical engineering recommendations would be incorporated into the final design plans consistent with standard practice to address any unstable geologic and related conditions present along the alignment. Consistent with MRDC requirements, Project structures would be designed to perform in accordance with the two-level seismic evaluation approach based on the MDE and ODE. At-grade and underground structures would be designed and would perform in accordance with federal, state, and local thresholds for seismicity. Compliance with these requirements and industry standards would ensure that strong seismic ground shaking would not cause potential substantial adverse effects, including the risk of loss, injury, or death.

Additionally, PM GEO-1 describes project compliance with MRDC Section 5, Structural, which dictates that during final design, a geotechnical investigation must be conducted, including detailed and site-specific evaluation of geotechnical hazards. Structural engineering standards to address geological conditions are part of standard construction requirements and standard construction practices. The resulting final geotechnical engineering recommendations and any additional recommendations that come out of the review process would be incorporated into the final design plans consistent with standard practice to address any unstable geologic and related conditions present along the alignment. The project would be designed to perform in accordance with the MDE and ODE thresholds. As described, the design criteria (MRDC, Caltrans Seismic Design Criteria, Los Angeles County Building Code/CBC) provide the design framework, including the ARP and shaking intensity. Compliance with these requirements and industry standards would ensure that strong seismic ground shaking would not cause potential substantial adverse effects, including the risk of loss, injury, or death.

Seismic-Related Ground Failure, Liquefaction, and Landslides

Alternative 2 is not within in a liquefaction zone and is located in an area of generally flat topography and on stable soils. Operations would not result in exposure to seismic-related ground failure, including liquefaction, or landslides. While these conditions are not expected to occur, as with Alternative 1, Alternative 2 would be designed in compliance with regulatory requirements, industry standards, and the MRDC, as identified in PM GEO-1. Compliance with these regulatory and design requirements would reduce potential impacts by ensuring that development is designed to withstand seismic or other geologic hazards.

Summary

As with Alternative 1, Alternative 2 would be designed in compliance with regulatory requirements, industry standards, and the MRDC as described in PM GEO-1; compliance with these regulatory and design requirements would reduce potential impacts by ensuring that development is designed to withstand seismic or other geologic hazards. Operation of Alternative 2 would not cause potential substantial adverse effects, including the risk of loss, injury, or death from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides. Therefore, the impact would be less than significant.

Design Option

Atlantic/Pomona Station Option

Alternative 2 with the Atlantic/Pomona Station Option would not have seismic risks that differ from the base Alternative 2. The Atlantic/Pomona Station Option would potentially be subject to seismic ground shaking, but it is not located within a liquefaction zone. As identified in PM GEO-1, Alternative 2 with the Atlantic/Pomona Station Option would be designed in compliance with regulatory requirements and the MRDC and would be the subject of a site-specific geotechnical evaluation during the final design phase that would include specific structural engineering recommendations. Because of compliance with these regulatory and design requirements and engineering standards, operation of Alternative 2 with the Atlantic/Pomona Station Option would not cause potential substantial adverse effects, including the risk of loss, injury, or death from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides. Therefore, the impact would be less than significant.

7.1.2.2 Construction Impacts

Rupture of a Known Earthquake Fault and Seismic Shaking

Construction activities for Alternative 2 would involve temporary excavation shoring, foundation support installation and earthwork along the alignment. Additionally, cut-and-cover excavation, roadway decking, temporary shoring, mass excavation, and underground construction would occur along Smithway Street at the TBM launching pit and then the TBM receiving pit west of Atlantic Boulevard and south of Pomona Boulevard. Alternative 2 would not cross any known active faults.

Like Alternative 1, Alternative 2 is located in a seismically active area, thus, construction of Alternative 2 would potentially be subject to seismic ground shaking which could result in damage to structures and human injury. To address potential seismic hazards, Alternative 2 would be constructed in compliance with the MRCD as identified in PM GEO-1, applicable portions of building and seismic code requirements including the most recent edition of the CBC, Metro's standard specifications, and industry standards. These requirements include development of site-specific design parameters to account for seismic shaking. Adherence with the latest seismic safety parameters would substantially reduce potential structural damage and the risk to public safety from seismic events.

Seismic-Related Ground Failure, Liquefaction, and Landslides

Alternative 2 is not within in a liquefaction zone and is located in an area of generally flat topography and on stable soils. Thus, construction would not result in exposure to seismic-related ground failure, including liquefaction, or landslides.

Alternative 2 would be designed and constructed in accordance with regulatory requirements, industry standards, and the MRDC, as described in PM GEO-1 and **Section 3.0**. As identified in the PM GEO-1, in compliance with the MRDC, a geotechnical investigation would be performed during final design; the geotechnical investigation would include structural engineering standards and recommendations for temporary construction activities to address geological conditions, including recommendations on sloping or shoring to ensure stability of temporary excavations. The results of the geotechnical investigation would inform the design parameters for structural integrity and ground stability, and ensure impacts associated seismic-related ground failure, liquefaction, and landslides would be less than significant.

Summary

Compliance with requirements and industry standards as described in PM GEO-1 would ensure that Alternative 2 would not cause potential substantial adverse effects, including the risk of loss, injury, or death during construction. Construction of Alternative 2 would not cause potential substantial adverse effects, including the risk of loss, injury, or death from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides. Therefore, the impact would be less than significant

Design Option

Atlantic/Pomona Station Option

Alternative 2 with the Atlantic/Pomona Station Option would not have seismic risks that differ from the base Alternative 2. The Atlantic/Pomona Station Option would be potentially subject to seismic ground shaking, but it is not located within a liquefaction zone. The Atlantic/Pomona Station Option would be designed and constructed in compliance with regulatory requirements, industry standards and the MRDC, and would be the subject of a site-specific geotechnical evaluation during the final design phase that would include specific structural engineering recommendations. Compliance with regulatory and design requirements as identified in PM GEO-1 would reduce potential impacts by ensuring that development is designed to withstand seismic or other geologic hazards. Construction of Alternative 2 with the Atlantic/Pomona Station Option would not cause potential substantial adverse effects, including the risk of loss, injury, or death from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides. Therefore, the impact would be less than significant.

7.1.3 Alternative 3 Atlantic to Greenwood IOS

7.1.3.1 Operational Impacts

Rupture of a Known Earthquake Fault and Seismic Shaking

Alternative 3 would not cross any known faults capable of ground rupture. Thus, there is no potential for ground rupture due to known active faulting. Alternative 3 is located in a seismically active area, thus, operation would potentially be subject to seismic ground shaking. Seismic shaking could result in damage to structures or human injury or death. As identified in PM GEO-1, to address potential risks associated with seismic hazards, Alternative 3 would be designed and constructed in conformance with the MRDC, applicable portions of building and seismic code requirements including the most recent edition of the CBC, Metro's standard specifications, and industry standards. Consistent with MRDC requirements, Project structures would be designed to perform in accordance with the two-level seismic evaluation approach based on the MDE and ODE. At-grade and underground structures would be designed and would perform in accordance with federal, state, and local thresholds for seismicity. Compliance with these requirements and industry standards would ensure that strong seismic ground shaking would not cause potential substantial adverse effects, including the risk of loss, injury, or death.

Additionally, PM GEO-1 describes project compliance with MRDC Section 5, Structural, which dictates that during final design, a geotechnical investigation must be conducted, including detailed and site-specific evaluation of geotechnical hazards. Structural engineering standards to address geological conditions are part of standard construction requirements and standard construction practices. The resulting final geotechnical engineering recommendations and any additional recommendations that come out of the review process would be incorporated into the final design plans consistent with standard practice to address any unstable geologic and related conditions present along the alignment. The project would be designed to perform in accordance with the MDE and ODE thresholds. As described, the design criteria (MRDC, Caltrans Seismic Design Criteria, Los Angeles County Building Code/CBC) provide the design framework, including the ARP and shaking intensity.

Compliance with these requirements and industry standards would ensure that strong seismic ground shaking would not cause potential substantial adverse effects, including the risk of loss, injury, or death.

Seismic-Related Ground Failure, Liquefaction, and Landslides

Alternative 3 is not within a liquefaction zone and is located in an area of generally flat topography and on stable soils. Operations would not result in exposure to seismic-related ground failure, including liquefaction, or landslides. While these conditions are not expected to occur, as with Alternative 1, Alternative 3 would be designed in compliance with regulatory requirements, industry standards, and the MRDC, as identified in PM GEO-1. Compliance with these regulatory and design requirements would reduce potential impacts by ensuring that development is designed to withstand seismic or other geologic hazards.

Summary

Alternative 3 would be designed in compliance with regulatory requirements, industry standards, and the MRDC as described in PM GEO-1; compliance with these regulatory and design requirements would reduce potential impacts by ensuring that development is designed to withstand seismic or other geologic hazards. Operation of Alternative 3 would not cause potential substantial adverse effects, including the risk of loss, injury, or death from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides. Therefore, the impact would be less than significant.

Design Options

Atlantic/Pomona Station Option

If the Atlantic/Pomona Station Option were selected, the operational impacts from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure, including liquefaction, and landslides would be similar to those described under the base Alternative 3 with an aerial configuration at this location. As with the base Alternative 3, the Atlantic/Pomona Station Option would be potentially subject to seismic ground shaking; it is not located within a liquefaction zone and is located in an area of generally flat topography and on stable soils. Operations would not result in exposure to seismic-related ground failure, including liquefaction, or landslides. As with Alternative 3, the Atlantic/Pomona Station Option would be designed in compliance with regulatory requirements and the MRDC and would be the subject of a site-specific geotechnical evaluation during the final design phase that would include specific structural engineering recommendations as identified in PM GEO-1. As with the base Alternative 3, because of compliance with these regulatory and design requirements and engineering standards, Alternative 3 with the Atlantic/Pomona Station Option would have less than significant operational impacts relative to known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides.

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the operational impacts from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure, including liquefaction, and landslides would be similar to those described under the base Alternative 3 with an aerial configuration at this location. As with Alternative 3, the at-grade guideway under the Montebello At-Grade Option would be potentially subject to seismic ground shaking; it is not located within a liquefaction zone and is located in an area of generally flat topography and on stable soils. Operations would not result in exposure to seismic-related ground failure, including liquefaction, or landslides. As with Alternative 3, the Montebello At-Grade Option would be designed in compliance with regulatory requirements and the MRDC and would be the subject of a site-specific geotechnical evaluation during the final design phase that would include specific structural engineering recommendations as identified in PM GEO-1. As with the base Alternative 3, because of compliance with these regulatory and design requirements and engineering standards, Alternative 3 with the Montebello At-Grade Option would have less than significant operational impacts relative to known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides.

7.1.3.2 Construction Impacts

Rupture of a Known Earthquake Fault and Seismic Shaking

Construction activities for Alternative 3 would involve temporary excavation shoring, foundation support installation and earthwork along the alignment. Additionally, cut-and-cover excavation, roadway decking, temporary shoring, mass excavation, and underground construction would occur along Smithway Street at the TBM launching pit. Alternative 3 would not cross any known active faults.

Like Alternative 1, Alternative 3 is located in a seismically active area, thus, construction of Alternative 3 would potentially be subject to seismic ground shaking which could result in damage to structures and human injury. To address potential seismic hazards, Alternative 3 would be constructed in compliance with the MRDC as identified in PM GEO-1, applicable portions of building and seismic code requirements including the most recent edition of the CBC, Metro's standard specifications, and industry standards. These requirements include development of site-specific design parameters to account for seismic shaking. Adherence with the latest seismic safety parameters would substantially reduce potential structural damage and the risk to public safety from seismic events.

Seismic-Related Ground Failure, Liquefaction, and Landslides

Alternative 3 is not within a liquefaction zone and is located in an area of generally flat topography and on stable soils. Thus, construction would not result in exposure to seismic-related ground failure, including liquefaction or landslides.

Alternative 3 would be designed and constructed in accordance with regulatory requirements, industry standards, and the MRDC, as described in PM GEO-1. While these conditions are not expected to occur, Alternative 3 would be designed and constructed in accordance with regulatory requirements, industry standards, and the MRDC, as described in PM GEO-1. As identified in the PM GEO-1, in compliance with the MRDC, a geotechnical investigation would be performed during final design. The geotechnical investigation would include structural engineering standards and recommendations for temporary construction activities to address geological conditions, including recommendations on sloping or shoring to ensure stability of temporary excavations. The results of the geotechnical investigation would inform the design parameters for structural integrity and ground stability, and ensure impacts associated seismic-related ground failure, liquefaction, and landslides would be less than significant.

Summary

Compliance with requirements and industry standards, as identified in PM GEO-1, would ensure that Alternative 3 would not cause potential substantial adverse effects, including the risk of loss, injury, or death from seismic hazards during construction. Construction of Alternative 3 would not cause potential substantial adverse effects, including the risk of loss, injury, or death from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides. Therefore, the impact would be less than significant.

