APPENDIX I

GEOTECHNICAL DOCUMENT IN SUPPORT OF THE ENVIRONMENTAL IMPACT REPORT

LOS ANGELES AERIAL RAPID TRANSIT
LOS ANGELES, CALIFORNIA

GEOTECHNICAL DOCUMENT

IN SUPPORT OF THE ENVIRONMENTAL IMPACT REPORT

Prepared for the Los Angeles Aerial Rapid Transit Draft Environmental Impact Report

PREPARED BY
ENGEO Incorporated

September 2022

PROJECT NO.
16037.000.000

ENGEO
Expect Excellence

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16037.000.000

September 2022

AECOM

GEOTECHNICAL DOCUMENT
Prepared for the Los Angeles Aerial Rapid Transit Draft Environmental Impact Report

We are pleased to submit this document characterizing the general geologic/geotechnical conditions of the Los Angeles Aerial Rapid Transit (LA ART) project in Los Angeles, California. This report is a compilation of adjacent publicly available previous geotechnical assessments and explorations to assist in preparation of the Draft Environmental Impact Report (EIR).

Sincerely,

ENGEO Incorporated

J. Brooks Ramsdell, CEG

Uri Eliahu, GE

bh/br/jtb/ue/dt

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1.0 EXECUTIVE SUMMARY

This report presents the results of the review of existing data for the Los Angeles Aerial Rapid Transit Project (Project) in Los Angeles, California. The purpose of the study was to review existing data at the site and provide preliminary geologic and geotechnical findings and conclusions in support of the Project's Draft Environmental Impact Report (EIR). The executive summary briefly summarizes results of the review and should be used only in conjunction with the findings and conclusions presented in the attached report. A summary of the significant findings and conclusions is presented below.

The subsurface soil along the proposed Project alignment generally consists of fill ranging in thickness from a few feet to up to 100 feet at the Dodger Stadium Station. This fill is generally considered uncertified and may require special design considerations. Beneath the fill is a layer of alluvial soil consisting of sand, gravel, and cobble up to 50 feet thick over Puente Formation bedrock.

- Groundwater is relatively shallow, at depths ranging from about 20 to 30 feet below ground surface, for most of the proposed Project alignment along Alameda and Spring Streets to the Los Angeles State Historic Park. The depth to groundwater increases to approximately 60 feet below the ground surface at the proposed Broadway Junction and Stadium Tower. The estimated depth to groundwater at the Dodger Stadium Station is approximately 70 feet below the ground surface.

- No active or potentially active faults capable of surface fault rupture are known to cross the site, and the site is not located within a currently delineated State of California Alquist-Priolo Earthquake Fault Zone. Accordingly, the risk of surface rupture due to faulting is considered low. However, the Project area may be subjected to strong ground shaking.

- The California Geological Survey (CGS, 2017) has identified that portions of the alignment are within an area designated as potentially liquefiable. Potential for liquefaction may exist at the site.

- The probability of other geologic hazards, such as tsunamis, seiches, deep-seated landslides, or ground subsidence affecting the site, is considered low.

- The proposed Project structures are likely to be heavily loaded structures, likely requiring deep foundations such as drilled piles/piers. Special consideration must be given to nearby structures, subsurface conditions, and loading in designing the foundations.

- Wet method drilling or casing may be required, with relatively clean cohesionless soil and groundwater expected at relatively shallow depths. Cobbles and possibly boulders should be expected, as well as possibly contaminated soil and groundwater.

It is ENGEO's professional opinion that the proposed Project is feasible from a geotechnical standpoint, provided the recommended mitigation measures presented in this geotechnical report are incorporated into the Project design and construction.

2.0 INTRODUCTION

ENGEO prepared this document to summarize the geologic and geotechnical conditions for the proposed Los Angeles Aerial Rapid Transit Project (Project). This document was prepared based on a desktop study of readily available publicly accessible geotechnical reports and data. Geotechnical explorations and laboratory testing were not a part of this initial preliminary study scope.

The information presented herein is intended to assist in the Project's Draft Environmental Impact Report (EIR). The document considers applicable federal, state, and local (county/city) regulations regarding seismic and other geotechnical or geological hazards.

This document was prepared for the use in preparing the Project Draft EIR. This document may not be reproduced for any other purposes, in whole or in part, by any means whatsoever, nor may it be quoted or excerpted without the express written consent of ENGEO.

3.0 PROJECT DESCRIPTION

3.1 PROJECT OVERVIEW

The proposed Los Angeles Aerial Rapid Transit Project (proposed Project) would connect Los Angeles Union Station (LAUS) to the Dodger Stadium property via an aerial gondola system. The proposed Project would include an intermediate station at the southernmost entrance of the Los Angeles State Historic Park. The proposed Project would provide an aerial rapid transit (ART) option for visitors to Dodger Stadium, while also providing access between the Dodger Stadium property, the surrounding communities, including Chinatown, Mission Junction, the Los Angeles State Historic Park, Elysian Park, and Solano Canyon, to the regional transit system accessible at LAUS. The aerial gondola system would be approximately 1.2 miles long and consist of cables, three passenger stations, a non-passenger junction, towers, and gondola cabins. When complete, the proposed Project would have a maximum capacity of approximately 5,000 people per hour per direction, and the travel time from LAUS to Dodger Stadium would be approximately 7 minutes. The proposed Project would provide amenities at the Los Angeles State Historic Park and would provide pedestrian improvements, including hardscape and landscape improvements. The ART system has the ability to overcome grade and elevation issues between LAUS and Dodger Stadium and provide safe, zero emission, environmentally friendly, and high-capacity transit connectivity in the Project area that would reduce greenhouse gas (GHG) emissions as a result of reduced vehicular congestion in and around Dodger Stadium and on neighborhood streets, arterial roadways, and freeways. The proposed Project would operate daily to serve existing residents, workers, park users, and visitors to Los Angeles.

Established aerial gondola transit systems worldwide, such as in La Paz, Bolivia, and Mexico City, Mexico, are being used as rapid transit for the urban population that they serve. The proposed Project would employ a Tricable Detachable Gondola system (also known as "3S").[1] 3S Gondola system cabins carry approximately 30 to 40 passengers. Similar systems are used in Koblenz, Germany, Phu Quoc, Vietnam, and Toulouse, France.

[1] The naming convention for this system is derived from the German word "seil", which translates in English to "rope". Hence, Tricable Detachable Gondola systems are known as a "3S" systems due to the use of three ropes, or cables.

3.2 PROJECT LOCATION

The proposed Project is located in the City of Los Angeles, situated northeast of downtown Los Angeles. Exhibit 3.2-1 shows the regional location of the proposed Project. The proposed Project would commence adjacent to LAUS and El Pueblo de Los Angeles (El Pueblo) and terminate at Dodger Stadium, with an intermediate station at the southernmost entrance of the Los Angeles State Historic Park. The proposed Project would include three stations, a non-passenger junction, and three cable-supporting towers at various locations along the alignment. As shown in Exhibit 3.2-2, the proposed Project location would generally be located within public right-of-way (ROW), or on publicly owned property, following Alameda Street and then continuing along Spring Street in a northeast direction through the community of Chinatown to the southernmost corner of the Los Angeles State Historic Park. The alignment would then continue northeast over the western edge of the Los Angeles State Historic Park and the Los Angeles County Metropolitan Transportation Authority (Metro) L Line (Gold) to the intersection of North Broadway and Bishops Road. At this intersection, the proposed Project alignment would turn and continue northwest following Bishops Road toward its terminus at Dodger Stadium, located in the Elysian Park community. Exhibit 3.2-2 provides an overview of the proposed Project location.

EXHIBIT 3.2-1: Regional Location Map

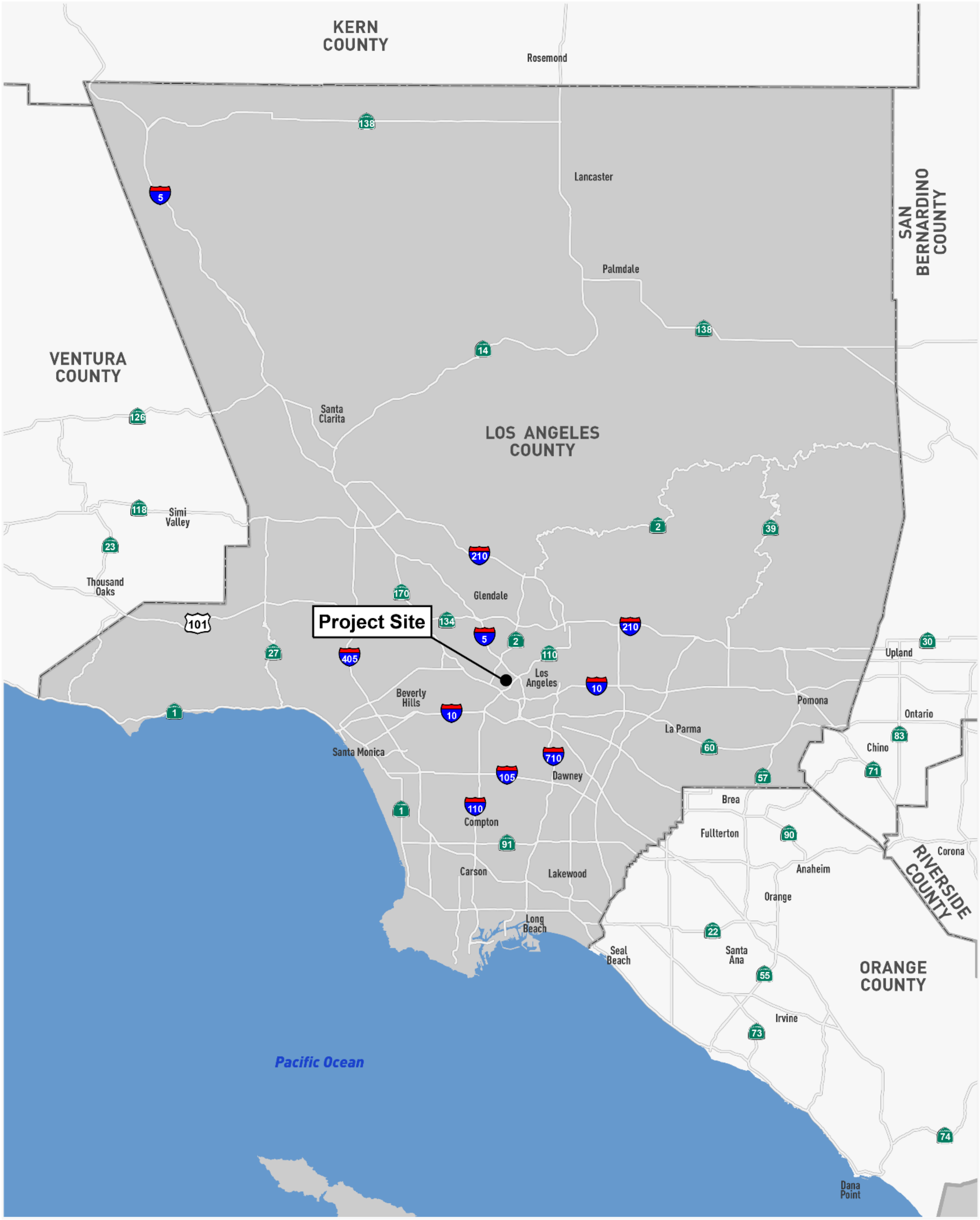
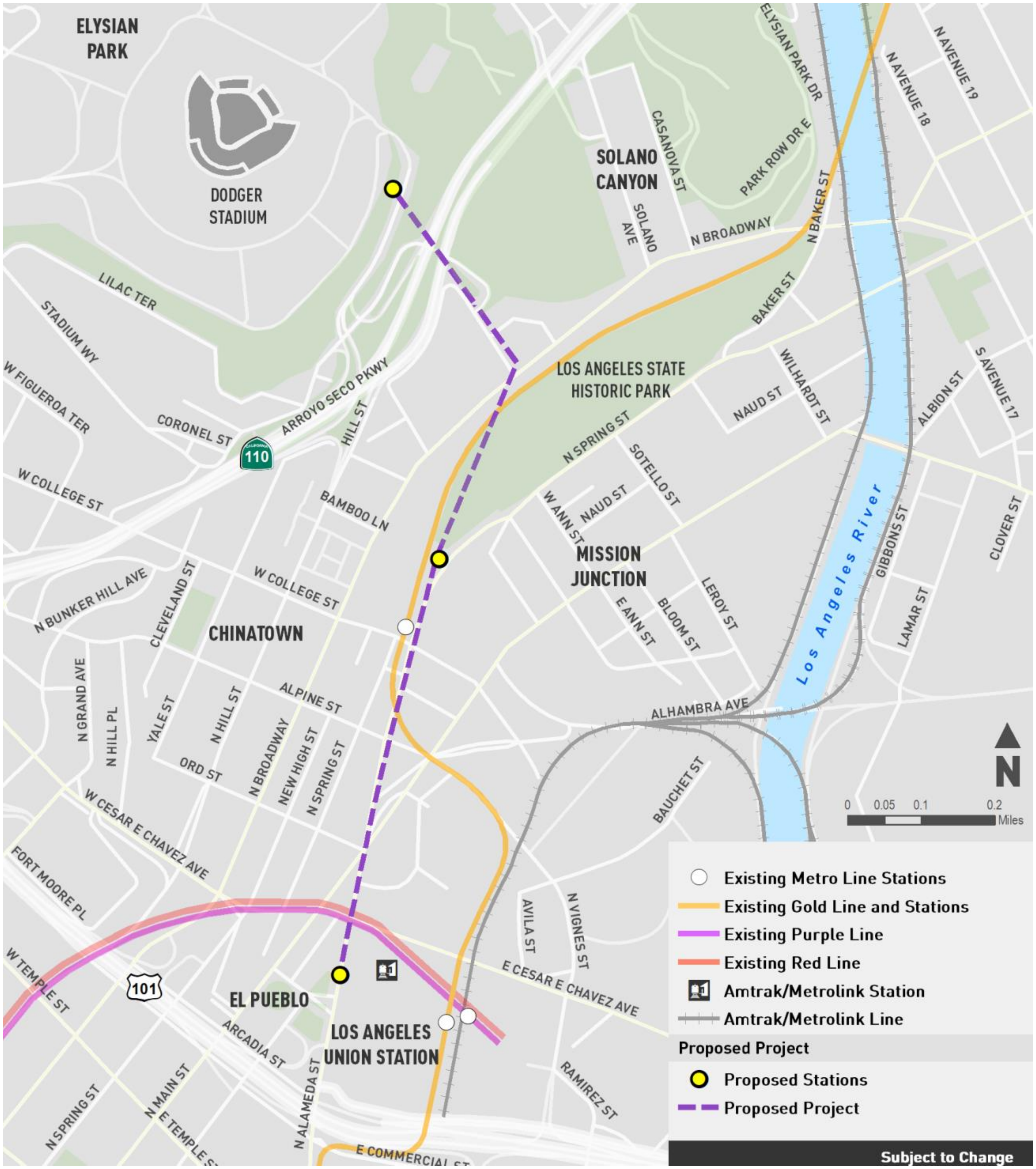