Design Options

Atlantic/Pomona Station Option

If the Atlantic/Pomona Station Option were selected, the construction impacts from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure, including liquefaction, and landslides would be similar to those described under the base Alternative 3 with an aerial configuration at this location. The Atlantic/Pomona Station Option would be potentially subject to seismic ground shaking. It is not located within a liquefaction zone. As with the base Alternative 3, Alternative 3 with the Atlantic/Pomona Station Option would be designed and constructed in compliance with regulatory requirements and the MRDC (see **Section 3.0)** and would be the subject of a site-specific geotechnical evaluation during the final design phase that would include construction recommendations, as identified in PM GEO-1. As with the base Alternative 3, because of compliance with these regulatory and design requirements and engineering standards, Alternative 3 with the Atlantic/Pomona Station Option would have less than significant construction impacts relative to known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides.

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the construction impacts from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure, including liquefaction, and landslides would be similar to those described under the base Alternative 3 with an aerial configuration at this location. The at-grade guideway under the Montebello At-Grade Option would be potentially subject to seismic ground shaking. It is not located within a liquefaction zone. As with the base Alternative 3, Alternative 3 with the Montebello At-Grade Option would be designed and constructed in compliance with regulatory requirements and the MRDC (see **Section 3.0**) and would be the subject of a site-specific geotechnical evaluation during the final design phase that would include construction recommendations, as identified in PM GEO-1. As with the base Alternative 3, because of compliance with these regulatory and design requirements and engineering standards, Alternative 3 with the Montebello At-Grade Option would have less than significant construction impacts relative to known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure including liquefaction, and landslides.

7.1.4 Maintenance and Storage Facilities

7.1.4.1 Operational Impacts

7.1.4.1.1 Commerce MSF

The Commerce MSF site option is not located on any known faults capable of ground rupture. Because there are no known active faults capable of ground rupture under the MSF site option, there is no potential for ground rupture due to known active faulting for the Commerce MSF site option. The Commerce MSF site option is not within in a liquefaction zone and is located in an area of generally flat topography and on stable soils. Operations would not result in exposure to seismic-related ground failure, including liquefaction, or landslides.

The potential to experience substantial seismic ground shaking is a common hazard for projects in Southern California. To address this risk, the Commerce MSF site option would be designed and constructed in conformance with the MRDC, as identified in PM GEO-1, applicable portions of building and seismic code requirements including the most recent edition of the CBC, Metro's standard specifications, and industry standards. Additionally, it would be the subject of a site-specific geotechnical evaluation during the final design phase that would include specific structural engineering recommendations as required by the MRDC and identified in PM GEO-1. Compliance with these requirements would reduce potential impacts by ensuring that development is designed to withstand seismic or other geologic hazards. Compliance with regulatory and design requirements would ensure that operational impacts from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure, including liquefaction, and landslides would be less than significant.

7.1.4.1.2 Montebello MSF

The Montebello MSF site option is not located on any known faults capable of ground rupture. Because there are no known active faults capable of ground rupture under the MSF site option, there is no potential for ground rupture due to known active faulting for the Montebello MSF site option. The Montebello MSF site option is not within in a liquefaction zone and is located in an area of generally flat topography and on stable soils. Operations would not result in exposure to seismic-related ground failure, including liquefaction, or landslides.

The potential to experience substantial seismic ground shaking is a common hazard for projects in Southern California. To address this risk, the Montebello MSF site option would be designed and constructed in conformance with the MRDC, as identified in PM GEO-1, applicable portions of building and seismic code requirements including the most recent edition of the CBC, Metro's standard specifications, and industry standards. Additionally, it would be the subject of a site-specific geotechnical evaluation during the final design phase that would include specific structural engineering recommendations as required by the MRDC and identified in PM GEO-1. Compliance with these requirements would reduce potential impacts by ensuring that development is designed to withstand seismic or other geologic hazards. Compliance with regulatory and design requirements would ensure operational impacts from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure, including liquefaction, and landslides would be less than significant.

Design Option

Montebello MSF At-Grade Option

Operation of the Montebello MSF At-Grade Option would generally have similar impacts as the Montebello MSF site option. To address the potential for strong seismic ground shaking, the Montebello MSF At-Grade Option would be designed and constructed in conformance with the MRDC, as identified in PM GEO-1, including applicable portions of building and seismic code requirements such as the most recent edition of the CBC, Metro's standard specifications, and industry standards, which would reduce potential impacts by ensuring that development is designed to withstand seismic or other geologic hazards. Compliance with regulatory and design requirements would ensure operational impacts from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure, including liquefaction, and landslides would be less than significant.

7.1.4.2 Construction Impacts

7.1.4.2.1 Commerce MSF

The Commerce MSF site option is not located on any known faults capable of ground rupture. Because there are no known active faults capable of ground rupture under the Project alignment, there is no potential for ground rupture due to known active faulting for the Commerce MSF site option. The Commerce MSF site option is not within in a liquefaction zone and is located in an area of generally flat topography and on stable soils. Construction would not cause potential substantial adverse effects related to seismic-related ground failure, including liquefaction, or landslides.

The potential to experience substantial seismic ground shaking is a common hazard for projects in Southern California. The Commerce MSF site option would be designed and constructed in conformance with the MRDC, as identified in PM GEO-1, including applicable portions of building and seismic code requirements including the most recent edition of the CBC, and industry standards, which would reduce potential impacts by ensuring that development is designed to withstand seismic or other geologic hazards. Further, the geotechnical investigation to be conducted during final design in compliance with the MRDC, as discussed in **Section 7.1.1.1**, would include structural engineering standards and recommendations for temporary construction activities to address geological conditions. Compliance with regulatory and design requirements would ensure construction impacts from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure, including liquefaction, and landslides would be less than significant.

7.1.4.2.2 Montebello MSF

The Montebello MSF site option is not located on any known faults capable of ground rupture. Because there are no known active faults capable of ground rupture under the Project alignment, there is no potential for ground rupture due to known active faulting for the Montebello MSF site option. The Montebello MSF site option is not within in a liquefaction zone and is located in an area of generally flat topography and on stable soils. Construction would not cause potential substantial adverse effects related to seismic-related ground failure, including liquefaction, or landslides.

The potential to experience substantial seismic ground shaking is a common hazard for projects in Southern California. The Montebello MSF site option would be designed and constructed in conformance with the MRDC, as described in PM GEO-1, including applicable portions of building and seismic code requirements such as the most recent edition of the CBC, and industry standards, which would reduce potential impacts by ensuring that development is designed to withstand seismic or other geologic hazards. Further, the geotechnical investigation to be conducted during final design, as identified in **Section 7.1.1.1**, would include structural engineering standards and recommendations for temporary construction activities to address geological conditions. Compliance with regulatory and design requirements would ensure construction impacts from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure, including liquefaction, and landslides would be less than significant.

Design Option

Montebello MSF At-Grade Option

Construction of the Montebello MSF At-Grade Option would generally have similar impacts as the Montebello MSF site option. The Montebello MSF At-Grade Option would be designed and constructed in conformance with the MRDC, as identified in PM GEO-1, including applicable portions of building and seismic code requirements including the most recent edition of the CBC, and industry standards, which would reduce potential impacts by ensuring that development is designed to withstand seismic or other geologic hazards. Further, the geotechnical investigation to be conducted during final design, as discussed in **Section 7.1.1.1**, would include structural engineering standards and recommendations to address geological conditions. Compliance with regulatory and design requirements would ensure operational impacts from known earthquake fault rupture, strong seismic ground shaking, seismic-related ground failure, including liquefaction, and landslides would be less than significant.

7.2 Impact GEO-2: Soil Erosion

Impact GEO-2: Would a Build Alternative result in substantial soil erosion or the loss of topsoil?

7.2.1 Alternative 1 Washington

7.2.1.1 Operational Impacts

Alternative 1 is located in an urbanized area that is primarily impervious with no exposed soil. There are some areas of pervious surfaces associated with the Rio Hondo Spreading Grounds and San Gabriel River and to a minimal extent, landscaped medians and setbacks, parks, and residential yards within the DSA. Operation of Alternative 1 would not result in ground disturbance or an increase in the amount of exposed soil as compared to existing conditions. Furthermore, operations would not change the amount of erosion in the Rio Hondo and spreading grounds or the San Gabriel River compared to existing conditions. Alternative 1 would comply with post-construction measures in applicable NPDES permits and LID standards required by Los Angeles County and other local jurisdictions, which aim to minimize erosion impacts from development projects. NPDES Permits and LID standards are discussed in more detail in the Eastside Transit Corridor Phase 2 Hydrology and

Water Quality Impacts Report. Thus, operation of Alternative 1 would not result in substantial soil erosion or the loss of topsoil and impacts would be less than significant.

Design Options

Atlantic/Pomona Station Option

Operation of Alternative 1 with the Atlantic/Pomona Station Option would not result in ground disturbance or a change in the amount of exposed soil as compared to existing conditions. Furthermore, operations would not change the amount of erosion in the Rio Hondo and spreading grounds or the San Gabriel River as compared to existing conditions. Alternative 1 with the Atlantic/Pomona Station Option would comply with post-construction measures in applicable NPDES permits and LID standards required by Los Angeles County and other local jurisdictions, which aim to minimize erosion impacts from development projects. Thus, operation of Alternative 1 with the Atlantic/Pomona Station Option would not result in substantial soil erosion, or the loss of topsoil and impacts would be less than significant.

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the operational impacts on erosion and topsoil would be similar to those described under the base Alternative 1 with an aerial configuration at this location. The Project is in an urbanized area that is primarily impervious with no exposed soil. Operation of Alternative 1 with the Montebello At-Grade Option would not result in ground disturbance or a change in the amount of exposed soil as compared to existing conditions. Furthermore, operations would not change the amount of erosion in the Rio Hondo and spreading grounds or the San Gabriel River as compared to existing conditions. Alternative 1 with the Montebello At-Grade Option would comply with post-construction measures in applicable NPDES permits and LID standards required by Los Angeles County and other local jurisdictions, which aim to minimize erosion impacts from development projects. NPDES Permits and LID standards are discussed in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. Thus, operation of Alternative 1 with the Montebello At-Grade Option would not result in substantial soil erosion, or the loss of topsoil and impacts would be less than significant.

7.2.1.2 Construction Impacts

Ground disturbing activities occurring during construction would temporarily expose surficial soils to wind and water erosion increasing the potential for soil erosion and loss of topsoil compared to existing conditions. During a storm event, soil erosion and loss of topsoil could occur at an accelerated rate. However, construction activities would be required to comply with existing regulatory requirements, including implementation of BMPs and other erosion and sedimentation control measures that would ensure grading, excavation, and other earth-moving activities would avoid a significant impact. For example, a SWPPP and erosion and sediment control plan would be prepared in compliance with applicable NPDES Permits. The SWPPP, NPDES permits, and erosion-control BMPs are described in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. The implementation of erosion control BMPs would prevent substantial soil erosion or the loss of topsoil from exposed soils, including within the Rio Hondo Spreading Grounds and San Gabriel River have soft, dirt bottoms with more potential for erosion. Erosion control BMPs may include, but would not be limited to, use of detention ponds or infiltration pits to collect and reduce erosion, using barriers to slow the rate of runoff, or controlling the use of water irrigation. These and other potential BMPs are discussed and identified as PM HWQ-2 in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report.

At the close of construction, areas of exposed soil that were previously paved would be restored to a paved condition. Construction of Alternative 1 would result in the localized and temporary movement of soils during construction; however, given compliance with regulatory requirements, substantial erosion of soils or loss of topsoil is not expected. Therefore, the impact would be less than significant.

Design Options

Atlantic/Pomona Station Option

Because ground disturbing construction activities have the potential to increase erosion and loss of topsoil, a SWPPP and erosion and sediment control plan would be prepared in compliance with applicable NPDES Permits. At the close of construction, areas of exposed soil that were previously paved would be restored to a paved condition. Construction of Alternative 1 with the Atlantic/Pomona Station Option would result in the localized and temporary movement of soils during construction; however, given compliance with regulatory requirements, substantial erosion of soils or loss of topsoil is not expected. Therefore, the impact would be less than significant.

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the construction impacts on erosion and topsoil would be similar to those described under the base Alternative 1 with an aerial configuration at this location. Because ground disturbing construction activities have the potential to increase erosion and loss of topsoil, a SWPPP and erosion and sediment control plan would be prepared in compliance with applicable NPDES Permits. The SWPPP, NPDES permits, and erosion-control BMPs are described in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. At the close of construction, areas of exposed soil that were previously paved would be restored to a paved condition. Construction of Alternative 1 with the Montebello At-Grade Option would result in the localized and temporary movement of soils during construction; however, given compliance with regulatory requirements, substantial erosion of soils or loss of topsoil is not expected. Therefore, the impact would be less than significant.

7.2.2 Alternative 2 Atlantic to Citadel IOS

7.2.2.1 Operational Impacts

Alternative 2 is in an urbanized area that is primarily impervious with no exposed soil. Operation of Alternative 2 would not result in ground disturbance or an increase in the amount of exposed soil as compared to existing conditions. Alternative 2 would comply with post-construction measures in applicable NPDES permits and LID standards required by Los Angeles County and other local jurisdictions, which aim to minimize erosion impacts from development projects. NPDES Permits and LID standards are discussed in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. Thus, operation of Alternative 2 would not result in substantial soil erosion or the loss of topsoil and impacts would be less than significant.