EXHIBIT 3.2-2: Proposed Project Location



3.3 PROPOSED PROJECT ALIGNMENT AND COMPONENTS

The proposed Project “alignment” includes the suspended above-grade cables and cabins following the position of the Project components along the proposed alignment from Alameda Station to Dodger Stadium Station.

3.3.1 Proposed Project Alignment

The proposed Project alignment would extend approximately 1.2 miles beginning near El Pueblo and LAUS on Alameda Street. The proposed Alameda Station would be constructed over Alameda Street between Los Angeles Street and Cesar E. Chavez Avenue, adjacent to the Placita de Dolores and planned Forecourt.

From the Alameda Station, the proposed Project alignment would remain primarily above the public ROW with portions above private property, and travel north along Alameda Street to the proposed Alameda Tower, which would be constructed on the Alameda Triangle, a portion of City ROW between Alameda Street, North Main Street, and Alhambra Street.

From the Alameda Tower, the proposed Project alignment would continue north along Alameda Street and cross Alpine Street. The proposed Alpine Tower would be constructed at the corner of Alameda Street and Alpine Street on City-owned parcel.

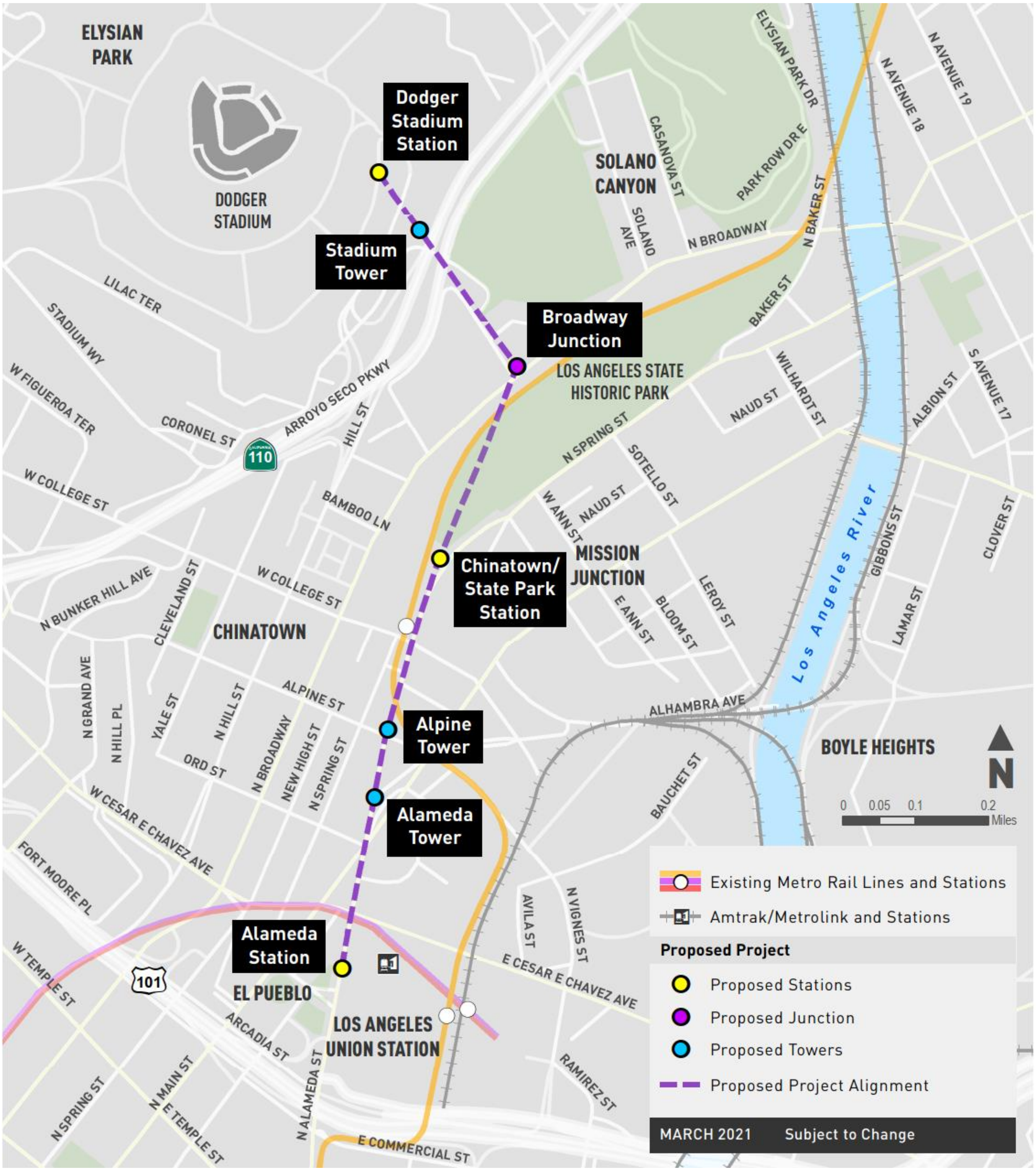
From the Alpine Tower, the proposed Project alignment would follow the public ROW and continue over the elevated Metro L Line (Gold). North of College Street, Alameda Street becomes Spring Street, and the proposed alignment would generally follow Spring Street in a northeast trajectory until it reaches the southernmost point of Los Angeles State Historic Park, where the proposed Chinatown/State Park Station would be constructed partially on City ROW and partially within the boundaries of the Los Angeles State Historic Park.

The alignment then crosses over the western edge of the Los Angeles State Historic Park and the Metro L Line (Gold) tracks.

The proposed Project alignment would continue traveling north towards the intersection of North Broadway and Bishops Road. The Broadway Junction would be located at the northern corner of the intersection of North Broadway and Bishops Road (1201 North Broadway). From the Broadway Junction, the proposed Project alignment would travel northwest primarily along Bishops Road, with portions above private property, crossing over SR-110 towards Dodger Stadium. The proposed Stadium Tower would be located on hillside private property north of Stadium Way between the Downtown Gate entrance road to Dodger Stadium and SR-110. The northern terminus of the system would be located in a parking lot at the Dodger Stadium property, where the proposed Dodger Stadium Station would be constructed.

Exhibit 3.3.1-1 depicts the proposed Project alignment, including station locations, junction location and tower locations.

EXHIBIT 3.3.1-1: Proposed Project Alignment



3.3.2 Proposed Project Components

Alameda Station: The Alameda Station would be located on Alameda Street adjacent to the planned Forecourt and Placita de Dolores between Los Angeles Street and Cesar E. Chavez Avenue. The station would be approximately 173 feet long, 109 feet wide, and 78 feet high at its tallest point, with the passenger loading platform approximately 31 feet above Alameda Street. Vertical circulation elements (i.e. elevators, escalators, stairs) for pedestrian access, which would also serve as queuing areas to the station, would be introduced at-grade north of the Placita de Dolores in a proposed new pedestrian plaza at El Pueblo on the west in an area currently used as a parking and loading area for El Pueblo. On the east, vertical circulation elements would be introduced at-grade from the planned Forecourt. Installation of the vertical circulation elements may include removal and replacement of trees, removal of parking and loading for El Pueblo, and installation of landscaping and hardscape.

Alameda Tower: The Alameda Tower would be located on the Alameda Triangle, a City ROW between Alameda Street, North Main Street, and Alhambra Avenue consisting of a small green space flanked on all sides by roadways. The Alameda Tower would be 195 feet tall with the cable suspended 175 feet above-ground. Implementation of the Alameda Tower would include reuse and integration of the existing pavers located at the Alameda Triangle, as well as landscape and hardscape updates to the Alameda Triangle.

Alpine Tower: The Alpine Tower would be located on a City-owned parcel, currently being used as non-public parking storage for City vehicles, at the northeast corner of Alameda Street and Alpine Street, adjacent to the Metro L Line (Gold). The Alpine Tower would be 195 feet tall at its tallest point, with the cable suspended 175 feet above ground. The Alpine Tower would also include the installation of landscaping and hardscaping near the base of the tower.