Design Option

Atlantic/Pomona Station Option

If the Atlantic/Pomona Station Option were selected, the operational impacts on erosion and topsoil would be similar to those described under the base Alternative 2. Operation of Alternative 2 with the Atlantic/Pomona Station Option would not result in ground disturbance or a change in the amount of exposed soil as compared to existing conditions. Alternative 2 with the Atlantic/Pomona Station Option would comply with post-construction measures in applicable NPDES permits and LID standards required by Los Angeles County and other local jurisdictions, which aim to minimize erosion impacts from development projects. Thus, operation of Alternative 2 with the Atlantic/Pomona Station Option would not result in substantial soil erosion, or the loss of topsoil and impacts would be less than significant.

7.2.2.2 Construction Impacts

Ground disturbing activities occurring during construction would temporarily expose surficial soils to wind and water erosion and have the potential to temporarily increase erosion and loss of topsoil. However, construction activities would be required to comply with existing regulatory requirements, including implementation of BMPs and other erosion and sedimentation control measures that would ensure grading, excavation, and other earth-moving activities would avoid a significant impact. A SWPPP and erosion and sediment control plan would be prepared in compliance with applicable NPDES Permits. The SWPPP, NPDES permits, and erosion-control BMPs are described in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. At the close of construction, areas of exposed soil that were previously paved would be restored to a paved condition. Construction of Alternative 2 would result in the localized and temporary movement of soils during construction; however, given compliance with regulatory requirements, substantial erosion of soils or loss of topsoil is not expected. Therefore, the impact would be less than significant.

Design Option

Atlantic/Pomona Station Option

Ground disturbing activities occurring during construction of Alternative 2 with the Atlantic/Pomona Station Option would temporarily expose surficial soils to wind and water erosion and have the potential to temporarily increase erosion and loss of topsoil. However, construction activities would be required to comply with existing regulatory requirements, including implementation of BMPs and other erosion and sedimentation control measures that would ensure grading, excavation, and other earth-moving activities would avoid a significant impact. Erosion control BMPs are discussed and evaluated in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. At the close of construction, areas of exposed soil that were previously paved would be restored to a paved condition. Construction of Alternative 2 with the Atlantic/Pomona Station Option would result in the localized and temporary movement of soils during construction; however, given compliance with regulatory requirements, substantial erosion of soils or loss of topsoil is not expected. Therefore, the impact would be less than significant.

7.2.3 Alternative 3 Atlantic to Greenwood IOS

7.2.3.1 Operational Impacts

Alternative 3 is located in an urbanized area that is primarily impervious with no exposed soil. Operation of Alternative 3 would not result in ground disturbance or a change in the amount of exposed soil as compared to existing conditions. The Project would comply with post-construction measures in applicable NPDES permits and LID standards required by Los Angeles County and other local jurisdictions, which aim to minimize erosion impacts from development projects. NPDES Permits and LID standards are discussed in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. Thus, operation of Alternative 3 would not result in substantial soil erosion or the loss of topsoil and impacts would be less than significant.

Design Options

Atlantic/Pomona Station Option

If the Atlantic/Pomona Station Option were selected, the operational impacts on erosion and topsoil would be similar to those described under the base Alternative 3. The Project is located in an urbanized area that is primarily impervious with no exposed soil. Operation of Alternative 3 with the Atlantic/Pomona Station Option would not result in ground disturbance or a change in the amount of exposed soil as compared to existing conditions. The Project would comply with post-construction measures in applicable NPDES permits and LID standards required by Los Angeles County and other local jurisdictions, which aim to minimize erosion impacts from development projects. NPDES Permits and LID standards are discussed in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. Thus, operation of Alternative 3 with the Atlantic/Pomona Station Option would not result in substantial soil erosion, or the loss of topsoil and impacts would be less than significant.

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the operational impacts on erosion and topsoil would be similar to those described under the base Alternative 3 with an aerial configuration at this location. The Project is located in an urbanized area that is primarily impervious with no exposed soil. Operation of Alternative 3 with the Montebello At-Grade Option would not result in ground disturbance or a change in the amount of exposed soil as compared to existing conditions. The Project would comply with post-construction measures in applicable NPDES permits and LID standards required by Los Angeles County and other local jurisdictions, which aim to minimize erosion impacts from development projects. NPDES Permits and LID standards are discussed in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. Thus, operation of Alternative 3 with the Montebello At-Grade Option would not result in substantial soil erosion, or the loss of topsoil and impacts would be less than significant.

7.2.3.2 Construction Impacts

Ground disturbing activities occurring during construction would temporarily expose surficial soils to wind and water erosion and have the potential to temporarily increase erosion and loss of topsoil.

However, construction activities would be required to comply with existing regulatory requirements, including implementation of BMPs and other erosion and sedimentation control measures that would ensure grading, excavation, and other earth-moving activities would avoid a significant impact. A SWPPP and erosion and sediment control plan would be prepared in compliance with applicable NPDES Permits. The SWPPP, NPDES permits, and erosion-control BMPs are described in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. At the close of construction, areas of exposed soil that were previously paved would be restored to a paved condition. Construction of Alternative 3 would result in the localized and temporary movement of soils during construction; however, given compliance with regulatory requirements, substantial erosion of soils or loss of topsoil is not expected. Therefore, the impact would be less than significant.

Design Options

Atlantic/Pomona Station Option

If the Atlantic/Pomona Station Option were selected, the construction impacts on erosion and topsoil would be similar to those described under the base Alternative 3. Ground disturbing construction activities have the potential to increase erosion and loss of topsoil around proposed construction and staging areas. A SWPPP and erosion and sediment control plan would be prepared in compliance with applicable NPDES Permits. The SWPPP, NPDES permits, and erosion-control BMPs are described in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. At the close of construction, areas of exposed soil that were previously paved would be restored to a paved condition. Construction of Alternative 3 with the Atlantic/Pomona Station Option would result in the localized and temporary movement of soils during construction; however, given compliance with regulatory requirements, substantial erosion of soils or loss of topsoil is not expected. Therefore, the impact would be less than significant.

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the construction impacts on erosion and topsoil would be similar to those described under the base Alternative 3. Ground disturbing construction activities have the potential to increase erosion and loss of topsoil around proposed construction and staging areas. A SWPPP and erosion and sediment control plan would be prepared in compliance with applicable NPDES Permits. The SWPPP, NPDES permits, and erosion-control BMPs are described in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. At the close of construction, areas of exposed soil that were previously paved would be restored to a paved condition. Construction of Alternative 3 with the Montebello At-Grade Option would result in the localized and temporary movement of soils during construction; however, given compliance with regulatory requirements, substantial erosion of soils or loss of topsoil is not expected. Therefore, the impact would be less than significant.

7.2.4 Maintenance and Storage Facilities

7.2.4.1 Operational Impacts

7.2.4.1.1 Commerce MSF

The Commerce MSF site option is in an urbanized area that is primarily impervious with no exposed soil. Operation of the MSF would not result in ground disturbance or a change in the amount of exposed soil as compared to existing conditions. The MSF site option would comply with post-construction measures in applicable NPDES permits and LID standards required by the city of Commerce, which aim to minimize erosion impacts from development projects. NPDES Permits and LID standards are discussed in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. Thus, operation of the Commerce MSF site option would not result in substantial soil erosion, or the loss of topsoil and impacts would be less than significant.

7.2.4.1.2 Montebello MSF

The Montebello MSF site option is in an urbanized area that is primarily impervious with no exposed soil. Operation of the MSF would not result in ground disturbance or a change in the amount of exposed soil as compared to existing conditions. The MSF site option would comply with post-construction measures in applicable NPDES permits and LID standards required by Los Angeles County and the city of Montebello, which aim to minimize erosion impacts from development projects. NPDES Permits and LID standards are discussed in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. Thus, operation of the Montebello MSF site option would not result in substantial soil erosion, or the loss of topsoil and impacts would be less than significant.

Design Option

Montebello MSF At-Grade Option

Operation of the proposed Montebello MSF At-Grade Option, including the connection between the alignment and MSF, would not result in ground disturbance or a change in the amount of exposed soil as compared to existing conditions. The MSF site option would comply with post-construction measures in applicable NPDES permits and LID standards required by the city of Montebello, which aim to minimize erosion impacts from development projects. NPDES Permits and LID standards are discussed in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. Thus, operation of the Montebello MSF At-Grade Option would not result in substantial soil erosion, or the loss of topsoil and impacts would be less than significant.

7.2.4.2 Construction Impacts

7.2.4.2.1 Commerce MSF

Ground disturbing activities occurring during construction would temporarily expose surficial soils to wind and water erosion and have the potential to temporarily increase erosion and loss of topsoil. However, construction activities would be required to comply with existing regulatory requirements, including implementation of BMPs and other erosion and sedimentation control measures that would ensure grading, excavation, and other earth-moving activities would avoid a significant impact. A SWPPP and erosion and sediment control plan would be prepared in compliance with applicable NPDES permits. The SWPPP, NPDES permits, and erosion-control BMPs are described in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. At the close of construction, areas of exposed soil that were previously paved would be restored to a paved condition. Construction of the Commerce MSF site option would result in the localized and temporary movement of soils during construction; however, given compliance with regulatory requirements, substantial erosion of soils or loss of topsoil is not expected. Therefore, the impact would be less than significant.

7.2.4.2.2 Montebello MSF

Ground disturbing activities occurring during construction would temporarily expose surficial soils to wind and water erosion and have the potential to temporarily increase erosion and loss of topsoil. However, construction activities would be required to comply with existing regulatory requirements, including implementation of BMPs and other erosion and sedimentation control measures that would ensure grading, excavation, and other earth-moving activities would avoid a significant impact. A SWPPP and erosion and sediment control plan would be prepared in compliance with applicable NPDES permits. The SWPPP, NPDES permits, and erosion-control BMPs are described in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. At the close of construction, areas of exposed soil that were previously paved would be restored to a paved condition. Construction of the Montebello MSF site option would result in the localized and temporary movement of soils during construction; however, given compliance with regulatory requirements, substantial erosion of soils or loss of topsoil is not expected. Therefore, the impact would be less than significant.

Design Option

Montebello MSF At-Grade Option

Construction of the proposed Montebello MSF At-Grade Option, including the connection between the alignment and MSF would require a SWPPP and erosion and sediment control plan prepared in compliance with applicable NPDES permits. The SWPPP, NPDES permits, and erosion-control BMPs are described in more detail in the Eastside Transit Corridor Phase 2 Hydrology and Water Quality Impacts Report. At the close of construction, areas of exposed soil that were previously paved would be restored to a paved condition. Construction of the Montebello MSF At-Grade Option would result in the localized and temporary movement of soils during construction; however, given compliance with regulatory requirements, substantial erosion of soils or loss of topsoil is not expected. Therefore, the impact would be less than significant.

7.3 Impact GEO-3: Soil Stability

Impact GEO-3: Would a Build Alternative 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?

7.3.1 Alternative 1 Washington

7.3.1.1 Operational Impacts

The underground and aerial segments of Alternative 1 are located on stable soils and not in an area mapped to have the potential to experience liquefaction and settlement. Operations of the underground and aerial segments would not occur on a geologic unit or soil that is unstable, or that would become unstable as a result of Alternative 1.

Conversely, the at-grade segment of Alternative 1 is underlain by young alluvial fan deposits from South Bluff Road to the eastern terminus of the alignment. These soils are potentially loose and compressible when subject to additional loading. Thus, these soils have the potential to settle due to traffic loading from the at-grade track, which could affect the overlying operation of the track. Further, as discussed under Impact GEO-1 in **Section 7.1**, this segment of the alignment is within a mapped liquefiable zone. Thus, the at-grade alignment, the proposed stations at Rosemead Boulevard, Norwalk Boulevard, and Lambert Road, and the associated parking facilities have the potential to be adversely affected by liquefaction and seismically-induced settlement. Additionally, existing lateral spread landslide potential may exist nearby the Rio Hondo and San Gabriel River due to the liquefiable soils and gentle slope topography. Ground shaking leading to liquefaction of saturated soil could result in lateral spreading where the soil undergoes a temporary loss of strength, and if the liquefied soil is not contained laterally, it may result in deformation or translation of the slope.

Structural engineering standards to address geological conditions are part of standard construction requirements and standard construction practices. As discussed under Impact GEO-1 in **Section 7.1**, Alternative 1 would be designed in accordance with MRDC Section 5, Structural; Metro's SDC (Metro 2017); and the California Seismic Hazards Mapping Act. Further, as described in PM GEO-1, Alternative 1 would be designed in accordance with recommendations developed in a detailed geotechnical report prepared during final design. The design-level geotechnical investigations would provide site-specific information pertaining to the depths and areal extents of liquefaction, lateral spread, and settlement. Recommendations specific to detrimental ground settlement from new structures or earth loads would be provided. Structural engineering standards to address geological conditions are part of standard construction requirements and standard construction practices. During the design process, if it is determined that these conditions identified in the geotechnical report could result in an unacceptable soil or structural response (to be defined during final design and dependent on the type of structure), the resulting final geotechnical engineering would include recommendations that would be incorporated into the final design plans consistent with standard practice to address any unstable geologic and related conditions present along the alignment. This may include deep foundations and/or ground improvements such as dynamic compaction, stone columns, jet grouting, and cement deep soil mixing and compaction grouting that would be implemented consistent with the design standards provided in **Section 3.4.1**.

Alternative 1 would be designed in compliance with MRDC, the California Seismic Hazards Mapping Act, industry standards and recommendations contained in the design level geotechnical report as described in PM GEO-1. Given compliance with these regulatory and design requirements, operation of Alternative 1 would have less than significant impacts related to soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse.

Design Options

Atlantic/Pomona Station Option

The Atlantic/Pomona Station Option portion of the alignment is located on stable soils and is not within a liquefaction zone. Further, as described in PM GEO-1, Alternative 1 with the Atlantic/Pomona Station Option would be designed in compliance with MRDC, the California Seismic Hazards Mapping Act, industry standards and recommendations contained in the design level geotechnical report. Given compliance with these regulatory and design requirements, operation of Alternative 1 with the Atlantic/Pomona Station Option would have less than significant impacts related to soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse.

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the operational impacts on soil stability, landslides, lateral spreading, subsidence, liquefaction, and collapse would be similar to those described under the base Alternative 1 with an aerial configuration at this location. The Montebello At-Grade Option portion of the alignment is underlain by old alluvial fan deposits and is located on stable soils and is not within a liquefaction zone. Further, as described in PM GEO-1, Alternative 1 with the Montebello At-Grade Option would be designed in compliance with regulatory requirements discussed under Impact GEO-1 and in **Section 3.0**; with compliance with these regulatory and design requirements, operation of Alternative 1 with the Montebello At-Grade Option would have less than significant impacts related to soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse.

7.3.1.2 Construction Impacts

Construction activities for Alternative 1 would involve temporary excavation shoring, foundation support installation and earthwork along the alignment. Certain construction activities, such as ground excavation, tunneling, and dewatering, could affect soil stability leading to ground movements (both lateral movements and settlements) or subsidence. Excavation and tunneling could impact soil stability by reducing lateral support for soil that is not excavated. Dewatering could affect soil stability by causing subsurface soil compaction and, consequently, sinking or settling of the ground above. Excavation for construction of underground structures, such as station boxes, tunnels, and tunnel portals would be reinforced by shoring systems to protect abutting buildings, utilities and other infrastructure. Tunneling using a TBM would result in ground volume loss and potential ground movements. Dewatering, when performed to create a dry work condition for construction of the underground structures, would result in compaction or consolidation of the subsurface soils and thus result in surface settlements. Without compliance with regulatory and design requirements, these activities described above could result in subsidence or collapse of the ground.

However, as with impact GEO-1: Exposure to Seismic Hazards, discussed under **Section 7.1** and described in PM GEO-1, Alternative 1 would be designed in accordance with MRDC Section 5, Structural; Metro's SDC (Metro 2017); and the California Seismic Hazards Mapping Act. These design standards dictate that during final design, a geotechnical investigation be conducted, including detailed evaluation of hazards. The investigation would be part of Metro's comprehensive geologic/geotechnical field investigation program that is being currently developed and would include a detailed evaluation of these hazards and would also include structural engineering standards and recommendations for temporary construction activities as well as project design and engineering to address geological conditions. The design-level geotechnical investigations and evaluations would provide information pertaining to the depths and areal extents of liquefaction, lateral spread, and seismically induced settlement. During the design process, if it is determined that these hazards could result in an unacceptable soil or structural response (to be defined during final design and dependent on the type of structure), the resulting final geotechnical engineering would include recommendations that would be incorporated into the Project's final design plans consistent with standard practice to address any unstable geologic and related conditions present along the alignment during construction. This would include recommendations for foundation construction, groundwater management (groundwater cutoff and/or dewatering), excavation and shoring, consistent with the design standards provided in **Section 3.0**.

Alternative 1 would be designed and constructed in compliance with regulatory requirements and the MRDC as discussed under Impact GEO-1 and in **Section 3.0** and as described in PM GEO-1; with compliance with these regulatory and design requirements, construction impacts related to soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

Design Options

Atlantic/Pomona Station Option

Alternative 1 with the Atlantic/Pomona Station Option would not have soil stability risks that differ from the base Alternative 1. The Atlantic/Pomona Station Option would be designed and constructed in compliance with regulatory requirements, the MRDC, and recommendations contained in the design level geotechnical report as described in PM GEO-1. Given compliance with these regulatory and design requirements, construction of Alternative 1 with the Atlantic/Pomona Station Option would have less than significant impacts related to soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse.

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the construction impacts on soil stability that could be associated with the potential for on- or off-site landslide, lateral spreading, subsidence, liquefaction, and collapse would be similar to those described under the base Alternative 1 with an aerial configuration at this location. As with the full alignment, the at-grade guideway under the Montebello At-Grade Option would be designed and constructed in compliance with regulatory requirements, the MRDC, and recommendations contained in the design level geotechnical report as described in PM GEO-1, including recommendations on engineering and design considerations to ensure soil stability during construction; compliance with these regulatory and design requirements would ensure construction impacts under Alternative 1 with the Montebello At-Grade Option associated with soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

7.3.2 Alternative 2 Atlantic to Citadel IOS

7.3.2.1 Operational Impacts

Alternative 2 is located on stable soils and not present in a liquefaction zone. Operations would not occur 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. As with Alternative 1, discussed in **Section 7.3.1.1**, Alternative 2 would be designed in compliance with regulatory requirements and the MRDC as addressed under Impact GEO-1, in **Section 3.0**, and described in PM GEO-1. Under Alternative 2, operational impacts related to soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

Design Option

Atlantic/Pomona Station Option

As with the base Alternative 2, Alternative 2 with the Atlantic/Pomona Station Option would be located on stable soils where no liquefaction zones are present. Operations would not occur on a geologic unit or soil that is unstable, or that would become unstable as a result of Alternative 2 with the Atlantic/Pomona Station Option, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse. Further, Alternative 2 with the Atlantic/Pomona Station Option would be designed in compliance with MRDC, the California Seismic Hazards Mapping Act, industry standards and recommendations contained in the design level geotechnical report as described in PM GEO-1. Given compliance with these regulatory and design requirements, operation of Alternative 2 with the Atlantic/Pomona Station Option would have less than significant impacts related to soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse.

7.3.2.2 Construction Impacts

Alternative 2 Atlantic to Citadel IOS is located on stable soils and not present in a liquefaction zone. However, construction activities for Alternative 2 would involve temporary excavation shoring, foundation support installation and earthwork along the alignment. Certain construction activities, such as ground excavation, tunneling, and dewatering, could affect soil stability leading to ground movements (both lateral movements and settlements) or subsidence. Excavation for construction of underground structures, such as station boxes, tunnels, and tunnel portals would be reinforced by shoring systems to protect abutting buildings, utilities and other infrastructure. Tunneling using a TBM would result in ground volume loss and potential ground movements. Dewatering, when performed to create a dry work condition for construction of the underground structures, would result in compaction or consolidation of the subsurface soils and thus result in surface settlements. Without compliance with regulatory and design requirements, these activities described above could result in subsidence or collapse of the ground.

However, as with Alternative 1, Alternative 2 would be designed and constructed in compliance with regulatory requirements, the MRDC, and recommendations contained in the design level geotechnical report. This would include incorporating recommendations on engineering and design considerations identified in the geotechnical report to ensure soil stability during construction. Thus, given compliance with design requirements as identified in PM GEO-1, construction impacts associated with soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

Design Option

Atlantic/Pomona Station Option

As with the base Alternative 2, Alternative 2 with the Atlantic/Pomona Station Option is located on stable soils and not present in a liquefaction zone. However, construction activities, such as ground excavation, tunneling, and dewatering, could affect soil stability leading to ground movements (both lateral movements and settlements) or subsidence. Excavation and tunneling could impact soil stability by reducing lateral support for soil that is not excavated. Dewatering could affect soil stability by causing subsurface soil compaction and, consequently, sinking or settling of the ground above. Excavation for construction of underground structures, such as station boxes, tunnels, and tunnel portals would be reinforced by shoring systems to protect abutting buildings, utilities and other infrastructure. Tunneling using a TBM would result in ground volume loss and potential ground movements. Dewatering, when performed to create a dry work condition for construction of the underground structures, would result in compaction or consolidation of the subsurface soils and thus result in surface settlements. Without compliance with regulatory and design requirements, these activities described above could result in subsidence or collapse of the ground.

Alternative 2 with the Atlantic/Pomona Station Option would be designed and constructed in compliance with regulatory requirements, the MRDC, and recommendations contained in the design level geotechnical report. This would include incorporating recommendations on engineering and design considerations identified in the geotechnical report to ensure soil stability during construction. Thus, given compliance with design requirements as identified in PM GEO-1, construction of Alternative 2 with the Atlantic/Pomona Station Option would have less than significant impacts related to soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse.

7.3.3 Alternative 3 Atlantic to Greenwood IOS

7.3.3.1 Operational Impacts

Alternative 3 is located on stable soils and not present in a liquefaction zone. Operations would not occur 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. As with Alternative 1, discussed under **Section 7.3.1.1**, Alternative 2 would be designed in compliance with regulatory requirements, the MRDC, and recommendations identified in a site-specific geotechnical investigation as addressed under Impact GEO-1 and in **Section 3.0** and as described in PM GEO-1. Under Alternative 3, operational impacts related to soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

Design Options

Atlantic/Pomona Station Option

If the Atlantic/Pomona Station Option were selected, the operational impacts on soil stability that could be associated with the potential for on- or off-site landslide lateral spreading, subsidence, liquefaction, and collapse would be similar to those described under the base Alternative 3. The Atlantic/Pomona Station Option is underlain by old alluvial fan deposits. It is located on stable soils and is not within a liquefaction zone. Further, the Atlantic/Pomona Station Option would be designed in compliance with regulatory requirements and the MRDC as discussed under Impact GEO-1 and **Section 3.0** and as described in PM GEO-1. Under Alternative 3 with the Atlantic/Pomona Station Option, operational impacts associated with soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the operational impacts on soil stability that could be associated with the potential for on- or off-site landslide lateral spreading, subsidence, liquefaction, and collapse would be similar to those described under the base Alternative 3 with an aerial configuration at this location. The Montebello At-Grade Option, the at-grade segment of the alignment is underlain by old alluvial fan deposits. It is located on stable soils and is not within a liquefaction zone. Further, the at-grade guideway under the Montebello At-Grade Option would be designed in compliance with regulatory requirements and the MRDC as discussed under Impact GEO-1 and **Section 3.0**. Under Alternative 3 with the Montebello At-Grade Option, operational impacts associated with soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

7.3.3.2 Construction Impacts

Alternative 3 is located on stable soils and not in a liquefaction zone. However, construction activities for Alternative 3 would involve temporary excavation shoring, foundation support installation and earthwork along the alignment. Certain construction activities, such as ground excavation, tunneling, and dewatering, could affect soil stability leading to ground movements (both lateral movements and settlements) or subsidence. Excavation for construction of underground structures, such as station boxes, tunnels, and tunnel portals would be reinforced by shoring systems to protect abutting buildings, utilities and other infrastructure. Tunneling using a TBM would result in ground volume loss and potential ground movements. Dewatering, when performed to create a dry work condition for construction of the underground structures, would result in compaction or consolidation of the subsurface soils and thus result in surface settlements. Without compliance with regulatory and design requirements, these activities described above could result in subsidence or collapse of the ground.