Chinatown/State Park Station: The Chinatown/State Park Station would be located adjacent to Spring Street in the southernmost portion of the Los Angeles State Historic Park. The southern portion of the station would be located on City ROW, while the northern portion of the station would be integrated into the southern boundary of the Los Angeles State Historic Park. The station would be approximately 200 feet long, 80 feet wide, and 98 feet tall at its tallest point, with the passenger boarding platform approximately 50 feet above-grade. Access to the boarding platform would be from the mezzanine via elevators and stairs. Comprised of three levels, elevators and stairs from the ground level would lead up to a mezzanine, 27 feet above-grade, and ramps for the queuing area would lead up to the boarding platform, which is 50 feet above-ground.

The Chinatown/State Park Station would also include Park amenities, including approximately 740 square feet of concessions, 770 square feet of restrooms, and a 220 square foot covered breezeway connecting the concessions and restrooms. Additionally, the Chinatown/State Park Station would include a mobility hub where passengers would be able to access a suite of first and last mile multi-modal options, such as a bike share program. Pedestrian access enhancements could include pedestrian improvements between Metro's L Line (Gold) Station and the Chinatown/State Park Station consistent with the Connect US Action Plan, including hardscape and landscape improvements, shade structures, and potential seating, as well as support for the future Los Angeles State Historic Park bike and pedestrian bridge. The Chinatown/State Park Station would require the removal of trees and vegetation; however, it would include the installation of landscaping and hardscaping, including integration of the granite pavers. The Chinatown/State Park Station would provide passenger access to Chinatown, the Los Angeles State Historic Park, and to nearby neighborhoods and land uses, including the Mission Junction neighborhood, which includes the William Mead Homes public housing complex.

Broadway Junction: The Broadway Junction is a non-passenger junction that would be located at the intersection of North Broadway and Bishops Road. The junction would primarily be located on privately-owned property with a portion of the junction and overhead cable infrastructure cantilevered and elevated above the public ROW. The existing commercial building located at 1201 N. Broadway would be demolished. The Broadway Junction would be approximately 227 feet long, 60 feet wide, and 98 feet high at its tallest point, with the platform approximately 50 feet above the ground. Vertical circulation elements (i.e., elevators and stairs) would be installed on the northwest side of the junction for staff and maintenance access to the platform.

Stadium Tower: The Stadium Tower would be located on hillside private property north of Stadium Way between the Downtown Gate and SR-110 and would stand 179 feet tall with the cable suspended 159 feet above-ground. The Stadium Tower would also include the installation of landscaping near the base of the tower.

Dodger Stadium Station: The Dodger Stadium Station would be located in the southeast portion of the Dodger Stadium property near the Downtown Gate. The site of the Dodger Stadium Station currently contains a paved surface parking area, drive aisle, and a landscaped berm. This station would be approximately 194 feet long, 180 feet wide, and 74 feet high at its tallest point. Cabins at this station would arrive and depart from an at-grade boarding platform, with the passenger queuing area also at-grade. The Dodger Stadium Station would include a subterranean area below the platform for storage and maintenance of cabins, as well as staff break rooms, lockers, and parts storage areas. The cabins would be transferred between the station platform and the subterranean area by way of a cabin elevator. Automated parking and controls would manage the process of storing cabins or returning them to service. Cabins would be returned to and stored at the Dodger Stadium Station when the system is not in use.

Restrooms for passenger use would be located at the station. The Dodger Stadium Station would also include a pedestrian connection to Dodger Stadium, including hardscape and landscape improvements and potential seating.

The Dodger Stadium Station is located adjacent to Dodger Stadium, which is operated as an MLB Stadium. The Project Sponsor will request consideration by the Los Angeles Dodgers of the potential for the Dodger Stadium Station to include a potential mobility hub where outside of game day periods, passengers would be able to access a suite of first and last mile multi-modal options, such as a bike share program and individual bike lockers, to access Elysian Park and other nearby neighborhoods, including Solano Canyon. Issues to be addressed in connection with such consideration as to the potential mobility hub include maintaining security for Dodger Stadium and the surrounding surface parking areas

Implementation of the Dodger Stadium Station would require the removal of parking spaces, as well as removal and replacement of landscaping.

3.4 SYSTEM OPERATIONS

During operations, the cabins would travel on a continuous loop between the Alameda Station and the Dodger Stadium Station. Cabins would pass through passenger stations at roughly 1 foot per second (less than 1 mile per hour) to allow for unloading and loading. If needed, a cabin could be stopped to accommodate passenger boarding. After the cabins pass through the unload/load zones, the doors would close, and the cabins would accelerate to match the line speed of the haul rope before reattaching to the haul rope.

At Alameda Station, arriving cabins (southbound) would decelerate, doors would open, and passengers would unload. The cabins would execute a U-turn in the station before passing through the load zone (for northbound passengers), load passengers (if any), close doors, then accelerate to be reattached to the haul rope.

At the Chinatown/State Park Station, cabins would detach from the rope and decelerate to the station speed. Since passenger access would be provided at this station, the cabins would decelerate to about 1 foot per second (less than 1 mile per hour) and the doors would open. After traveling through the unload and load zones, the cabin doors would close, and the cabins would accelerate to line speed and then reattach to the haul rope.

At the Broadway Junction, where passenger unloading or loading is not proposed, the cabins would detach from the haul rope, decelerate to a speed of approximately 6 mph, execute a slight turn to follow the alignment, and then re-accelerate and reattach to the haul rope. As described in Section 2.5.2, the Alameda Station to Broadway Junction and Broadway Junction to Dodger Stadium Station systems come together at the Broadway Junction. When the cabins detach from the haul rope in the Junction, their move from one haul rope to the other haul rope would not be perceptible by passengers.

At the Dodger Stadium Station, the cabins would decelerate, doors would open, and passengers would unload. Since the Dodger Stadium Station would be an end station, the cabins would execute a U-turn in the station before passing through the load zone (for southbound passengers), load passengers (if any), close doors, then accelerate and reattach to the haul rope. As described above, gondola cabins would enter, traverse, and depart stations under fully automated control. Operation of the proposed Project would require approximately 20 personnel. Station attendants would be located within each station to assure safe boarding or to execute stops, if necessary. Attendants would also provide customer interaction and observation; if a passenger needs special assistance, an attendant may either further slow or stop a cabin. A separate operator may sit in a booth adjacent to the boarding area and monitor screens, which would show activities in each cabin and station, as well as the system controls.

3.5 CONSTRUCTION

Construction of the proposed Project is anticipated to begin as early as 2024 and take approximately 25 months, including construction, cable installation, and system testing. The detailed construction procedures informing the environmental impact analyses are included as Appendix B to the Draft EIR. A summary of the construction activities is provided below. Construction of the Project components may partially overlap in schedule, especially since construction would occur at several physically separated sites.

Utility relocations would occur prior to construction of the proposed Project components and would be coordinated directly with the utility providers. Following utility relocations, construction would commence. Detailed information on utilities relocations is included as Appendix B to the Draft EIR.

During construction, some parking spaces at Dodger Stadium would be temporarily closed for construction of the Dodger Stadium Station and for overall Project construction, trailers, laydown and staging areas, and construction worker parking.

Construction of more than one Project component would occur at the same time, with consideration of available materials, work crew availability, and coordination of roadway closures. Table 3.5-1 below includes the estimated duration to complete construction of each of the proposed Project components, the maximum depths of drilled piles, the maximum depth of excavation, the amount of excavation, and the amount of materials (soil and demolition debris) to be exported for each component of the proposed Project.

TABLE 3.5-1: Proposed Project Construction Details

COMPONENT	CONSTRUCTION DURATION	MAXIMUM DEPTH OF DRILLED PILES	MAXIMUM DEPTH OF EXCAVATION	AMOUNT OF EXCAVATION	AMOUNT OF MATERIALS EXPORTED
Alameda Station	17 months	125 feet	10 feet	2,728 cubic yards	2,295 cubic yards
Alameda Tower	12 months	120 feet	10 feet	2,850 cubic yards	2,292 cubic yards
Alpine Tower	11 months	120 feet	10 feet	3,606 cubic yards	2,887 cubic yards
Chinatown/State Park Station	19 months	80 feet	10 feet	6,267 cubic yards	4,567 cubic yards
Broadway Junction	19 months	120 feet	7 feet	6,407 cubic yards	5,379 cubic yards
Stadium Tower	12 months	120 feet	7 feet	1,286 cubic yards	1,202 cubic yards
Dodger Stadium Station	20 months	55 feet	42 feet	44,313 cubic yards	44,001 cubic yards

Following completion of construction, the gondola cables would be installed, followed by system testing and inspections.

Working hours would vary to meet special circumstances and restrictions, but are anticipated to be consistent with the City's allowable construction hours of Monday through Friday between 7:00 a.m. to 9:00 p.m. and Saturdays and National Holidays between 8:00 a.m. to 6:00 p.m. While not anticipated, approval would be required from the City of Los Angeles Board of Police Commissioners for any extended construction hours and possible construction on Sundays.

Anticipated closures would include lane closures in which lanes would be closed 24 hours a day during certain phases of construction, or alternating closures during certain phases of construction, in which closures would occur during construction hours for approximately 10 hours a day, and roads would reopen during non-construction hours for approximately 14 hours a day. For alternating closures, during non-construction hours, steel plates would be placed over construction sites to the extent feasible to allow for vehicular and pedestrian circulation. The closures and hours would vary between location and phase of construction. The proposed Project would implement a Construction Traffic Management Plan that would include detours and ensure that emergency access is maintained throughout all construction activities.

4.0 EXISTING CONDITIONS

4.1 GEOLOGY AND SOILS

In this section, the following four general topic areas are discussed: topography, geology, soil, and faulting and seismicity.

4.1.1 Regional Geologic and Seismic Setting

The proposed Project is located in the City of Los Angeles, situated northeast of downtown Los Angeles (Figure 1). The proposed Project is located along the southern boundary of the Transverse Ranges Geomorphic Province adjacent to the northern boundary of the Los Angeles Basin. The Los Angeles Basin occupies an area at the intersection between the east-west-trending Transverse Ranges Geomorphic Province and the north-northwest-trending Peninsular Ranges Geomorphic Province.

The Transverse Ranges are characterized by east-west-trending mountain ranges formed by localized contractional deformation and transpressional reverse faulting along the transform boundary between the North American and Pacific Plates. The localized compressional forces along the plate boundary are often attributed to a restraining bend along the San Andreas Fault Zone referred to as the "Big Bend." The Transverse Ranges are also characterized by thick Cenozoic sediments that have been folded and faulted with rapid uplift rates.

The Peninsular Ranges Geomorphic Province is characterized by a series of north-northwest-trending mountain ranges and intervening alluviated valleys extending from Baja California to Los Angeles. The Peninsular Ranges are bounded on the east by the Salton Trough and on the west by deeper parts of the Pacific Ocean beyond Catalina Island. The basement rocks within the Peninsular Ranges dominantly comprise Jurassic and Cretaceous plutonic rocks of the Peninsular Ranges Batholith with screens of variably metamorphosed rocks.

The Los Angeles Basin is an alluviated coastal lowland plain within the Peninsular Ranges Geomorphic Province that slopes gradually southwestward towards the coast. The Los Angeles Basin is 50 miles long and 20 miles wide and bounded by mountains and hills on the north, northeast, east, and southeast. The basin is underlain by a deep structural depression filled with a thick sequence of marine and non-marine sediments that were deposited during a time period that spanned from the early Cenozoic era through the present day as the basin subsided. The sedimentary bedrock underlying the Los Angeles Basin is a major source of hydrocarbons. Many of the bedrock formations contain naturally occurring methane, tar, and hydrogen sulfide. These products migrate upward from the deeper formations through discontinuities (fractures and faults) in bedrock and through the soils.

The unique topography that includes the geomorphic provinces described above is a result of several major faults in the area that bound large blocks of the Earth's crust. The blocks are in motion adjacent to and along the boundary between the North American and Pacific plates. The Pacific plate (on the west) is moving northwestward in relation to the North American plate (on the east) at a rate of about 2 inches per year. Most of the relative motion between the two plates takes place along the San Andreas Fault, located approximately 32 miles northeast of the Project site, although other major faults also carry some portion of the relative motion. The San Andreas is the primary fault in an intricate network that cuts through rocks of the California coastal region. The entire San Andreas Fault system is more than 800 miles long and extends to depths of approximately 10 miles within the earth (Wallace, 1990). The predominant fault system affecting the Project area is the Transverse Ranges fault system, which trends east-west and relieves strain primarily through reverse-slip, and left-lateral, strike-slip displacement.

4.1.2 Site Topography

The majority of the proposed Project alignment occupies a gentle, south-sloping alluvial plain located approximately ½ mile west of the Los Angeles River (Figures 1 and 2). The northern end of the alignment slopes up more steeply towards the Dodger Stadium property and Elysian Park. Elevations along the gently sloping portion of the proposed Project alignment range from approximately 280 feet (NAVD88) at the southern end to approximately 300 feet just south of where the alignment changes direction and heads northwest towards Dodger Stadium. Elevations along the northern portion of the alignment climb gradually from approximately 300 feet at the southeast up to approximately 515 feet at its northern terminus.

4.1.3 Local Geology

Most of the proposed Project alignment is underlain by Quaternary alluvium associated with the Los Angeles River located approximately ½ mile east of the Project site. Alluvial fan deposits and a significant volume of artificial fill are present along the approach to and at the Dodger Stadium Station. Bedrock underlying the alluvium and fill in the vicinity of Dodger Stadium consist of marine sedimentary rocks of the early Pliocene and late Miocene Puente Formation, Figure 3 (Campbell, 2014).

4.1.3.1 Artificial Fill

The northern portion of the alignment near Stadium Way and the Downtown Gate E is underlain by artificial fill placed during construction of Dodger Stadium. Based on a comparison of historical topographic maps and current topography, fill up to approximately 100 feet thick are present along the alignment between the 110 Freeway and proposed Dodger Stadium Station. Historical aerial photographs from 1960, taken during grading for the stadium, suggest that the fill was derived from on-site cut for the stadium. The proposed Stadium Tower appears to be located very close to the cut-fill transition; and therefore, may be underlain by relatively thin deposits of artificial fill.

4.1.3.2 Alluvial Fan Deposits

West of North Broadway, the alignment is underlain by Holocene to Pleistocene alluvial fan deposits (Qyf1) fed by southeast-trending drainages including Chavez Ravine emanating from the highlands of the Elysian Park area. According to geologic mapping by Campbell (2014), the alluvial fan deposits consist of unconsolidated gravel, sand, and silt, with boulders common along hill fronts (Figure 3). This geologic unit was deposited primarily from flood deposits and debris flows.

4.1.3.3 Flood and Stream Channel Deposits

According to geologic mapping by Campbell (2014), the alignment from the southern end to where it crosses North Broadway is underlain by late Pleistocene alluvium (Figure 3 - Qya_2). The alluvium generally consists of unconsolidated sand with occasional gravel and cobble lenses deposited across the flood plain. This geologic unit was deposited primarily from flood and stream channel deposits.

4.1.3.4 Puente Formation

Bedrock units underlying the surface deposits along the alignment consist of marine sedimentary rocks of the early Pliocene and late Miocene Puente Formation (Figure 3). Previous subsurface explorations in the vicinity of the proposed Project alignment indicate that the bedrock lies beneath the alluvium at a depth of approximately 25 to 50 feet below the ground surface. The Puente Formation in the vicinity of the proposed Project alignment generally consists of well-bedded, interbedded siltstone and sandstone, massive silty sandstone, and sandstone with scattered cobbles (Campbell, 2014). The rock units are generally poorly to moderately cemented and vary in color from yellowish gray to gray, and bluish gray to dark brown. The Puente Formation is petroliferous in the area and occasional natural oily stains and hydrocarbon odor are reported from borings in the area.

The geologic structure in the area of the site is characterized by the northeast-southwest-trending Elysian Park Anticline and the underlying Elysian Park Blind Thrust fault. The Project site is located over the southwest limb of the anticline. Bedding in the Puente Formation in the area generally dips from 25 to 50 degrees towards the southwest.

4.1.4 Native Soil

The site vicinity is heavily developed with over a century of historical land use in the area; therefore, the native soil along the Project alignment have been disturbed by grading related to previous land uses and it is not anticipated that undisturbed native soil is present at surficial or shallow depths along the alignment.

4.1.4.1 Expansive Soil

Expansive soil is clay-based soil that tends to expand (increase in volume) as it absorbs water and shrinks (lessen in volume) as water is drawn away. Expansive soil can result in damage to structures, slabs, pavements, and retaining walls if wetting and drying of the soil are not controlled. Expansive soil is high in expansive clay or silt. On-site alluvium consists of silt, sand, and gravel. Therefore, the on-site alluvial deposits west of North Broadway and along the approach to Dodger Stadium with high silt contents have the potential to be expansive.

4.1.4.2 Soil Corrosivity

Soil corrosivity is the potential for corrosion on concrete and steel caused by contact with some types of soil under certain environmental conditions. Knowledge of soil corrosivity is critical for effective design of buried concrete or steel. Several factors affect the response of concrete and steel to soil corrosion, and include soil composition, soil and pore-water chemistry, moisture content, and pH. Soil with high moisture content, high electrical conductivity, high acidity, high sulfates, and high dissolved salt content is most corrosive. In general, sandy and silty-sandy soil have high resistivities and are the least corrosive. Clay soil, including those that contain interstitial saltwater, can be highly corrosive. The Project area consists of alluvial deposits and artificial fill which mainly consist of silty, sandy, and gravelly soil. This sandy and silty soil has a low potential for soil corrosion to occur, but there is potential corrosive soil may be encountered during site-specific investigations.

4.1.5 Groundwater

Groundwater is present within the alluvial sediments underlying the Project alignment. The southern portion of the site overlies the Gaspur aquifer, which occupies the alluvial sediments overlying the bedrock in the area (DWR Bulletin 104). Recorded groundwater levels in the area generally range from approximately 20 to 60 feet below the ground surface.

Along the southern portion of the proposed Project alignment, in the vicinity of Union Station, groundwater levels generally range from 20 to 25 feet below the ground surface (URS, 2003). Groundwater was encountered in borings at approximately 25 feet below the ground surface in the vicinity of the proposed Project alignment, near the intersection of N. Alameda Street and North Main Street (Geomatrix, 2002). Groundwater levels in the vicinity of the southern portion of the Los Angeles State Historic Park generally range from 27 to 35 feet below the ground surface, with depths increasing towards the northwest (Arcadis, 2019). The depth to groundwater increases to more than 60 feet below the ground surface in the vicinity of the intersection of North Broadway and Bishops Road (Arcadis, 2002). Groundwater levels approximately 1,200 feet northwest of the proposed Dodger Stadium Station are approximately 60 feet below the ground surface (Leidos, 2015). The groundwater gradient appears to slope towards the southeast in the north-central portion of the Dodger Stadium parking lot (Leidos, 2015). Assuming the groundwater gradient is relatively consistent towards the southeast, the depth to groundwater below the proposed Dodger Stadium Station is approximately 70 feet below the ground surface.

Groundwater in the basin is recharged from the Los Angeles River in sections where it is not lined with concrete and from percolation of precipitation where urban development has not prevented recharge.

Based on the number of nearby environmental monitoring wells and industrial activities in the region, groundwater in the Project area may contain hydrocarbon pollution and organic contaminants. The alluvial deposits are generally coarse grained and will likely yield large water volumes during excavation and drilling below the depth of groundwater.

4.2 GEOLOGIC HAZARDS

Potential geologic hazards in the vicinity of the proposed Project alignment is predominantly related to the high seismicity in the Los Angeles area. Seismic hazards at the Project site include ground shaking, liquefaction, lateral spreading, and ground lurching. In addition, portions of the Project alignment are located within identified Los Angeles Methane Zones in relation to the proximity of the Los Angeles City Oil Field.

4.2.1 Seismic Hazards

Movements along faults (often accompanied by earthquakes) are an important factor in the Southern California environment. They are in a large way responsible for the region's topography, drainage, and, as a result, biological patterns. When earthquakes are experienced, it is mostly the secondary effects that are noticed. Few people are directly affected by the rupture of the faults or the displacement of the land around the fault. They are more likely to experience ground shaking, often many miles from the actual fault. Other secondary effects include liquefaction, differential settlement, landslides, or earthquake-caused waves in bodies of standing water (seiches).

In this subsection, both the primary and secondary effects of earthquakes will be considered. When earthquakes are discussed, “moment magnitude” (Mw) will be used to express their sizes. The moment magnitude scale (a successor to the Richter scale) was introduced in 1979 and is used by seismologists to compare the energy released by earthquakes.

The Project site is located in a seismically active area of Southern California. Numerous small earthquakes occur every year in Southern California and larger earthquakes have been recorded and can be expected to occur in the future. Figure 4 shows the approximate locations of faults and epicenters of significant historic earthquakes recorded within the Los Angeles Region.

4.2.1.1 Faulting

The southern California area contains numerous active and potentially active earthquake faults. According to California Geologic Survey (CGS) Special Publication 42, an active fault is defined as one that has had surface displacement within Holocene time (the last 11,700 years - CGS SP42, Revised 2018). According to SP42, a Pre-Holocene fault is defined as a fault for which the most recent movement is older than 11,700 years; and therefore, does not meet the criteria of Holocene-active faults as defined in the State Mining and Geology Board (SMGB) regulations.

The Project site is not located within a State of California Earthquake Fault Zone for known Holocene-active faults capable of fault surface rupture (CGS, 2017) or located within an Alquist--Priolo Earthquake Fault Zone.

The following table summarizes nearby active and significant Pre-Holocene faults, which are identified on the 2008 USGS fault database spatial query within 20 miles of the site.

TABLE 4.2.1.1-1: Nearby Active Faults (USGS 2008) Latitude =34.065019; Longitude = - 118.235495

FAULT NAME	DISTANCE FROM SITE (MILES)	DIRECTION FROM SITE	MAXIMUM MOMENT MAGNITUDE
Elysian Park (Upper)*	<0.1	Underlying Site “Concealed Blind Thrust Fault”	6.7
Hollywood	3.7	North	6.7
Raymond	3.9	North	6.9
Santa Monica (Connected)	4.2	West	7.4
Puente Hills (LA)*	5.0	South	7.0
Verdugo	6.2	West	6.9
Newport Inglewood	8.5	Southwest	7.5
Sierra Madre Connected	10.4	Northeast	7.3
Elsinore	11.8	Southeast	7.8
Clamshell-Sawpit (Sierra Madre fault zone)	15.6	Northeast	6.7
Malibu Coast	16.9	West	6.7

Distances measured from approximate center of site, Latitude 34.065019°, Longitude -118.235495°.
*Elysian Park and Puente Hills are "blind" or blind thrust faults[2]

[2] A blind fault is a thrust fault that does not rupture all the way up to the surface so there is no evidence of it on the ground. It is "buried" under the uppermost layers of rock in the crust.

The United States Geologic Survey evaluated California seismicity through a study by the 2014 Working Group on California Earthquake Probabilities (WGCEP) (Field, 2014), which led to development of the Uniform California Earthquake Rupture Forecast (UCERF 3). The 2014 WGCEP evaluated the 30-year probability of a moment-magnitude (M_W) 6.7 or greater earthquake occurring on the known active fault systems in the Los Angeles Region, and the 2014 WGCEP estimated an overall probability of 60 percent for this area.