However, as with Alternative 1, Alternative 3 would be designed and constructed in compliance with regulatory requirements, the MRDC, and recommendations contained in the design level geotechnical report as described in PM GEO-1. This would include incorporating recommendations on engineering and design considerations to ensure soil stability during construction. Under Alternative 3, given compliance with design requirements as identified in PM GEO-1, construction impacts associated with soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

Design Options

Atlantic/Pomona Station Option

If the Atlantic/Pomona Station Option were selected, the construction impacts on soil stability that could be associated with the potential for on- or off-site landslide lateral spreading, subsidence, liquefaction, and collapse would be similar to those described under the base Alternative 3. The Atlantic/Pomona Station Option is located on stable soils underlain by old alluvial fan deposits and is not within a liquefaction zone. Further, the Atlantic/Pomona Station Option would be designed in compliance with regulatory requirements and the MRDC as discussed under Impact GEO-1 and **Section 3.0** and described in PM GEO-1. Under Alternative 3 with the Atlantic/Pomona Station Option, construction impacts associated with soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the construction impacts on soil stability that could be associated with the potential for on- or off-site landslide lateral spreading, subsidence, liquefaction, and collapse would be similar to those described under the base Alternative 3 with an aerial configuration at this location. Under the Montebello At-Grade Option, the at-grade segment of the alignment is located on stable soils underlain by old alluvial fan deposits and is not within a liquefaction zone. Further, the at-grade guideway under the Montebello At-Grade Option would be designed in compliance with regulatory requirements and the MRDC as discussed under Impact GEO-1 and **Section 3.0** and described in PM GEO-1. Under Alternative 3 with the Montebello At-Grade Option, construction impacts associated with soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

7.3.4 Maintenance and Storage Facilities

7.3.4.1 Operational Impacts

7.3.4.1.1 Commerce MSF

The Commerce MSF site option is located on stable soils and not within a mapped liquefiable zone. Operations would not occur on a geologic unit or soil that is unstable, or that would become unstable as a result of the MSF site option, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse. As with the Build Alternatives, discussed under **Section 7.3.1**, **Section 7.3.2**, and **Section 7.3.3**, the Commerce MSF site option would be designed in compliance with regulatory requirements, the MRDC, and recommendations contained in the design level geotechnical report, including recommendations on engineering and design considerations as described in PM

GEO-1. Operational impacts associated with soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

7.3.4.1.2 Montebello MSF

The Montebello MSF site option is located on stable soil and not within a mapped liquefiable zone. Operations would not occur on a geologic unit or soil that is unstable, or that would become unstable as a result of the MSF site option, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse. As with the Build Alternatives, discussed under **Section 7.3.1**, **Section 7.3.2**, and **Section 7.3.3**, the Montebello MSF site option would be designed in compliance with regulatory requirements, the MRDC, and recommendations contained in the design level geotechnical report as described in PM GEO-1, including recommendations on engineering and design considerations to ensure soil stability. Operational impacts associated with soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

Design Option

Montebello MSF At-Grade Option

Operation of the Montebello MSF At-Grade Option would generally have similar impacts as the base Montebello MSF site option related to soil stability that could be associated with the potential for on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse. The Montebello MSF At-Grade Option would be designed in compliance with regulatory requirements, the MRDC, and recommendations contained in the design level geotechnical report as described in PM GEO-1, including recommendations on engineering and design considerations to ensure soil stability. Construction impacts associated with soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

7.3.4.2 Construction Impacts

7.3.4.2.1 Commerce MSF

The Commerce MSF site option is located on stable soil and not within a mapped liquefiable zone. Construction would not occur on a geologic unit or soil that is unstable, or that would become unstable as a result of the MSF site option, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse. As with the Build Alternatives, discussed under **Section 7.3.1**, **Section 7.3.2**, and **Section 7.3.3**, the Commerce MSF site option would be designed and constructed in compliance with regulatory requirements, the MRDC, and recommendations contained in the design level geotechnical report as described in PM GEO-1, including recommendations on engineering and design considerations to ensure soil stability during construction. Construction impacts associated with soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

7.3.4.2.2 Montebello MSF

The Montebello MSF site option is located on stable soil and is not within a mapped liquefiable zone. Construction would not occur on a geologic unit or soil that is unstable, or that would become unstable as a result of the MSF site option, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse. As with the Build Alternatives, discussed under **Section 7.3.1**, **Section 7.3.2**, and **Section 7.3.3**, the Montebello MSF site option would be designed and constructed in compliance with regulatory requirements, the MRDC, and recommendations contained in the design level geotechnical report as described in PM GEO-1, including recommendations on engineering and design considerations to ensure soil stability during construction. Construction impacts associated with soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

Design Option

Montebello MSF At-Grade Option

Construction of the Montebello MSF At-Grade Option would generally have similar impacts as the base Montebello MSF site option. The Montebello MSF At-Grade Option would be designed and constructed in compliance with regulatory requirements, the MRDC, and recommendations contained in the design level geotechnical report as described in PM GEO-1, including recommendations on engineering and design considerations to ensure soil stability during construction; compliance with these regulatory and design requirements would ensure construction impacts associated with soil stability that could potentially result in landslides, lateral spreading, subsidence, liquefaction, or collapse would be less than significant.

7.4 Impact GEO-4: Expansive Soils

Impact GEO-4: Would a Build Alternative be located on expansive soil, as defined in Section 1803.5.3 of the CBC, creating substantial direct or indirect risks to life or property?

7.4.1 Alternative 1 Washington

7.4.1.1 Operational and Construction Impacts

As discussed in **Section 6.1**, clay-rich soils may exist locally within alluvial soils present along Alternative 1 that could swell and shrink with wetting and drying. The change in soil volume is capable of exerting enough force on structures to damage foundations, structures, and underground utilities. Damage can also occur as these soils dry out and contract. Expansive soils could have an impact on project components, including the stations, guideway, tunnel, and other fixed structures; expansive soils do not have distinct construction or operational impacts and are addressed through project design. Alternative 1 would be designed and constructed in accordance with the MRDC, Los Angeles County and other applicable local building codes, CBC, and other applicable design specifications as described in PM GEO-1 and described in **Section 3.0**. These design standards dictate that during final design, a geotechnical investigation (MRDC Section 5.6.2) be conducted, including detailed evaluation of hazards. The investigation would be part of Metro's comprehensive geologic/geotechnical field investigation program that is being currently developed and would include a detailed evaluation of these hazards. The design-level geotechnical investigations would provide information pertaining to the depths and areal extents of liquefaction, soil expansiveness, lateral spread, and seismically induced settlement. This includes obtaining soil samples and performing tests to assess the potentials for corrosion, consolidation, expansion and collapse. Based on the investigation and test results, design recommendation would incorporate the any of these issues, if they exist. Alternative 1 would be designed and constructed in accordance with the recommendations contained in the detailed design geotechnical investigation, including remediation of expansive soils if required. Expansive soil remediation could include soil removal and replacement, chemical treatment, or structural enhancements. Compliance with regulatory requirements, including compliance with the MRDC and adherence to recommendations identified in the geotechnical investigation as set forth in PM GEO-1, would ensure that construction and operation of Alternative 1 would not create a substantial direct or indirect risk associated with being located on expansive soils. Compliance with these regulatory and design requirements would ensure that impacts associated with expansive soils would be less than significant.

Design Options

Atlantic/Pomona Station Option

Alternative 1 with the Atlantic/Pomona Station Option would not have risks associated with expansive soils that differ from the base Alternative 1. The Atlantic/Pomona Station Option would be designed and constructed in compliance with regulatory requirements discussed in **Section 3.0**, including compliance with the MRDC and adherence to recommendations identified in the geotechnical investigation as set forth in PM GEO-1. Compliance with these regulatory and design requirements would ensure that operation and construction of Alternative 1 with the Atlantic/Pomona Station Option would not create a substantial direct or indirect risk associated with being located on expansive soil and the impact would be less than significant.

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the operational and construction impacts from expansive soils would be similar to those described under the base Alternative 1. The at-grade guideway under the Montebello At-Grade Option would be designed and constructed in compliance with regulatory requirements and the MRDC described in PM GEO-1 and as and as discussed in **Section 3.0**; compliance with these regulatory and design requirements would ensure that under Alternative 1 with the Montebello At-Grade Option, operational and construction impacts associated with expansive soils would be less than significant.

7.4.2 Alternative 2 Atlantic to Citadel IOS

7.4.2.1 Operational and Construction Impacts

As discussed in **Section 6.1**, clay-rich soils may exist locally within alluvial soils present along Alternative 2 that could swell and shrink with wetting and drying. The change in soil volume is capable of exerting enough force on structures to damage foundations, structures, and underground utilities. Damage can also occur as these soils dry out and contract. Expansive soils could have an impact on project components, including the stations, guideway, tunnel, and other fixed structures; expansive soils do not have distinct construction or operational impacts and are addressed through project design. Alternative 2 would be designed and constructed in accordance with the MRDC, Los Angeles County and other applicable local building codes, CBC, and other applicable design specifications as described in PM GEO-1 and as described in **Section 3.0**. These design standards dictate that during final design, a geotechnical investigation be conducted, including detailed evaluation of hazards. The investigation would be part of Metro's comprehensive geologic/geotechnical field investigation program that is being currently developed and would include a detailed evaluation of these hazards. The design-level geotechnical investigations would provide information pertaining to the depths and areal extents of liquefaction, soil expansiveness, lateral spread, and seismically induced settlement. Alternative 2 would be designed and constructed in accordance with the recommendations to be included in the detailed geotechnical final design reports. Expansive soil remediation could include soil removal and replacement, chemical treatment, or structural enhancements.

Alternative 2 would be designed and constructed in compliance with regulatory requirements and the MRDC as described in PM GEO-1 and as discussed in **Section 3.0**; compliance with these regulatory and design requirements would ensure that operational and construction impacts associated with expansive soils would be less than significant.

Design Option

Atlantic/Pomona Station Option

If the Atlantic/Pomona Station Option were selected, the operational and construction impacts from expansive soils would be similar to those described under the base Alternative 2. The Atlantic/Pomona Station Option would be designed and constructed in compliance with regulatory requirements and the MRDC as described in PM GEO-1 and as discussed in **Section 3.0**; compliance with these regulatory and design requirements would ensure that under Alternative 2 with the Atlantic/Pomona Station Option, operational and construction impacts associated with expansive soils would be less than significant.

7.4.3 Alternative 3 Atlantic to Greenwood IOS

7.4.3.1 Operational and Construction Impacts

As discussed in **Section 6.1**, clay-rich soils may exist locally within alluvial soils present along Alternative 3 that could swell and shrink with wetting and drying. Alternative 3 would be designed and constructed in accordance with the MRDC Los Angeles County and other applicable local building codes, CBC, and other applicable design specifications as described in PM GEO-1 and as described in **Section 3.0**. These design standards dictate that during final design, a geotechnical investigation be conducted, including detailed evaluation of geotechnical hazards. The investigation would be part of Metro's comprehensive geologic/geotechnical field investigation program that is being currently developed and would include a detailed evaluation of these hazards. The design-level geotechnical investigations would provide information pertaining to the depths and areal extents of liquefaction, soil expansiveness, lateral spread, and seismically induced settlement. Alternative 3 would be designed and constructed in accordance with the recommendations to be included in the detailed geotechnical final design reports. Expansive soil remediation could include soil removal and replacement, chemical treatment, or structural enhancements.

Alternative 3 would be designed in compliance with regulatory requirements and the MRDC as described in PM GEO-1 and as discussed in **Section 3.0**; compliance with these regulatory and design requirements would ensure that operational and construction impacts associated with expansive soils would be less than significant.

Design Options

Atlantic/Pomona Station Option

If the Atlantic/Pomona Station Option were selected, the operational and construction impacts from expansive soils would be similar to those described under the base Alternative 3. The Atlantic/Pomona Station Option would be designed and constructed in compliance with regulatory requirements and the MRDC as described in PM GEO-1 and as discussed in **Section 3.0**; compliance with these regulatory and design requirements would ensure that under Alternative 3 with the Atlantic/Pomona Station Option, operational and construction impacts associated with expansive soils would be less than significant.

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the operational and construction impacts from expansive soils would be similar to those described under the base Alternative 3 with an aerial configuration at this location. The at-grade guideway under the Montebello At-Grade Option would be designed and constructed in compliance with regulatory requirements and the MRDC as described in PM GEO-1 and as discussed in **Section 3.0**; compliance with these regulatory and design requirements would ensure that under Alternative 3 with the Montebello At-Grade Option, operational and construction impacts associated with expansive soils would be less than significant.

7.4.4 Maintenance and Storage Facilities

7.4.4.1 Operational and Construction Impacts

7.4.4.1.1 Commerce MSF

As discussed in **Section 6.1**, clay-rich soils may exist locally within the Commerce MSF site option that could swell and shrink with wetting and drying. The placement of the MSF on such soils could result in structural damage or distress. As with the Build Alternatives, discussed under **Section 7.4.1**, **Section 7.4.2**, and **Section 7.4.3**, the Commerce MSF site option would be designed and constructed in compliance with regulatory requirements and the MRDC as described in PM GEO-1 and as discussed in **Section 3.0**; compliance with these regulatory and design requirements would ensure that operational impacts associated with expansive soils would be less than significant.

7.4.4.1.2 Montebello MSF

As discussed in **Section 6.1**, clay-rich soils may exist locally within the Montebello MSF site option that could swell and shrink with wetting and drying. The placement of the MSF on such soils could result in structural damage or distress. As with the Build Alternatives, (see **Section 7.4.1**, **Section 7.4.2**, and **Section 7.4.3**), the Montebello MSF site option would be designed and constructed in compliance with regulatory requirements and the MRDC as described in PM GEO-1 and as discussed in **Section 3.0**; compliance with these regulatory and design requirements would ensure that operational and construction impacts associated with expansive soils would be less than significant relative to expansive soils.

Design Option

Montebello MSF At-Grade Option

Operation and construction of the Montebello MSF At-Grade Option would generally have similar impacts as the base Montebello MSF site option. The Montebello MSF At-Grade Option would be designed and constructed in compliance with regulatory requirements and the MRDC as described in PM GEO-1 and as discussed in **Section 3.0**; compliance with these regulatory and design requirements would ensure that the construction and operation of the Montebello MSF At-Grade Option would have less than significant impacts relative to expansive soils.

7.5 Impact GEO-5: Paleontological Resources

Impact GEO-5: Would a Build Alternative directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

7.5.1 Alternative 1 Washington

7.5.1.1 Operational Impacts

Operation of Alternative 1 would consist of LRT and would not involve any additional ground disturbance that could have a substantial adverse effect on a paleontological resources. Therefore, no impacts would occur.

Design Options

Atlantic/Pomona Station Option

Operation of Alternative 1 with the Atlantic/Pomona Station Option would consist of LRT and would not involve any additional ground disturbance that could have a substantial adverse effect on a paleontological resources. Therefore, no impacts would occur

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the operational impacts on paleontological resources would be the same as those described under the base Alternative 1 with an aerial configuration at this location. No operational impacts would occur.

7.5.1.2 Construction Impacts

Most of Alternative 1 is located in area of high sensitivity for paleontological resources. This means that paleontological resources are likely to be present, and loss of paleontological resources would occur during construction. Construction of Alternative 1 where resources are likely to be present would result in a direct impact to paleontological resources from soil disturbance including excavation, tunneling, and construction of underground stations. Additionally, the aerial and at-grade features would be located in areas that have a high sensitivity for paleontological resources, including undisturbed sediments hear the surface. Thus, there would also be direct impacts to paleontological resources associated with installation of supports for the aerial station and aerial guideways, ground disturbance for construction of the at-grade stations and installation of posts to support catenary systems for the at-grade alignment. The direct impacts to paleontological resources would include the loss of significant paleontological specimens and their pertinent stratigraphic and geographic data and would be significant without mitigation measures.

Implementation of MM GEO-1 through MM GEO-4, as described in **Section 9.5.1,** would reduce the potential impact on paleontological resources from some manual and mechanical construction activities. MM GEO-1 would provide for a qualified paleontologist and paleontological monitor to monitor excavation areas where paleontological resources are likely to occur during construction activities. MM GEO-2 would permit sampling, empower the paleontologist and monitor to temporarily halt construction or modify construction techniques if resources are discovered, and record and preserve any recovered specimens. MM GEO-3 and MM GEO-4 require that any recovered specimens will be prepared, catalogued, and submitted to a professional accredited museum repository. Together, these mitigation measures would reduce the potential impact from construction activities where monitoring is feasible.

Monitoring is feasible during excavation where the excavation site is reasonably accessible and visible, where soil spoils can be reasonably observed, and where construction methods do not completely destroy any potential specimen. Because of the nature of how the TBM operates, monitoring is not feasible. Consequently, while any ground disturbance in previously undisturbed sediments could encounter resources, the primary construction impact would result from boring the underground section from South La Verne Avenue to Smithway Street.

Given the boring technologies employed in recent Metro projects, there is no known way to monitor or mitigate boring impacts on paleontological resources because the TBM grinds the material as it moves forward, making it impossible to preserve fossils or bones. There is no fossil record for the area in which the TBM would operate that would provide a basis for determining how many paleontological resources could be impacted or the magnitude of the impact. The conclusion that there would be a significant impact is based on the sediment type alone and evidence that this sediment type has a high sensitivity for paleontological resources. Thus, construction using TBM would result in significant direct impacts on paleontological resources.

As described above, ground disturbance associated with construction of Alternative 1 would result in significant impacts on paleontological resources. MM GEO-1 through MM GEO-4 as identified in **Section 9.5.1** would be implemented to reduce impacts; however, because monitoring of tunnel boring is not feasible, unique paleontological resources may be destroyed and impacts would be significant and unavoidable. See **Section 9.5.1** for the proposed mitigation and impacts after incorporation of mitigation.

Design Options

Atlantic/Pomona Station Option

Alternative 1 with the Atlantic/Pomona Station Option would have similar paleontological impacts as the base Alternative 1. The Atlantic/Pomona Station Option is located within old alluvial fan deposits which have a high sensitivity for paleontological resources, including undisturbed sediments near the surface. Therefore, construction of Alternative 1 with the Atlantic/Pomona Station Option could disturb significant paleontological resources. Significant impacts on paleontological resources would occur. MM GEO-1 through MM GEO-4, which require monitoring for resources and cataloging any finds as described under the base Alternative 1, would be implemented; however, because monitoring TBM operations is not feasible, unique paleontological resources may be destroyed and impacts would be significant and unavoidable. See **Section 9.5.1** for the proposed mitigation and impacts after incorporation of mitigation.

Montebello At-Grade Option

Alternative 1 with the Montebello At-Grade Option would have similar paleontological impacts as the base Alternative 1. The Montebello At-Grade Option is located within old alluvial fan deposits which have a high sensitivity for paleontological resources, including undisturbed sediments near the surface. Therefore, construction of Alternative 1 with an at-grade guideway and an at-grade station at this location have the potential to disturb significant paleontological resources. Impacts would be similar to construction of the base Alternative 1. Significant impacts on paleontological resources could occur. MM GEO-1 through MM GEO-4, which require monitoring for resources and cataloging any finds as described under the base Alternative 1, would be implemented; however, because monitoring TBM operations is not feasible, unique paleontological resources may be destroyed and impacts would be significant and unavoidable. See **Section 9.5.1** for the proposed mitigation and impacts after incorporation of mitigation.

7.5.2 Alternative 2 Atlantic to Citadel IOS

7.5.2.1 Operational Impacts

Operation of Alternative 2 would consist of LRT and would not involve any additional ground-disturbance that could have a substantial adverse effect on a paleontological resources. Therefore, no impacts would occur.

Design Option

Atlantic/Pomona Station Option

Operation of Alternative 2 with the Atlantic/Pomona Station Option would consist of LRT and would not involve any additional ground-disturbance that could have a substantial adverse effect on paleontological resources. Therefore, no impacts would occur.

7.5.2.2 Construction Impacts

Alternative 2 is located in area of high sensitivity for paleontological resources and loss of paleontological resources would occur during construction. Construction of Alternative 2 would result in an impact to paleontological resources from excavation and soil disturbance where resources are likely to be present. Operation of the TBM and construction requiring excavation or other ground disturbance would result in direct impacts to paleontological resources. Implementation of MM GEO-1 through MM GEO-4, which require monitoring for resources and cataloging any finds as described in **Section 9.5.2,** would reduce the potential impact on paleontological resources from some manual and mechanical construction activities. Together, these mitigation measures would reduce the potential impact from construction activities where monitoring is feasible.

Monitoring is feasible during excavation where the excavation site is reasonably accessible and visible, where soil spoils can be reasonably observed, and where construction methods do not completely destroy any potential specimen. Because of the nature of how the TBM operates, monitoring is not feasible. Consequently, while any ground disturbance in previously undisturbed sediments could encounter resources, the primary construction impact would result from operation of the TBM to bore the underground section from South La Verne Avenue to Smithway Street. There is no known way to monitor or mitigate boring impacts on paleontological resources because the TBM grinds the material as it moves forward, making it impossible to preserve fossils or bones. Because tunnel boring would occur in sediments with a high sensitivity for paleontological resources, construction using TBM would result in significant direct impacts on paleontological resources.

As described above, ground disturbance associated with construction of Alternative 2 would result in significant impacts on paleontological resources. MM GEO-1 through MM GEO-4 as identified in **Section 9.5.2**, would be implemented to reduce impacts; however, because monitoring of tunnel boring is not feasible, unique paleontological resources may be destroyed and impacts would be significant and unavoidable. See **Section 9.5.2** for the proposed mitigation and impacts after incorporation of mitigation.

Design Option

Atlantic/Pomona Station Option

The Atlantic/Pomona Station Option is located within old alluvial fan deposits which have a high potential for paleontological resources, including undisturbed sediments near the surface. Therefore, construction of Alternative 2 with the Atlantic/Pomona Station Option has the potential to disturb paleontological resources. Significant impacts on paleontological resources would occur. MM GEO-1 through MM GEO-4, which require monitoring for resources and cataloging any finds as described under the base Alternative 1, would be implemented; however, because monitoring TBM operations is not feasible, unique paleontological resources may be destroyed and impacts would be significant and unavoidable. **Section 9.5.2** for the proposed mitigation and impacts after incorporation of mitigation.

7.5.3 Alternative 3 Atlantic to Greenwood IOS

7.5.3.1 Operational Impacts

Operation of Alternative 3 would consist of LRT and would not involve any additional ground-disturbance that could have a substantial adverse effect on a paleontological resources. Therefore, no impacts would occur.

Design Options

Atlantic/Pomona Station Option

If the Atlantic/Pomona Station Option were selected, the operational impacts on paleontological resources would be the same as those described under the base Alternative 3 with an aerial configuration at this location. No operational impacts would occur.

Montebello At-Grade Option

If the Montebello At-Grade Option were selected, the operational impacts on paleontological resources would be the same as those described under the base Alternative 3 with an aerial configuration at this location. No operational impacts would occur.

7.5.3.2 Construction Impacts

Alternative 3 is located in an area of high sensitivity for paleontological resources and loss of paleontological resources would occur during construction. Construction of Alternative 3 where resources are likely to be present would result in a direct impact to paleontological resources from soil disturbance including excavation, tunneling, and construction of underground stations. Additionally, the aerial features would be located in areas that have a high sensitivity for paleontological resources, including undisturbed sediments hear the surface. Thus, there would be direct impacts to paleontological resources associated with installation of supports for the aerial station and aerial. Implementation of MM GEO-1 through MM GEO-4, which require monitoring for resources and cataloging any finds as identified in **Section 9.5.3,** would reduce the potential impact on paleontological resources from some manual and mechanical construction activities.

Monitoring is feasible during excavation where the excavation site is reasonably accessible and visible, where soil spoils can be reasonably observed, and where construction methods do not completely destroy any potential specimen. Because of the nature of how the TBM operates, monitoring is not feasible. Consequently, while any ground disturbance in previously undisturbed sediments could encounter resources, the primary construction impact would result from operation of the TBM to bore the underground section from South La Verne Avenue to Smithway Street.

Given the boring technologies employed in recent Metro projects, there is no known way to monitor or mitigate boring impacts on paleontological resources because the TBM grinds the material as it moves forward, making it impossible to preserve fossils or bones. There is no fossil record for the area in which the TBM would operate that would provide a basis for determining how many paleontological resources could be impacted or the magnitude of the impact. The conclusion that there would be a significant impact is based on the sediment type alone and evidence that this sediment type has a high sensitivity for paleontological resources. Thus, construction using TBM would result in significant direct impacts on paleontological resources.

As described above, construction of Alternative 3 would result in significant impacts on paleontological resources. MM GEO-1 through MM GEO-4, identified in **Section 9.5.3,** would be implemented to reduce impacts; however, because monitoring of tunnel boring is not feasible, unique paleontological resources may be destroyed and impacts would be significant and unavoidable. See **Section 9.5.3** for the proposed mitigation and impacts after incorporation of mitigation.

Design Options

Atlantic/Pomona Station Option

The Atlantic/Pomona Station Option is located within old alluvial fan deposits which have a high potential for paleontological resources, including undisturbed sediments near the surface. Therefore, construction of Alternative 3 with the Atlantic/Pomona Station Option has the potential to disturb paleontological resources. Significant impacts on paleontological resources would occur. MM GEO-1 through MM GEO-4, which require monitoring for resources and cataloging any finds as described under the base Alternative 1, would be implemented; however, because monitoring TBM operations is not feasible, unique paleontological resources may be destroyed and impacts would be significant and unavoidable. See **Section 9.5.3** for the proposed mitigation and impacts after incorporation of mitigation.

Montebello At-Grade Option

The Montebello At-Grade Option is located within old alluvial fan deposits which have a high potential for paleontological resources, including undisturbed sediments near the surface. Therefore, construction of Alternative 3 with an at-grade guideway and an at-grade station at this location have the potential to disturb paleontological resources. MM GEO-1 through MM GEO-4, which require monitoring for resources and cataloging any finds as described under the base Alternative 1, would be implemented; however, because monitoring TBM operations is not feasible, unique paleontological resources may be destroyed and impacts would be significant and unavoidable. See **Section 9.5.3** for the proposed mitigation and impacts after incorporation of mitigation.

7.5.4 Maintenance and Storage Facilities

7.5.4.1 Operational Impacts

7.5.4.1.1 Commerce MSF

The Commerce MSF site option is within sediments mapped as older alluvial fan deposits. However, operations would not involve additional ground disturbance that could result in direct or indirect destruction of paleontological resources. Therefore, no impacts would occur.

7.5.4.1.2 Montebello MSF

The Montebello MSF site option is within sediments mapped as older alluvial fan deposits. However, operations would not involve additional ground disturbance that could result in direct or indirect destruction of paleontological resources. Therefore, no impacts would occur.

Design Option

Montebello MSF At-Grade Option

Operation of the Montebello MSF At-Grade Option would not involve additional ground disturbance that could result in direct or indirect destruction of paleontological resources. Therefore, no impacts would occur.

7.5.4.2 Construction Impacts

7.5.4.2.1 Commerce MSF

The Commerce MSF site option is within sediments mapped as older alluvial fan deposits which have a high potential for paleontological resources, including undisturbed sediments near the surface. Construction would have a significant impact on paleontological resources. Implementation of MM GEO-1 through MM GEO-4 would reduce the potential impact on paleontological resources from some manual and mechanical construction activities, as discussed in **Section 9.5.4**. Together, these mitigation measures would reduce the potential impact from construction activities at the MSF site options, where monitoring of the ground disturbance activities is feasible. Implementation of MM GEO-1 through MM GEO-4 as discussed in **Section 9.5.4** would reduce impacts to less than significant. See **Section 9.5.4** for the proposed mitigation and impacts after incorporation of mitigation.