Elysian Park Fault (Blind Thrust Fault)

The fault closest to the Project site is the Elysian Park fault. According to the USGS Quaternary fault and fold database, the location of the Upper Elysian Park fault is inferred to cross under the alignment. The Upper Elysian Park fault is a north-to-northeast-dipping fault that underlies the northern Los Angeles basin from Griffith Park to Garvey Reservoir. However, the Upper Elysian Park fault is a blind thrust fault, which means it is not capable of surface fault rupture and; therefore, is not subject to the conditions of the Alquist-Priolo Act. It is thought to be seismogenic (capable of generating earthquakes) from a depth of approximately 2 miles below ground surface in the south-southwest to approximately 10 miles below ground surface in the north-northeast.
Because there is no surface expression of the Elysian Park fault, constraints on the long-term slip rates on the fault come primarily from geodetic modeling using permanent GPS stations at the surface, rather than from paleoseismic data. Although these constraints are limiting, the most current models (UCERF3) indicate it has approximately 1.2% probability of participating in an earthquake of magnitude greater than 6.7 before 2038. The upper 95% confidence limit on this estimate is approximately 2.2% of an event with a magnitude greater than 6.7 before 2038. The likelihood of experiencing an event of Magnitude > 7.0 is 0.8%, and the likelihood of experiencing an event of Magnitude > 7.5 is less than 0.1% in that time period.

4.2.1.2 Liquefaction

When loosely packed soil in proximity to water (such as groundwater) is subjected to seismic shaking, a process called liquefaction can occur. This phenomenon typically occurs in loose, saturated sediments of primarily sandy composition with ground accelerations over 0.2 g. When this occurs, the sediments involved have a total or substantial loss of shear strength and behave more like a liquid or semi-viscous substance. This can cause ground settlement, foundation failures, and the buoyant rise of buried structures. When soil liquefies, loss of bearing strength may occur beneath a structure, possibly causing the structure to settle or tilt. Liquefaction is known generally to occur in saturated or near-saturated cohesionless soil at depths shallower than 50 feet below the ground surface. Factors known to influence liquefaction potential include composition and thickness of soil layers, grain size, relative density, groundwater level, degree of saturation, and both intensity and duration of ground shaking.

The sediment and groundwater conditions at portions of the Project alignment overlying alluvial deposits support the potential for liquefaction. These portions of the Project alignment are located in an area mapped as potentially subject to liquefaction on the Safety Element Exhibit B of City of Los Angeles General Plan and the State of California Seismic Hazards Zones map as shown on Figure 5. The Alameda Station, Alameda Tower, Alpine Tower, Chinatown/State Park Station, and Broadway Junction are located in an area mapped as potentially subject to liquefaction. The Stadium Tower and Dodger Stadium Station are located approximately 20 feet and 60 feet from a mapped liquefaction zone, respectively. Liquefaction may result in ground failures such as lateral spreading, ground lurching, or seismically induced settlement.

4.2.1.3 Lateral Spreading

Lateral spreading can occur when liquefaction transforms a subsurface layer into a fluid-like mass and gravity causes the earthquake to move the mass downslope. Lateral spreading can occur on gentle slopes that range from 0.3 to 3 degrees. It can displace the ground surface for many feet, potentially damaging pipelines, utilities, bridges, roads, and other structures. As discussed above, portions of the site are located in an area susceptible to liquefaction; therefore, there is a moderate potential for lateral spreading at the Project site to occur.

4.2.1.4 Ground Lurching

Soft, saturated soil has been observed to move in a wave-like manner in response to intense seismic ground shaking, forming ridges or cracks on the ground surface. The potential for ground lurching to occur at a given site can be predicted only generally. Areas underlain by a thick accumulation of colluvium and alluvium appear to be the most susceptible to ground lurching. Under strong ground motion conditions, lurching can be expected in loose, cohesionless soil or in clay-rich soi with high moisture content. As discussed above, portions of the site are located in an area susceptible to liquefaction; therefore, there is a moderate potential for ground lurching to occur.

4.2.1.5 Seismically Induced Settlement

Under certain conditions, strong ground shaking can cause the densification of soil, resulting in local or regional settlement of the ground surface. During strong shaking, soil grains become more tightly packed due to the collapse of voids and pore spaces. This type of ground failure typically occurs in loose, granular, cohesionless soil in either wet or dry conditions. Unconsolidated young alluvium is especially susceptible to this hazard. Artificial fill may also experience seismically induced settlement. Damage to structures typically occurs as a result of local differential settlements. Regional settlement can damage pipelines or change the flow gradient of water and sewers. Fracturing and offset of the ground can also occur as a result of settlement.

The portions of the Project alignment that may be susceptible to seismically induced settlement are generally the same areas that may also be susceptible to liquefaction as indicated in Figure 5.

4.2.1.6 Seismically Induced Slope Failure

Strong ground motions can worsen existing unstable slope conditions, particularly if coupled with saturated ground conditions. Seismically induced landslides can overrun structures, sever utility lines, and block roads, hindering rescue operations after an earthquake. Numerous types of earthquake-induced landslides have been identified. The most widespread type consists of generally shallow failures involving surficial soil and the uppermost weathered bedrock in moderate to steep hillside terrain. Rockfalls and rockslides on very steep slopes are also common.

A combination of geologic conditions leads to landslide vulnerability. These include high seismic potential, steep slopes and deeply incised canyons, highly fractured rock, and rock with inherent weaknesses. These conditions occur in the steeper portions of the site near the proposed Broadway Junction and the approach to Dodger Stadium Station. These portions of the Project alignment are located adjacent to an area mapped as potential earthquake-induced landslide zones on the State of California Seismic Hazards Zones map, as shown on Figure 5. These structures are positioned at distances ranging from approximately 250 feet to 500 feet from mapped landslide zones. Additionally, the Stadium Tower and Dodger Stadium Station sites are located in a City-designated hillside area, indicating the sites may have an increased susceptibility to landslides.[3]

Because of the steep slopes and high seismicity in the vicinity of the proposed Stadium Tower and the Dodger Stadium Station, the potential for earthquake-induced slope failure could be considered moderate to high.

4.2.2 Subsidence

Subsidence is the loss of surface elevation due to the removal of subsurface support. Subsidence is the reduction of pore space in the ground that was formerly occupied by a fluid such as water or oil, caused by activities that contribute to the loss of support materials within the underlying soil, such as agricultural practices or the overdraft of an aquifer. The existing alluvium of the Project area is susceptible to collapse or settlements; therefore, there is a moderate potential for subsidence to occur.

4.2.3 Mineral Resources

The CGS and the SMGB classify the regional significance of mineral resources in accordance with the California Surface Mining and Reclamation Act of 1975 (SMARA). The SMGB uses a classification system that divides land into four Mineral Resource Zones (MRZs) that have been designated based on quality and significance of mineral resources. Based on review of the SMGB map in the site vicinity, no portion of proposed Project alignment is located in an area identified as an MRZ-2 site. The proposed Project alignment is located in an area classified as MRZ-3 as shown on Figure 6. MRZ-3 is defined as “areas containing mineral the significance of which cannot be evaluated from available data.” The proposed Project alignment is also located just beyond the eastern end of, but not within, what is designated as the Los Angeles City Oil Field.

4.2.4 Methane Zones

According to the City of Los Angeles Department of Building and Safety maps, portions of the proposed Project alignment pass through identified Methane Zones and/or Buffer Zones (Figure 7). These zones are usually a result of naturally occurring tar and crude oil, or shallow soil contamination by old oil drilling wells. The Los Angeles Methane Zone Map categorizes two types of zones; methane buffer zones and methane zones. The different zones are based on the proximity to a methane gas source.

Methane gas is known to be generated in the area, and portions of the Project area are located within a City-designated Methane Zone. Methane is generated by the biodegradation of organic matter in the absence of oxygen. Non-pressurized methane is not normally problematic if properly monitored and controlled per California Occupational Safety and Health Administration regulations. If the gas accumulates to high concentrations and becomes pressurized, detectable levels may enter the interior of a structure through cracks or other penetrations present in floor slabs. Methane exposure to workers during construction can be hazardous at higher levels, especially in confined spaces. In addition, methane seepage can result in an explosion if an adequate concentration of methane gas exists where combustion is possible.

[3] City of Los Angeles. Zone Information and Map Access (ZIMAS). Available at: http://zimas.lacity.org/. Accessed May 2022.

The proposed Project would be required to be designed and constructed to comply with the regulations of Division 71 of the Los Angeles Municipal Code. Compliance with Division 71 Section 91.7104.1, which includes appropriate methane exposure or release identification protocols based on a site-specific evaluation of the risk during construction, would be required to ensure worker health and safe construction. Additionally, all excavation work would be conducted in accordance with the California Occupational Health and Safety Administration regulations, which require monitoring before and during construction. Although long-term methane controls are not required, preliminary construction planning should adhere to Section 91.7101 of the Los Angeles Municipal Code, which controls for methane intrusion emanating from geologic formations. The need for methane controls may be reduced or eliminated by conducting site-specific methane testing for elements constructed within the methane zones and buffer zones to evaluate the potential hazard, pursuant to Section 91.7104.1.

5.0 REGULATORY SETTING

5.1 FEDERAL LAWS, REGULATIONS, AND STANDARDS

There are no federal laws, regulation, or standards related to geology and soils that are applicable to the Project.

5.2 STATE LAWS, REGULATIONS, AND STANDARDS

5.2.1 Alquist-Priolo Act

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. Under the Alquist-Priolo Act, the California State geologist identifies areas in the State that are at risk from surface fault rupture. The primary purpose of the Alquist-Priolo Act is to prevent the construction of buildings used for human occupancy on the surface traces of active faults. The act addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards. The law requires the State geologist to establish regulatory zones (known as Earthquake Fault Zones or Alquist-Priolo Zones) around the surface traces of active faults and issue appropriate maps. The maps are distributed to all affected cities, counties, and State agencies for their use in planning and controlling construction. Local agencies must regulate most development projects within the zones. Projects include land divisions and most structures for human occupancy. Local agencies can be more restrictive than State law requires.

Before a project can be permitted, a geologic investigation is required to demonstrate that proposed buildings would not be constructed across active faults capable of surface fault rupture. An evaluation and written report of a specific site must be prepared by a licensed geologist. If an active fault capable of surface fault rupture is found, a structure for human occupancy cannot be placed over the trace of the fault and must be set back from the fault (generally 50 feet). The Elysian Park fault, which crosses the proposed Project alignment, is a blind fault that is not capable of surface fault rupture; and therefore, is not subject to the conditions of the Alquist-Priolo Act. As no active faults capable of surface rupture cross the site, a fault investigation is not required.

5.2.2 Seismic Hazards Mapping Act of 1990

The California State Seismic Hazards Mapping Act of 1990 addresses earthquake hazards other than surface fault rupture, including liquefaction and seismically induced landslides. Through the act, the State establishes city, county, and state agency responsibilities for identifying and mapping seismic hazard zones and mitigating seismic hazards to protect public health and safety. It requires the California Department of Conservation, Division of Mines and Geology, to map seismic hazards and establishes specific criteria for project approval that apply within seismic hazard zones, including the requirement for a geological technical report. The California Department of Conservation has mapped seismic hazards or established specific criteria for the area that includes the Project site (CGS, 1998).

The geological reports prepared for the Project satisfy the requirements of the Seismic Hazards Mapping Act at the preliminary project level. Additional site-specific studies designed to explore the subsurface conditions in areas of planned development will be completed prior to submittal of final plans.

5.2.3 California Building Code

The California Code of Regulations, Title 24 (California Building Code [CBC]) applies to applications for building permits. The CBC (also called the California Building Standards Code) has incorporated the Uniform Building Code (first enacted by the International Conference of Building Officials in 1927 and updated approximately every 3 years since that time). The current version of the CBC (2019) became effective in 2020. The next update of the entire CBC is expected in 2023.

Local agencies must ensure that development in their jurisdictions comply with guidelines contained in the CBC. Cities and counties, however, can adopt building standards beyond those provided in the code.

5.3 CITY OF LOS ANGELES LAWS, REGULATIONS, AND STANDARDS

5.3.1 City of Los Angeles General Plan

The City of Los Angeles General Plan (General Plan) includes policies related to geology and soil in the Safety Element, as required by State law (Los Angeles City Planning Department 1996). Chapter II of the Safety Element provides a discussion of the existing conditions, hazards and a history of mitigation in the City of Los Angeles. Chapter III of the Safety Element includes the goals, objectives, and policies related to safety, including Goal 1: Hazard Mitigation, which establishes the standard that the City of Los Angeles will be a place where “potential injury, loss of life, property damage and disruption of the social and economic life… due to… [a] seismic event [and existing] geologic conditions… is minimized.” In addition, the Safety Element includes a discussion of hazardous materials, including methane gas from naturally occurring deposits found within the Los Angeles area. Section 11 of the Conservation Element of the General Plan also addresses “Geologic Hazards” but primarily references the Safety Element as the relevant General Plan component with respect to protecting people and property from problems related to geology, seismicity, and liquefaction.

5.3.1.1 Downtown Los Angeles 2040 Draft Community Plan

The City of Los Angeles is currently in the process of updating the Central City and Central City North Community Plans through the Downtown Los Angeles 2040 Draft Community Plan. The following policies are applicable to the proposed Project.

Land Use and Urban Form Element
Policy LU 17.10: Encourage building design that promotes earthquake resilience so that buildings remain usable after earthquakes.

5.3.2 City of Los Angeles Municipal Code

The City of Los Angeles Municipal Code (LAMC) includes regulations related to geology and soil in Chapter IX (Building Regulations), Article 1 (Buildings). The City of Los Angeles adopted the majority of the CBC, but Chapter IX, Article 1 of the LAMC documents amendments to specific sections of the CBC. Three divisions within Article 1 include amendments to CBC sections applicable to the Project.

Preliminary design concepts for the Project include deep foundations extending into bedrock. Division 18 (Soils and Foundations) provides direction on geotechnical explorations for foundations extending into bedrock and limits deep foundation design values without explicit approval from the Los Angeles Department of Building and Safety. The Los Angeles Department of Building and Safety may approve higher deep-foundation design limits based on geotechnical explorations or load testing completed in accordance with the CBC.

Division 70 (Grading, Excavations, and Fills) includes regulations identifying project types requiring geologic or soil reports and what content must be included. The majority of the proposed Project alignment components are in an area mapped as having the potential for liquefaction, as described in Section 4.2.1.2 of this report. LAMC Section 91.7006.2 directs soil/geologic reports be submitted to evaluate the liquefaction risk for projects located in areas identified as having liquefaction potential.

Division 71 (Methane Seepage Regulations) describes methane testing and mitigation requirements based on building type, building use/occupation, and whether a structure is located within a methane zone or buffer zone. The proposed Project alignment crosses a methane zone and buffer zone and may require site-specific methane testing for particular structures, depending on the final architectural design.

6.0 METHODOLOGY

To analyze geological conditions at the Project site, geological information was collected from the City of Los Angeles General Plan, geologic maps, the U.S. Geological Survey, the California Building Code, the California Geologic Survey, and the Southern California Earthquake Center. Information was compared to CEQA Appendix G (Environmental Checklist Form) to determine impacts related to ground shaking, ground failure, unstable soil, and expansive soil. In accordance with Appendix G of the CEQA Guidelines, the Project would have a significant geological impact if it would:

A. 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.
   - Strong seismic ground shaking.
   - Seismic-related ground failure, including liquefaction.
   - Landslides.

B. Result in substantial soil erosion or the loss of topsoil.

C. Be located on a geologic unit or soil that is unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.

D. Be located on expansive soil, as defined in Section 1803.5.3 of the current CBC, creating substantial direct or indirect risks to life or property.[4]

E. Have soil incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater.

The following threshold from Appendix G of the CEQA Guidelines is not addressed in this report, as paleontological resources are addressed under separate cover in the Archaeological and Paleontological Resources Assessment prepared for the proposed Project.

> Would the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

Section 7, Impact Analyses, summarizes ENGEO's evaluation of the potential impacts and, when applicable, recommends mitigation measures to reduce impacts.

7.0 IMPACT ANALYSES

7.1 PROPOSED PROJECT ALIGNMENT

7.1.1 GEO-1: Would the project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:

- Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault.
- Strong seismic ground shaking.
- Seismic-related ground failure, including liquefaction.
- Landslides?

[4] The definition of expansive soils is based on California Building Code Section 1803.5.3. 2019 California Building Code, Title 24, Part 2, Volume 2, Chapter 18, Section 1803.5.3. Available at: https://codes.iccsafe.org/content/CABCV22019JUL21S/chapter-18-soils-and-foundations. Please note that this material is either covered under a NDA, otherwise confidential, and/ or copywritten. Due to copyright agreements, this document is unable to be downloaded as a pdf, though it is available for viewing online.

Impact: There is potential for the proposed Project to expose people or structures to seismic hazards listed above. Mitigation measures would be required to reduce impacts to a less than significant level.

Construction

The Project site is located in a seismically active region that contains a number of active faults. The United States Geologic Survey evaluated California seismicity through a study by the 2014 Working Group on California Earthquake Probabilities (WGCEP) (Field, 2014), which led to development of the Uniform California Earthquake Rupture Forecast (UCERF 3). The 2014 WGCEP evaluated the 30-year probability of a moment-magnitude (M_W) 6.7 or greater earthquake occurring on the known active fault systems in the Los Angeles Region, and the 2014 WGCEP estimated an overall probability of 60 percent for this area. An earthquake of moderate to high magnitude generated within the Los Angeles region could cause considerable ground shaking at the Project site, similar to that which has occurred in the past. To mitigate the shaking effects, structures should be designed using sound engineering judgment and the current CBC requirements, as a minimum. However, the proposed Project alignment is not located within a State of California Earthquake Fault Zone for known Holocene-active faults capable of fault surface rupture (CGS, 2017) or located within an Alquist-Priolo Earthquake Fault Zone. Accordingly, the risk of surface rupture due to faulting is considered low. As such, the Project would not directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault. Impacts would be considered less than significant.

The sediment and groundwater conditions at portions of the proposed Project alignment overlying alluvial deposits support the potential for liquefaction and are located in an area mapped as potentially subject to liquefaction on the State of California Seismic Hazards Zones map as shown on Figure 5. Liquefaction-induced total and differential settlement can happen in the free field during a seismic event, but can also be exacerbated by increased loading, such as construction of the proposed towers, junction, and stations. Because there is potential for liquefaction-induced total and differential settlement and collapse during a strong to severe ground-shaking event, damage to on-site structures and infrastructure could occur on the Project site. Damage to structures and infrastructure could result in loss of property or risk to human health and safety. Therefore, impacts related to strong seismic ground shaking, seismic-related ground failure, including liquefaction during grading for the proposed Project and construction of on-site development, are potentially significant.

The actual risk of the liquefaction hazard and related damages should be evaluated in the site-specific geotechnical report. The Project would be required to comply with all standards, requirements, and conditions contained in construction-related codes (e.g., the current CBC, Los Angeles amendments to the CBC, and the Los Angeles Grading Regulations), which would ensure structural integrity and safe construction. The continuation of design review and code enforcement to meet current seismic standards is the primary mitigation strategy to avoid or reduce damage from an earthquake. Per Mitigation Measure GEO-A, a final geotechnical exploration and report, to be approved by the City of Los Angeles, would be required, and implementation of the recommendations contained in the approved geotechnical report during project design and construction would be required.

According to the State of California Seismic Hazards Zones map, as shown on Figure 5, the northeastern portion of the proposed Project alignment, including the Stadium Tower and Dodger Stadium Station, is located adjacent to areas mapped as a potential earthquake-induced landslide zone, as well as City-designated hillside area, indicating the sites may have an increased susceptibility to landslides. Therefore, impacts related to earthquake-induced slope failure could be considered moderately significant to significant and should be addressed per Mitigation Measure GEO-A.

Compliance with existing laws and regulations, and implementation of Mitigation Measure GEO-A, requiring the development and implementation of geotechnical recommendations to be incorporated into the design plans and specifications, would reduce impacts to less than significant.

<u>Operation</u>

Upon completion of the construction activities, the proposed Project would have complied with the CBC, Los Angeles amendments to the CBC, and Grading Regulations regarding seismic-related ground shaking and seismic-induced ground failures (i.e., liquefaction and settlement), as well as Mitigation Measure GEO-A. Operation of the aerial gondola system would have a less than significant impact with respect to exposing people or structures to seismic hazards if appropriate mitigation measures are applied during construction.

<u>Mitigation Measures</u>

Mitigation Measure GEO-A: Prepare a Site-Specific Final Geotechnical Report.

The Project Sponsor shall engage a California-registered geotechnical engineer to prepare and submit a site-specific final geotechnical investigation and report to the City of Los Angeles for review, consistent with the requirements of the CBC, applicable Los Angeles amendments, and California Geological Survey Special Publication 117 (as amended). A site-specific geotechnical exploration program, along with associated laboratory testing, is necessary to complete a design-level evaluation of the geologic hazards and conditions, seismic hazards, grading conditions, and foundation capacities. The site-specific final geotechnical report will provide a description of the geological and geotechnical conditions at the site, the findings, conclusions and mitigation recommendations for potential geologic and seismic hazards, and design-level geotechnical recommendations in support of grading and foundation design. Recommended measures to reduce potential impacts related to landslides, subsidence, liquefaction, differential settlement, expansive soil, soil corrosivity, or other potential ground failures induced by the Project shall be included. The submittal and approval of the final geotechnical report shall be a condition of the grading and construction permits issued by the City of Los Angeles Department of Building and Safety. The Project sponsor shall implement the recommendations contained in the approved report during project design and construction.

Significance after Mitigation: With implementation of Mitigation Measure GEO-A, impacts would be less than significant.

With regards to Impact GEO-1, the report will include an evaluation of site-specific seismic hazards based on geological and geotechnical conditions, and recommended measures to reduce potential impacts related to slope instability, seismic shaking, liquefaction, differential settlement, or other potential seismic-related ground failures. Therefore, impacts would be less than significant.

7.1.2 GEO-1: Would the project result in substantial soil erosion or the loss of topsoil?

Impact: The proposed Project would not result in substantial soil erosion or the loss of topsoil. Impacts would be less than significant.

Construction

Topsoil typically consists of the top 2 to 3 inches of soil, primarily composed of dark decomposed organic material. The majority of the Project site consists of disturbed areas with existing rights of way, paved areas, and developed properties, with the exception of the proposed Stadium Tower and Dodger Stadium Station locations.

The proposed Stadium Tower would have a relatively small footprint, approximately 870 square feet, where it intersects the ground in an undeveloped area. During construction, we anticipate the contractors will use an approximately 23,500 square feet area around the tower base for construction support activities.

The proposed Dodger Stadium Station has a footprint of approximately 27,770 square feet at ground level; however approximately 87,000 square feet would be used for construction support space. The Dodger Stadium Station would be partially located on an existing parking lot and partially located over the existing vegetated slope.