7.5.4.2.2 Montebello MSF

The Montebello MSF site option is within sediments mapped as older alluvial fan deposits which have a high potential for paleontological resources, including undisturbed sediments near the surface. Construction would have a significant impact on paleontological resources. Implementation of MM GEO-1 through MM GEO-4 would reduce the potential impact on paleontological resources from some manual and mechanical construction activities as discussed in **Section 9.5.4**. Together, these mitigation measures would reduce the potential impact from construction activities at the MSF site options, where monitoring of the ground disturbance activities is feasible. Implementation of MM GEO-1 through MM GEO-4 as discussed in **Section 9.5.4** would reduce impacts to less than significant. See **Section 9.5.4** for the proposed mitigation and impacts after incorporation of mitigation.

Design Option

Montebello MSF At-Grade Option

The Montebello MSF site option is within sediments mapped as older alluvial fan deposits which have a high potential for paleontological resources, including undisturbed sediments near the surface. Construction of the Montebello MSF At-Grade Option could have the same impacts as construction of the base Montebello MSF site option. Construction impacts of the Montebello MSF At-Grade Option would be significant. Implementation of MM GEO-1 through MM GEO-4 would reduce the potential impact on paleontological resources from some manual and mechanical construction activities as discussed in **Section 9.5.4**. Together, these mitigation measures would reduce the potential impact from construction activities at the MSF site options, where monitoring of the ground disturbance activities is feasible. Implementation of MM GEO-1 through MM GEO-4 as discussed in **Section 9.5.4** would reduce impacts to less than significant. See **Section 9.5.4** for the proposed mitigation and impacts after incorporation of mitigation.

8.0 PROJECT MEASURES

Project measure are design features, best management practices, or other measures required by law and/or permit approvals. These measures are components of the Project and are applicable to all Build Alternatives, design options, and MSF site options and MSF design option.

PM GEO-1: The Build Alternatives shall be designed and constructed per the 2018 Metro Rail Design Criteria (MRDC). The MRDC incorporates various design specifications from the Federal Highway Administration (FHWA), California Department of Transportation (Caltrans), the State of California, the County of Los Angeles, and other sources by reference. Key compliance sections of the MRDC relative to geology and soils are Section 5.3, Section 5.4, Section 5.6, and MRDC Section 5 Appendix, Metro Supplemental Seismic Design Criteria. Section 5.6 of the MRDC provides detailed requirements for planning and conducting a geotechnical investigation, geotechnical design methodologies, and reporting. In addition, Caltrans and the Los Angeles County Building Code (based on the CBC) have independent design criteria for bridges and aerial structures (Caltrans) and building structures (County of Los Angeles) that are also required. In accordance with the MRDC, geotechnical report recommendations shall be incorporated into the project plans and specifications. These recommendations shall be a product of final design and shall address potential subsurface hazards. Without these report recommendations, the project plans and specifications shall not be approved and the Build Alternatives shall not be allowed to advance into the final design stage or into construction.

9.0 MITIGATION MEASURES AND IMPACTS AFTER MITIGATION

9.1 GEO-1: Exposure to Seismic Hazards

Impact GEO-1: Would a Build Alternative expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

- Rupture of a known earthquake fault, as delineated on the most recent 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)
- Strong seismic ground shaking
- Seismic-related ground failure, including liquefaction
- Landslides

9.1.1 Alternative 1 Washington

As discussed in **Section 7.1.1**, operation and construction of the base Alternative 1 or Alternative 1 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option, would have a less than significant impact under Impact GEO-1; therefore, no mitigation measures would be required.

9.1.2 Alternative 2 Atlantic to Citadel IOS

As discussed in **Section 7.1.2**, operation and construction of the base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option would have a less than significant impact under Impact GEO-1; therefore, no mitigation measures would be required.

9.1.3 Alternative 3 Atlantic to Greenwood IOS

As discussed in **Section 7.1.3** operation and construction of the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option would have a less than significant impact under Impact GEO-1; therefore, no mitigation measures would be required.

9.1.4 Maintenance and Storage Facilities

As discussed in **Section 7.1.4**, operation and construction of either the Commerce MSF site option, the Montebello MSF site option, or the Montebello MSF At-Grade Option would have no operational or construction impacts under Impact GEO-1. Therefore, no mitigation is required.

9.2 GEO-2: Soil Erosion

Impact GEO-2: Would a Build Alternative result in substantial soil erosion or the loss of topsoil?

9.2.1 Alternative 1 Washington

As described in **Section 7.2.1**, operation and construction of the base Alternative 1 or Alternative 1 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option would have a less than significant impact under Impact GEO-2; therefore, no mitigation measures would be required.

9.2.2 Alternative 2 Atlantic to Citadel IOS

As described in **Section 7.2.2**, operation and construction of the base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option would have a less than significant impact under Impact GEO-2; therefore, no mitigation measures would be required.

9.2.3 Alternative 3 Atlantic to Greenwood IOS

As described in **Section 7.2.3**, construction and operation of the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option would have a less than significant impact under Impact GEO-2; therefore, no mitigation measures would be required.

9.2.4 Maintenance and Storage Facilities

As described in **Section 7.2.4** the operation and construction of either the Commerce MSF site option, the Montebello MSF site option, or the Montebello MSF At-Grade Option would have a less than significant impact under Impact GEO-1; therefore, no mitigation measures would be required.

9.3 GEO-3: Soil Stability

Impact GEO-3: Would a Build Alternative 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?

9.3.1 Alternative 1 Washington

As discussed in **Section 7.3.1**, operation and construction of the base Alternative 1 or Alternative 1 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option would have less than significant impact under Impact GEO-3; therefore, no mitigation would be required.

9.3.2 Alternative 2 Atlantic to Citadel IOS

As discussed in **Section 7.3.2**, operation and construction of the base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option would have less than significant impacts under Impact GEO-3; therefore, no mitigation is required.

9.3.3 Alternative 3 Atlantic to Greenwood IOS

As discussed in **Section 7.3.3**, operation and construction of the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option would have less than significant impacts under GEO-3; therefore, no mitigation is required.

9.3.4 Maintenance and Storage Facilities

As discussed in **Section 7.3.4**, operation and construction of either the Commerce MSF site option, the Montebello MSF site option, or the Montebello MSF At-Grade Option would result in less than significant impacts under Impact GEO-3; therefore, no mitigation is required.

9.4 GEO-4: Expansive Soils

Impact GEO-4: Would a Build Alternative be located on expansive soil, as defined in Section 1803.5.3 of the CBC, creating substantial direct or indirect risks to life or property?

9.4.1 Alternative 1 Washington

As discussed in **Section 7.4.1**, the base Alternative 1 or Alternative 1 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option would not be located on expansive soils; construction and operation of the base Alternative 1 or Alternative 1 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option would have less than significant impacts under GEO-4; therefore, no mitigation is required.

9.4.2 Alternative 2 Atlantic to Citadel IOS

As discussed in **Section 7.4.2**, the base Alternative 2 or Alternative 2 with the Atlantic/Pomona Station Option would not be located on expansive soils; construction and operation of Alternative 2 would have less than significant impacts under GEO-4; therefore, no mitigation is required.

9.4.3 Alternative 3 Atlantic to Greenwood IOS

As discussed in **Section 7.4.3**, the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option would not be located on expansive soils; construction and operation of Alternative 3 would have less than significant impacts under GEO-4; therefore, no mitigation is required.

9.4.4 Maintenance and Storage Facilities

As discussed in **Section 7.4.4**, the Commerce MSF site option, Montebello MSF site option, or the Montebello MSF At-Grade Option would not be located on expansive soils; construction and operation would have less than significant impacts under GEO-4; therefore, no mitigation is required.

9.5 GEO-5: Paleontological Resources

Impact GEO-5: Would a Build Alternative directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

9.5.1 Alternative 1 Washington

As discussed in **Section 7.5.1**, the base Alternative 1 would have no operational impacts on paleontological resources. However, there would be significant impacts on paleontological resources during construction from boring the underground portion of the alignment and ground disturbance associated with the construction of aerial guideways, at-grade and aerial station construction, installation of posts to support catenary systems for the at-grade alignment and constructing the underground stations.

9.5.1.1 Potential Operational and Construction Mitigation Measures

For construction impacts, the following mitigation measures would reduce impacts to paleontological resources where the TBM is not used:

MM GEO-1: Metro shall retain a qualified paleontologist and a qualified paleontological monitor to carry out the following tasks: The qualified paleontologist shall supervise the qualified paleontological monitor to monitor excavation in areas identified as likely to contain paleontological resources. These areas are defined as all areas within the Older alluvium in the project site where planned excavation will exceed three feet below the surface or three feet into undisturbed sediments and all areas within the Younger alluvium in the project site where planned excavation will exceed 10 feet below the surface or 10 feet into undisturbed sediments. The qualified paleontologist shall retain the option to reduce monitoring if, in his or her professional opinion, sediments being monitored are previously disturbed. Monitoring may also be reduced if the potentially fossiliferous units are determined to have low potential to contain fossil resources.

MM GEO-2: Metro shall make sure that the qualified paleontologist and the qualified paleontological monitor are equipped to salvage fossils and samples of sediment as they are unearthed to avoid construction delays and empowered to temporarily halt or divert equipment to allow removal of abundant or large specimens. Since Older alluvium yields small fossil specimens (microvertebrate fossils) likely to go unnoticed during typical large-scale paleontological monitoring, matrix samples shall be collected and processed to determine the potential for small fossils to be recovered prior to substantial excavations in those sediments. If this sampling indicates that these units do possess small fossils, a matrix sample of 6,000 pounds shall be collected at various locations, to be specified by the paleontologist, within the construction area. These matrix samples shall also be processed for small fossils.

MM GEO-3: The qualified paleontologist shall make certain that recovered specimens be prepared to a point of identification and permanent preservation, including washing of sediments to recover small invertebrate and vertebrate fossils.

MM GEO-4: Metro shall make certain that specimens shall be curated into a professional accredited museum repository with permanent retrievable storage. A report of findings, with an appended itemized inventory of specimens, shall be prepared. The report and inventory, when submitted to the professional accredited museum repository, shall signify completion of the program to mitigate impacts to paleontological resources.

9.5.1.2 Design Option Potential Operational or Construction Mitigation Measures

Atlantic/Pomona Station Option

MM GEO-1 through MM GEO-4, discussed in **Section 9.5.1.1**, will be implemented during construction. No additional mitigation measures are proposed for Alternative 1 with the Atlantic/Pomona Station Option.

Montebello At-Grade Option

MM GEO-1 through MM GEO-4, discussed in **Section 9.5.1.1**, will be implemented during construction. No additional mitigation measures are proposed for Alternative 1 with the Montebello At-Grade Option.

9.5.1.3 Impacts After Mitigation

9.5.1.3.1 Operational Impacts Determination

No mitigation is required for operation of the base Alternative 1 or Alternative 1 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option.

9.5.1.3.2 Construction Impacts Determination

Impacts would be reduced through compliance with MM GEO-1 through MM GEO-4 during construction of base Alternative 1 or Alternative 1 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option. However, impacts from boring cannot be mitigated. Therefore, impacts on paleontological resources would be significant and unavoidable.

9.5.2 Alternative 2 Atlantic to Citadel IOS

As discussed in **Section 7.5.2**, the base Alternative 2 would have no operational impacts on paleontological resources. However, there would be significant impacts on paleontological resources during construction.

9.5.2.1 Potential Operational and Construction Mitigation Measures

MM GEO-1 through MM GEO-4, described in **Section 9.5.1.1,** will be implemented during construction. No additional mitigation is proposed for the base Alternative 2.

9.5.2.2 Design Option Potential Operational or Construction Mitigation Measures

Atlantic/Pomona Station Option

MM GEO-1 through MM GEO-4, described in **Section 9.5.1.1**, will be implemented during construction. No additional mitigation is proposed for Alternative 2 with the Atlantic/Pomona Station Option.

9.5.2.3 Impacts After Mitigation

9.5.2.3.1 Operational Impacts Determination

No mitigation is required for operation of the base Alternative 2.

Atlantic/Pomona Station Option

No mitigation is required for operation of Alternative 2 with the Atlantic/Pomona Station Option.

9.5.2.3.2 Construction Impacts Determination

Impacts would be reduced through compliance with MM GEO-1 through MM GEO-4 during construction of the base Alternative 2. However, impacts from boring cannot be mitigated. Therefore, impacts on paleontological resources would be significant and unavoidable.

Atlantic/Pomona Station Option

Impacts would be reduced through compliance with MM GEO-1 through MM GEO-4 during construction of Alternative 2 with the Atlantic/Pomona Station Option. However, impacts from boring cannot be mitigated. Therefore, impacts on paleontological resources would be significant and unavoidable.

9.5.3 Alternative 3 Atlantic to Greenwood IOS

As discussed in **Section 7.5.3**, the base Alternative 3 would have no operational impacts on paleontological resources. However, there would be significant impacts on paleontological resources during construction.

9.5.3.1 Potential Operational and Construction Mitigation Measures

MM GEO-1 through MM GEO-4, described in **Section 9.5.1.1**, will be implemented during construction. No additional mitigation is proposed for the base Alternative 3.

9.5.3.2 Design Option Potential Operational or Construction Mitigation Measures

Atlantic/Pomona Station Option

MM GEO-1 through MM GEO-4, described in **Section 9.5.1.1**, will be implemented during construction. No additional mitigation is proposed for Alternative 3 the Atlantic/Pomona Station Option.

Montebello At-Grade Option

MM GEO-1 through MM GEO-4, described in **Section 9.5.1.1**, will be implemented during construction. No additional mitigation is proposed for Alternative 3 the Montebello At-Grade Option.

9.5.3.3 Impacts After Mitigation

9.5.3.3.1 Operational Impacts Determination

No mitigation is required for operation of the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option.

9.5.3.3.2 Construction Impacts Determination

Impacts would be reduced through compliance with MM GEO-1 through MM GEO-4 during construction of the base Alternative 3 or Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option. However, impacts from boring cannot be mitigated. Therefore, impacts on paleontological resources would be significant and unavoidable.

9.5.4 Maintenance and Storage Facilities

As discussed in **Section 7.5.4,** the Commerce MSF site option and Montebello MSF site option would have no operational impacts on paleontological resources. However, there would be significant impacts on paleontological resources during construction.

9.5.4.1 Commerce Potential Operational or Construction Mitigation Measures

MM GEO-1 through MM GEO-4, described in **Section 9.5.1.1**, will be implemented during construction. No additional mitigation is required for operation or construction of the Commerce MSF site option.

9.5.4.2 Montebello Potential Operational or Construction Mitigation Measures

MM GEO-1 through MM GEO-4, described in **Section 9.5.1.1**, will be implemented during construction. No additional mitigation is required for operation or construction of the Montebello MSF site option.

Design Option

Montebello MSF At-Grade Option

MM GEO-1 through MM GEO-4, described in **Section 9.5.1.1**, will be implemented. No additional mitigation is required for operation or construction of the Montebello MSF At-Grade Option.

9.5.4.3 Impacts After Mitigation

9.5.4.3.1 Operational Impacts Determination

Commerce MSF

Operation of the Commerce MSF site option would have no impact under Impact GEO-5 and no mitigation is required.

Montebello MSF and Design Option

Operation of the Montebello MSF site option or the Montebello MSF At-Grade Option would have no impact under Impact GEO-4 and no mitigation is required.

9.5.4.3.2 Construction Impacts Determination

Commerce MSF

Implementation of MM GEO-1 through MM GEO-4 would reduce construction impacts to less than significant.

Montebello MSF and Design Option

Implementation of MM GEO-1 through MM GEO-4 would reduce impacts associated with construction of the Montebello MSF site option and Montebello MSF At-Grade Option to less than significant.

9.6 Mitigation Measure Applicability

As described above, one or more Build Alternatives and/or MSF site options have been identified as having significant geology, soils, seismicity and paleontological resources impacts. Mitigation measures to address these impacts are also identified. **Table 8-1** summarizes which measures are applicable to each Build Alternative and MSF site option. Unless otherwise noted, the Build Alternative mitigation measures apply to the base alternative and design option, and the MSF mitigation measures apply to the Commerce MSF site option and the Montebello MSF site option. If there would be no impact or the impact is less than significant, no mitigation is required and, therefore, as identified in **Table 8-1**, mitigation measures are not applicable (N/A).

See **Table 8-1** for summary of mitigation measures.

Table 8-1. Summary of Mitigation Measure Alternative Applicability

Mitigation Measure	Washington Alternative	Atlantic to Citadel IOS	Atlantic to Greenwood IOS	MSF
GEO-1 Exposure to Seismic Hazards				
None	N/A	N/A	N/A	N/A
GEO-2 Soil Erosion				
None	N/A	N/A	N/A	N/A
GEO-3 Soil Stability				
None	N/A	N/A	N/A	N/A
GEO-4 Expansive Soils				
None	N/A	N/A	N/A	N/A
GEO-5 Paleontological Resources				
MM GEO-1	Applicable	Applicable	Applicable	Applicable
MM GEO-2	Applicable	Applicable	Applicable	Applicable
MM GEO-3	Applicable	Applicable	Applicable	Applicable
MM GEO-4	Applicable	Applicable	Applicable	Applicable

10.0 NO PROJECT ALTERNATIVE

10.1 No Project Alternative

10.1.1 Description

The No Project Alternative is required by CEQA Guidelines Section 15126.6 (e)(2) and assumes that the Project would not be implemented by Metro. The No Project Alternative would maintain existing transit service through the year 2042. No new transportation infrastructure would be built within the Project vicinity aside from projects currently under construction or funded for construction and operation by 2042 via the 2008 Measure R or 2016 Measure M sales taxes. This alternative would include the highway and transit projects in Metro's LRTP Update and SCAG's 2020 RTP/SCS. Under the No Project Alternative, none of the proposed Build Alternatives, design options, or MSFs would be constructed or operated.

10.1.2 Impacts

No Project-related construction activities or changes in operation are proposed under the No Project Alternative. Therefore, no Project-related impacts would occur related to geotechnical, subsurface and seismic hazards under the No Project Alternative.

10.1.2.1 Exposure to Seismic Hazards

No Project Alternative would not involve Project-related construction or operation that could directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, strong seismic ground shaking, seismic-related ground failure, or landslides. The No Project Alternative would not increase exposure to seismic hazards and there would be no impact.

10.1.2.2 Soil Erosion

The No Project Alternative would not involve Project-related construction or operations that could result in erosion of soils. There would be no impact.

10.1.2.3 Soil Stability

The No Project Alternative would not result in new Project-related construction or operations on unstable soils or reduce soil stability. There would be no impact.

10.1.2.4 Expansive Soils

The No Project Alternative would not result in new Project-related construction or operations located on expansive soils. There would be no impact.

10.1.2.5 Paleontological Resources

The No Project Alternative would not result in new Project-related construction or operations and would destroy paleontological resources. There would be no impact.

11.0 SUMMARY OF ALTERNATIVES

Table 10-1 provides a summary of impacts for the No Project Alternative, Build Alternatives, and the MSF site options.

Table 10-1. Significant Impacts Remaining After Mitigation

Impact Topic	No Project Alternative	Alternative 1	Alternative 2	Alternative 3	MSF
Impact GEO-1: Exposure to Seismic Hazards	No impact	Less than significant impact	Less than significant impact	Less than significant impact	Less than significant impact
Impact GEO-2: Soil Erosion	No impact	Less than Significant	Less than significant impact	Less than significant impact	Less than Significant
Impact GEO-3: Soil Stability	No impact	Less than significant impact	Less than significant impact	Less than significant impact	Less than significant impact
Impact GEO-4: Expansive Soil	No impact	Less than significant impact	Less than significant impact	Less than significant impact	Less than significant impact
Impact GEO-5: Paleontological Resources	No impact	Significant and unavoidable	Significant and unavoidable	Significant and unavoidable	Less than significant impact

11.1 No Project

The No Project Alternative would maintain existing transit service through the year 2042. No new transportation infrastructure would be built within the GSA or DSA aside from projects currently under construction or funded for construction and operation by 2042 via the 2008 Measure R or 2016 Measure M sales taxes. This alternative would include the highway and transit projects in Metro's LRTP Update and the 2020 SCAG RTP. The No Project Alternative would not result in significant impacts under GEO-1 exposure to seismic hazards, GEO-2 soil erosion, GEO-3 soil stability, GEO-4 expansive soils, or GEO-5 paleontological resources; therefore, no mitigation measures would be required.

11.2 Alternative 1 Washington + MSF

The operation and construction of the base Alternative 1 and the either the Commerce MSF or Montebello MSF site option would have a less than significant impact under Impacts GEO-1, GEO-2, GEO-3, and GEO-4. No mitigation measures would be required.

The operation of Alternative 1 and the Commerce MSF site option or Montebello MSF site option would have a less than significant operational impact on paleontological resources under Impact GEO-5. No mitigation measures would be required. However, the construction of the base Alternative

1 and the either the Commerce MSF or Montebello MSF site option would have a significant construction impact on paleontological resources under Impact GEO-5. While impacts would be reduced with implementation of MM GEO-1, MM GEO-2, MM GEO-3, and MM GEO-4, impacts associated with tunnel boring for the underground portion of the alignment would remain significant and unavoidable.

11.2.1 Alternative 1 Washington + MSF + Design Options

The construction and operation of Alternative 1 with either the Atlantic/Pomona Station Option or the Montebello At-Grade Option and the Commerce MSF site option, Montebello MSF site option or Montebello MSF At-Grade Option would have a less than significant impact under Impacts GEO-1, GEO-2, GEO-3, and GEO-4. No mitigation measures would be required.

The operation of Alternative 1 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option and either the Commerce site option, Montebello MSF site option, or the Montebello MSF At-Grade Option would have a less than significant impact on paleontological resources under Impact GEO-5. No mitigation measures would be required. However, the construction of Alternative 1 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option and either the Commerce site option, Montebello MSF site option, or the Montebello MSF At-Grade Option would have a significant construction impact on paleontological resources under Impact GEO-5. While impacts would be reduced with implementation of MM GEO-1, MM GEO-2, MM GEO-3, and MM GEO-4, impacts associated with tunnel boring for the underground portion of the alignment would remain significant and unavoidable.

11.3 Alternative 2 Atlantic to Citadel IOS + MSF

The construction and operation of the base Alternative 2 and the Commerce MSF site option would have a less than significant impact under Impacts GEO-1, GEO-2, GEO-3, and GEO-4. No mitigation measures would be required.

The operation of the base Alternative 2 and the Commerce MSF site option would have a less than significant operational impact on paleontological resources under Impact GEO-5. No mitigation measures would be required. However, the construction of the base Alternative 2 and the Commerce MSF site option would have a significant construction impact on paleontological resources under Impact GEO-5. Even with implementation of MM GEO-1, MM GEO-2, MM GEO-3, and MM GEO-4, impacts associated with tunnel boring for the underground portion of the alignment would remain significant and unavoidable.

11.3.1 Alternative 2 Atlantic to Citadel IOS + MSF + Design Option

The construction and operation of Alternative 2 with the Atlantic/Pomona Station Option and the Commerce MSF site option would have a less than significant impact under Impacts GEO-1, GEO-2, GEO-3, and GEO-4. No mitigation measures would be required.

The operation of Alternative 2 with the Atlantic/Pomona Station Option and the Commerce MSF site option would have a less than significant operational impact on paleontological resources under Impact GEO-5. No mitigation measures would be required. However, the construction of Alternative 2 with the Atlantic/Pomona Station Option and the Commerce MSF site option would have a significant construction impact on paleontological resources under Impact GEO-5. Even with implementation of MM GEO-1, MM GEO-2, MM GEO-3, and MM GEO-4, impacts associated with tunnel boring for the underground portion of the alignment would remain significant and unavoidable.

11.4 Alternative 3 Atlantic to Greenwood IOS + MSF

The construction and operation of the base Alternative 3 and either the Commerce MSF site option or Montebello MSF site option would have a less than significant impact under Impacts GEO-1, GEO-2, GEO-3, and GEO-4. No mitigation measures would be required.

The operation of the base Alternative 3 and either the Commerce MSF site option or Montebello MSF site option would have a less than significant impact on paleontological resources under Impact GEO-5. No mitigation measures would be required. However, the construction of the base Alternative 3 and either the Commerce MSF site option or Montebello MSF site option would have a significant construction impact on paleontological resources under Impact GEO-5. While impacts would be reduced with implementation of MM GEO-1, MM GEO-2, MM GEO-3, and MM GEO-4, impacts associated with tunnel boring for the underground portion of the alignment would remain significant and unavoidable.

11.4.1 Alternative 3 Atlantic to Greenwood + MSF + Design Options

The construction and operation of Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option and either the Commerce site option, Montebello MSF site option, or the Montebello MSF At-Grade Option would have a less than significant impact under Impacts GEO-1, GEO-2, GEO-3, and GEO-4. No mitigation measures would be required.

The operation of Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option and either the Commerce site option, Montebello MSF site option, or the Montebello MSF At-Grade Option would have a less than significant operational impact on paleontological resources under Impact GEO-5. No mitigation measures would be required. However, the construction of Alternative 3 with the Atlantic/Pomona Station Option and/or the Montebello At-Grade Option and either the Commerce site option, Montebello MSF site option, or the Montebello MSF At-Grade Option would have a significant construction impact on paleontological resources under Impact GEO-5. While impacts would be reduced with implementation of MM GEO-1, MM GEO-2, MM GEO-3, and MM GEO-4, impacts associated with tunnel boring for the underground portion of the alignment impacts would remain significant and unavoidable.

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Hong Yang PhD, PE, GE, PG, CEG	Senior Geotechnical Engineer	PhD, Geotechnical Engineering, Iowa State University, Iowa, US, 2005. M.Eng., Geotechnical Engineering, Nanyang Technological University, Singapore, 2002 B.Eng., Hydrogeology and Engineering Geology, Tongji University, Shanghai, China, 1990	31
John Newby PE, GE	Principal Geotechnical Engineer	B.Sc., Civil Engineering, University of California, Berkeley, 1976 M.Sc., Civil Engineering, University of California, Berkeley, 1976	45

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