The potential for impacts relative to topsoil is extremely low due to the urban nature of the Project area, the small foundation footprint of the proposed Stadium Tower, and the portion of the Dodger Stadium Station that extends onto a currently vegetated slope. Impacts associated with the loss of topsoil would be less than significant during construction of the proposed Project.

Operation

Once the Project is constructed, there would not be a substantial area of exposed surfaces, which could be subjected to accelerated soil erosion during operations. The pavement, landscaping, and engineered fill around exposed foundation and structural elements would be returned to their original state or improved, if disturbed. Impacts would be less than significant.

Mitigation Measures

No mitigation measures are required.

Significance after Mitigation: No mitigation measures are required. Impacts would be less than significant.

7.1.3 GEO-3: Would the project be located on a geologic unit or soil that is unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?

Impact: The proposed Project alignment is located on a geologic unit or soil that is unstable as a result of the Project, and would potentially result in landslide, subsidence, liquefaction, or collapse. Mitigation measures would be required to reduce impacts to a less than significant level.

Construction

The northern portion of the proposed Project alignment near Stadium Way and Downtown Gate E is underlain by artificial fill placed during construction of Dodger Stadium. This area includes the Dodger Stadium Station and the Stadium Tower, as the tower location is near the cut-fill transition and therefore may have artificial fill at that site. Based on a comparison of historical topographic maps and current topography, artificial fill ranging between 10 feet and up to approximately 100 feet in thickness is present along the proposed Project alignment between the 110 Freeway and the proposed Dodger Stadium Station. The additional load from the proposed Stadium Tower and Dodger Stadium Station can result in total and differential settlements in the artificial fill.

In general, settlement can be exacerbated along the entire alignment by increased loading, such as from the construction of stations, junctions, and towers. Because development would involve the construction of heavy structures, the Project site could be subject to subsidence. Hydroconsolidation occurs when soil layers collapse (settle) as water is added under loads. Natural deposits susceptible to hydroconsolidation are typically aeolian, alluvial, or colluvial materials, with high apparent strength when dry. The existing alluvium may be susceptible to collapse and excessive settlements. Therefore, on-site hydroconsolidation could potentially occur.

The Alameda Station, Alameda Tower, Alpine Tower, Chinatown/State Park Station, and Broadway Junction are located in an area mapped as potentially subject to liquefaction on the Safety Element, Exhibit B, of the City of Los Angeles General Plan and the State of California Seismic Hazards Zones map as shown on Figure 5. The Stadium Tower and Dodger Stadium Station are located approximately 20 feet and 60 feet from a mapped liquefaction zone, respectively. Liquefaction may result in ground failures such as lateral spreading, ground lurching, or seismically induced settlement. Additionally, the Stadium Tower and Dodger Stadium Station sites are located in a City-designated hillside area, indicating the sites may have an increased susceptibility to landslides.

Construction includes foundations and concrete work, with piles to be installed at depths between 55 feet and 125 feet below ground surface. Bedrock in the vicinity of the proposed Project alignment lies beneath the alluvium at a depth of approximately 25 to 50 feet below the ground surface.

Damage to structures and infrastructure could result in loss of property or risk to human health and safety due to total and differential settlements in the artificial fill, hydroconsolidation, subsidence in the alluvial deposits, liquefaction-induced ground failures, and slope instability. Therefore, impacts related to lateral spreading, subsidence, liquefaction, or collapse during grading and construction of the sites of the Project components are potentially significant. The actual risk of settlement in the fill, subsidence, hydroconsolidation, liquefaction, landslides, and related damages should be evaluated in the site-specific geotechnical report. Compliance with existing laws and regulations, and implementation of Mitigation Measure GEO-A, requiring the development and implementation of geotechnical recommendations to be incorporated into the design plans and specifications, would result in the impact being less than significant.

Operation

Upon completion of construction, potential impacts related to subsidence, liquefaction, and total and differential settlement would be addressed during the construction phase. With the incorporation of the recommendations presented in the final geotechnical investigation per

Mitigation Measure GEO-A, the operational impacts related to subsidence, liquefaction, and total and differential settlement would be less than significant.

Significance after Mitigation: With implementation of Mitigation Measure GEO-A, impacts would be less than significant.

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

Impact: The proposed Project could be located on expansive soil, as defined in Section 1803.5.3 of the California Building Code (2019), or corrosive soil, creating substantial risks to life or property. Mitigation measures would be required to reduce impacts to a less than significant level.

<u>Construction</u>

On-site alluvium consists of silt, sand, and gravel. Expansive soil has high expansive clay or silt content. Therefore, the on-site deposits that have high silt contents have the potential to be expansive.

Expansive soil is soil that swells and shrinks with wetting and drying, respectively. Shrinking and swelling can cause damage to foundations, concrete slabs, flatwork, and pavement. However, construction of the proposed Project would be required to comply with the current CBC, which includes provisions for construction on expansive soil. The CBC requirements include proper fill selection, moisture control, and compaction during construction, which prevent expansive soil from causing substantial damage. Expansive soil can be treated by removal (typically the upper 3 feet below finish grade) and replacement with low-expansive soil, lime treatment, and moisture conditioning. Mandatory compliance with CBC requirements would ensure that impacts related to expansive soil would be less than significant.

There is potential for soil corrosion in the soil beneath the Project site. Mitigation Measure GEO-A would require soil samples be tested for corrosivity of the soil beneath the Project site to identify corrosion concerns for steel, iron, concrete, and buried metals during design geotechnical explorations. The corrosivity potential should be considered for foundation design and site improvements based on the current CBC and the American Concrete Institute Manual that specify minimum thresholds. Moreover, the final geotechnical investigation report shall also include a report prepared by a corrosion consultant that evaluates whether specific corrosion recommendations are advised for the Project as required by the CBC and the applicable Los Angeles amendments. Compliance with existing laws and regulations, and implementation of Mitigation Measure GEO-A, requiring preparation of a Site-Specific Geotechnical Report, and, if required, the soil samples be tested for corrosivity, would result in the impact being less than significant.

<u>Operation</u>

Upon completion of construction, potential impacts related to expansive soil and/or soil corrosion would have been addressed during the construction phase. With the implementation of the recommendations presented in the final geotechnical investigation per Mitigation Measure GEO-A, to protect against any potential expansive soil and/or soil corrosion, the operational impacts related to expansive soil and/or soil corrosion would be less than significant.

Significance after Mitigation: With implementation of Mitigation Measure GEO-A, impacts would be less than significant.

7.1.5 GEO-5: Have soil incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?

Impact: The proposed Project site would not have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater. There is no impact.

Construction

Where temporary wastewater disposal systems are required during construction, the systems would be above ground and involve wastewater that would be transported to an appropriate off-site disposal facility or routed to the sanitary sewer system. Therefore, there is no impact during construction.

Operation

The proposed Chinatown/State Park Station includes separate facilities for concessions and restrooms, and Dodger Stadium Station could include restroom facilities for employees and passengers. Therefore, both sites would generate wastewater. The proposed stations would connect to local sanitary-sewer infrastructure with wastewater treatment provided by the City of Los Angeles. As such, the Project would not require the use of septic tanks or an alternative wastewater disposal system. There is no impact during operation.

Mitigation Measures

No mitigation measures are required.

Significance after Mitigation: No mitigation measures are required. There is no impact.

8.0 CONCLUSION

The proposed Project would have less than significant impacts with respect to geologic and geotechnical hazards with application of the recommended mitigation measures. Prior to grading and construction permits being issued, a site-specific final geotechnical report should be prepared, as recommended in Mitigation Measure GEO-A. The final geotechnical report should include site-specific measures and design considerations for the stations, junction, and towers. The recommendations may vary depending on the geologic and geotechnical conditions at each location.

9.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

This document presents geotechnical and geologic information for use in preparation of the Draft EIR for the proposed Project. If changes occur in the nature or design of the Project, ENGEO should be allowed to review this document and provide additional information or recommendations. It is the responsibility of the owner to transmit the information and recommendations of this document to the appropriate organizations or individuals involved in the design of the Project, including but not limited to owners, contractors, architects, engineers, and designers. The conclusions and recommendations contained in this report are solely professional opinions and are valid for a period of no more than 5 years from the date of document issuance.

We strived to perform our professional services in accordance with generally accepted principles and practices currently employed in the area; there is no warranty, either express or implied. There are risks of earth movement and property damages inherent in building on or with earth materials. We are unable to eliminate all risks; therefore, we are unable to guarantee or warrant the results of our services.

This document is based upon publicly available reports and data readily available at the time of document preparation. We developed this document with limited subsurface exploration data. We assumed that subsurface exploration data are representative of the actual subsurface conditions at nearby locations along the alignment.

This document must not be subject to unauthorized reuse, that is, reuse without written authorization of ENGEO. Such authorization is essential because it requires ENGEO to evaluate the document's applicability given new circumstances, not the least of which is passage of time.

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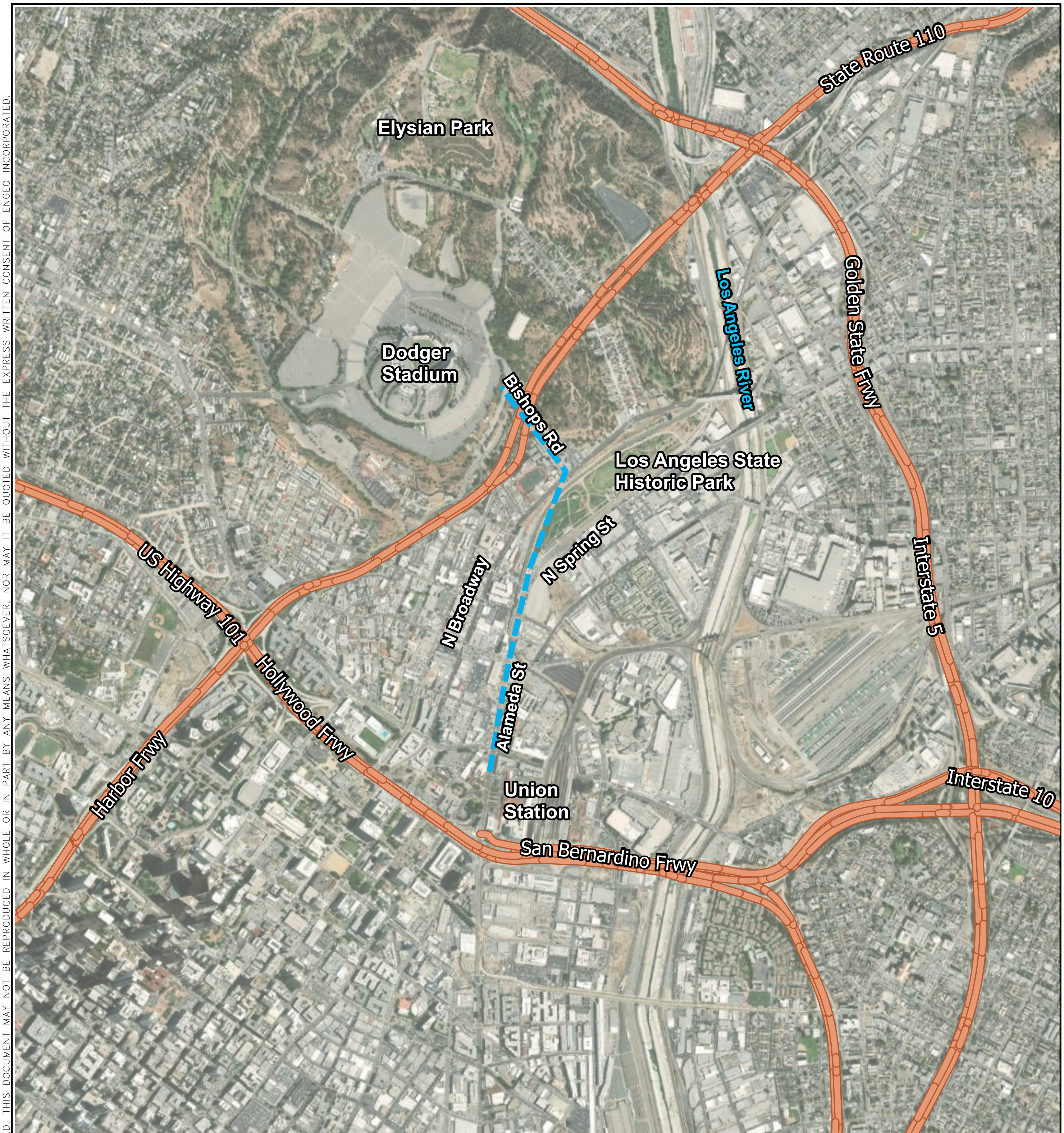
FIGURES



EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

PROPOSED PROJECT ALIGNMENT

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VICINITY MAP

LA AERIAL RAPID TRANSIT PRELIMINARY GEOTECHNICAL REPORT

LOS ANGELES, CALIFORNIA

PROJECT NO.: 16037.000.000	FIGURE NO. 1
SCALE: AS SHOWN	
DRAWN BY: QRL	CHECKED BY: UE

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EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

- FOUNDATION (TOWER)
- FOUNDATION (STATION/JUNCTION)
- PROPOSED PROJECT ALIGNMENT
- CALTRANS STATE BRIDGE (MULTIPLE BORINGS)
- CGS BOREHOLE LOCATION
- THE ARTS COMPLEX (MULTIPLE BORINGS)

BASE MAP SOURCE:
ESRI MAPPING SERVICE 2018

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SITE PLAN
LA AERIAL RAPID TRANSIT PRELIMINARY GEOTECHNICAL REPORT
LOS ANGELES, CALIFORNIA

PROJECT NO. : 16037.000.000	FIGURE NO. 2
SCALE: AS SHOWN	
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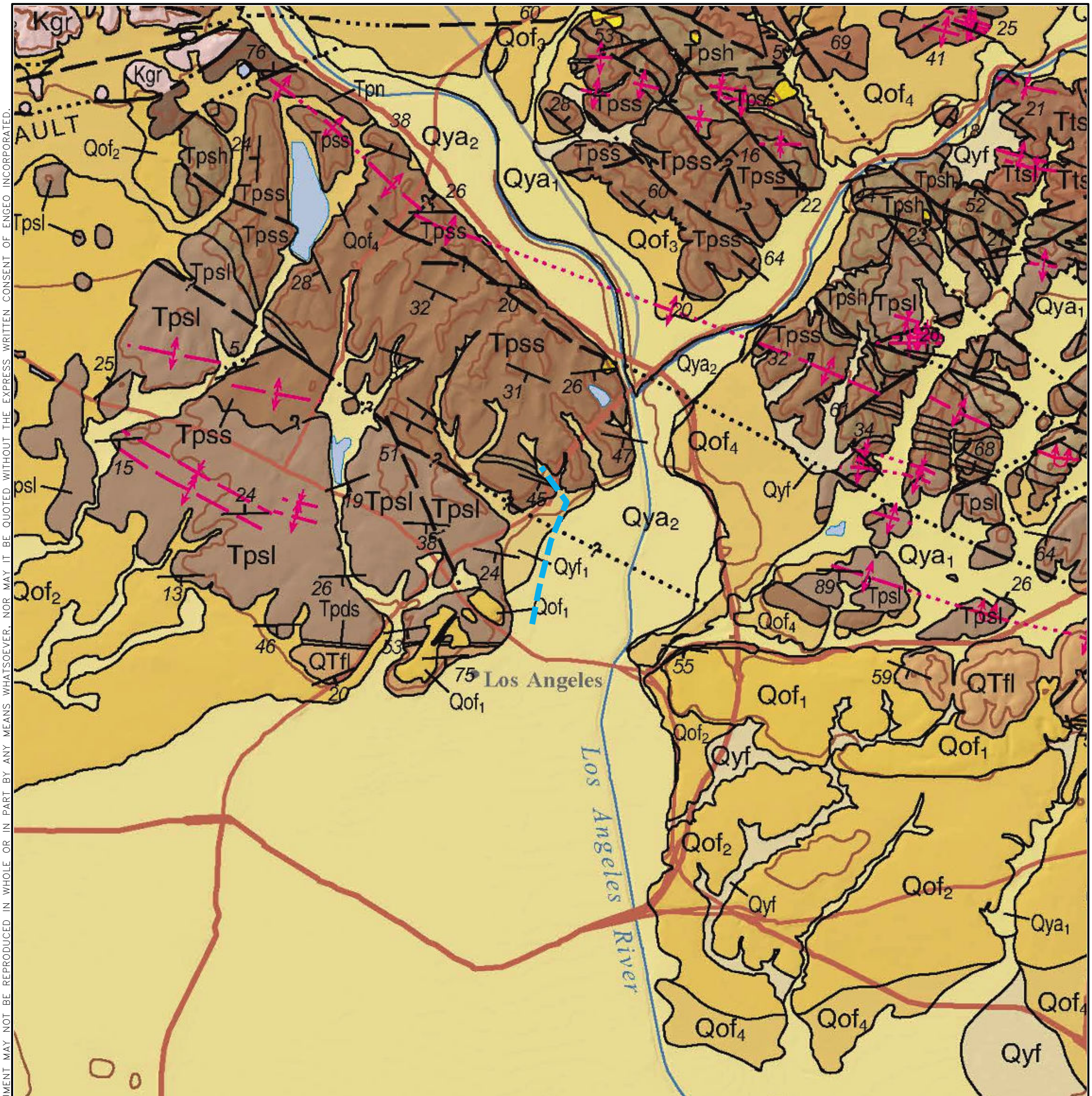

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

- - - PROPOSED PROJECT ALIGNMENT

Qya_2	YOUNG ALLUVIUM UNIT 2	Qyf1	OLD ALLUVIAL FAN DEPOSITS UNIT 1
Qyf	YOUNG ALLUVIAL FAN DEPOSITS	QTfl	FERNANDO FORMATION LOWER MEMBER
Qyf_1	YOUNG ALLUVIAL FAN DEPOSITS UNIT 1	Tpsl	PUENTE FORMATION SILTSTONE
Qof	OLD ALLUVIAL FAN DEPOSITS	Tpss	PUENTE FORMATION SANDSTONE
Qyf_4	OLD ALLUVIAL FAN DEPOSITS UNIT 4	kgr	GRANITIC ROCKS

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BASEMAP SOURCE: CAMPBELL 2014

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REGIONAL GEOLOGIC MAP

LA AERIAL RAPID TRANSIT PRELIMINARY GEOTECHNICAL REPORT

LOS ANGELES, CALIFORNIA

PROJECT NO. :	16037.000.000
SCALE:	AS SHOWN
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FIGURE NO.	3

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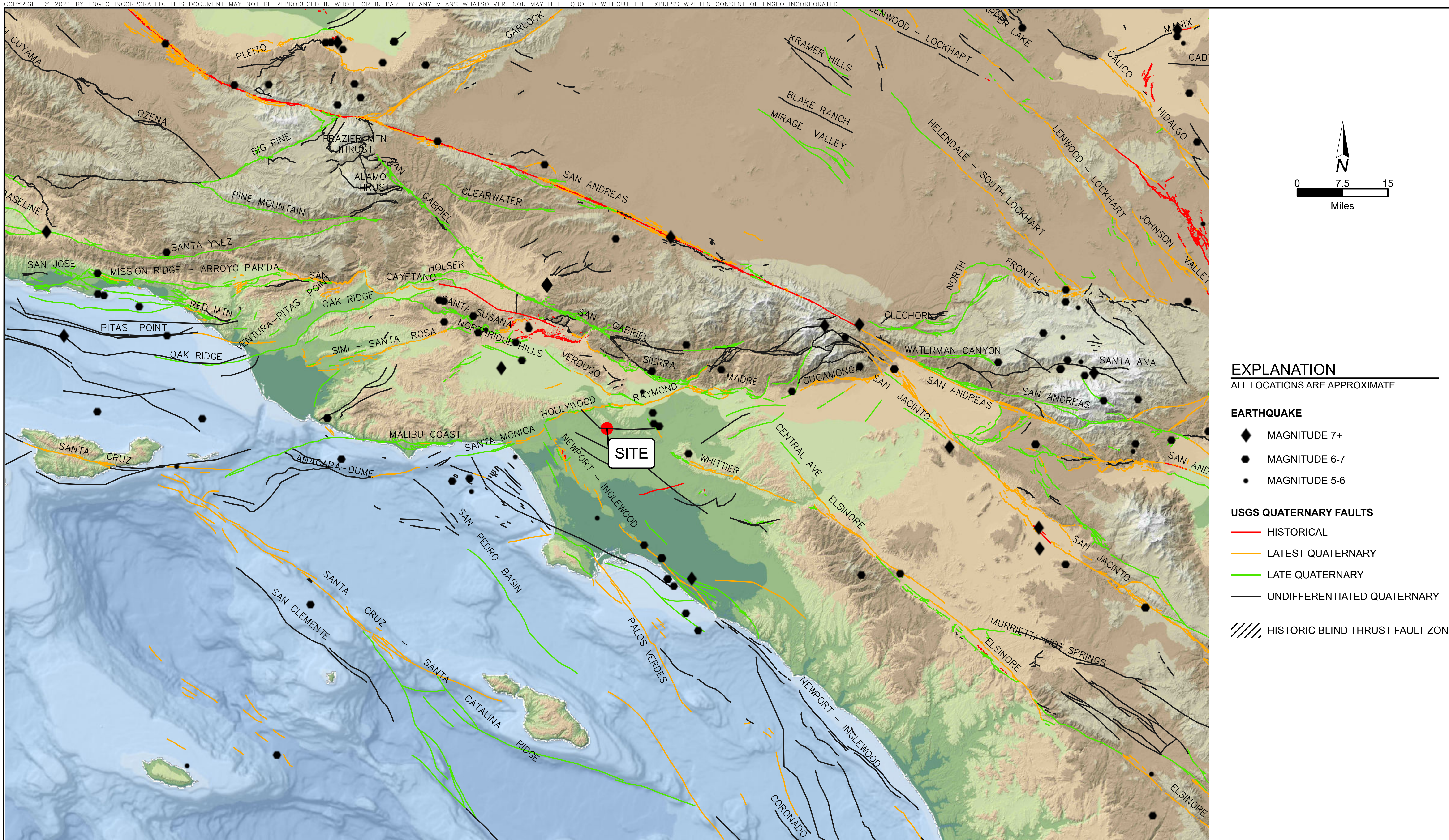

BASE MAP SOURCE
ESRI, GEBCO, DELORME, NATURALVUE
COLOR HILLSHADE IMAGE BASED ON THE NATIONAL ELEVATION DATA SET (NED) AT 30 METER RESOLUTION
U.S.G.S. QUATERNARY FAULT DATABASE, 2018
U.S.G.S. HISTORIC EARTHQUAKE DATABASE (1800-PRESENT)

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REGIONAL FAULTING AND SEISMICITY LA AERIAL RAPID TRANSIT PRELIMINARY GEOTECHNICAL REPORT LOS ANGELES, CALIFORNIA	PROJECT NO.: 16037.000.000		FIGURE NO. 4
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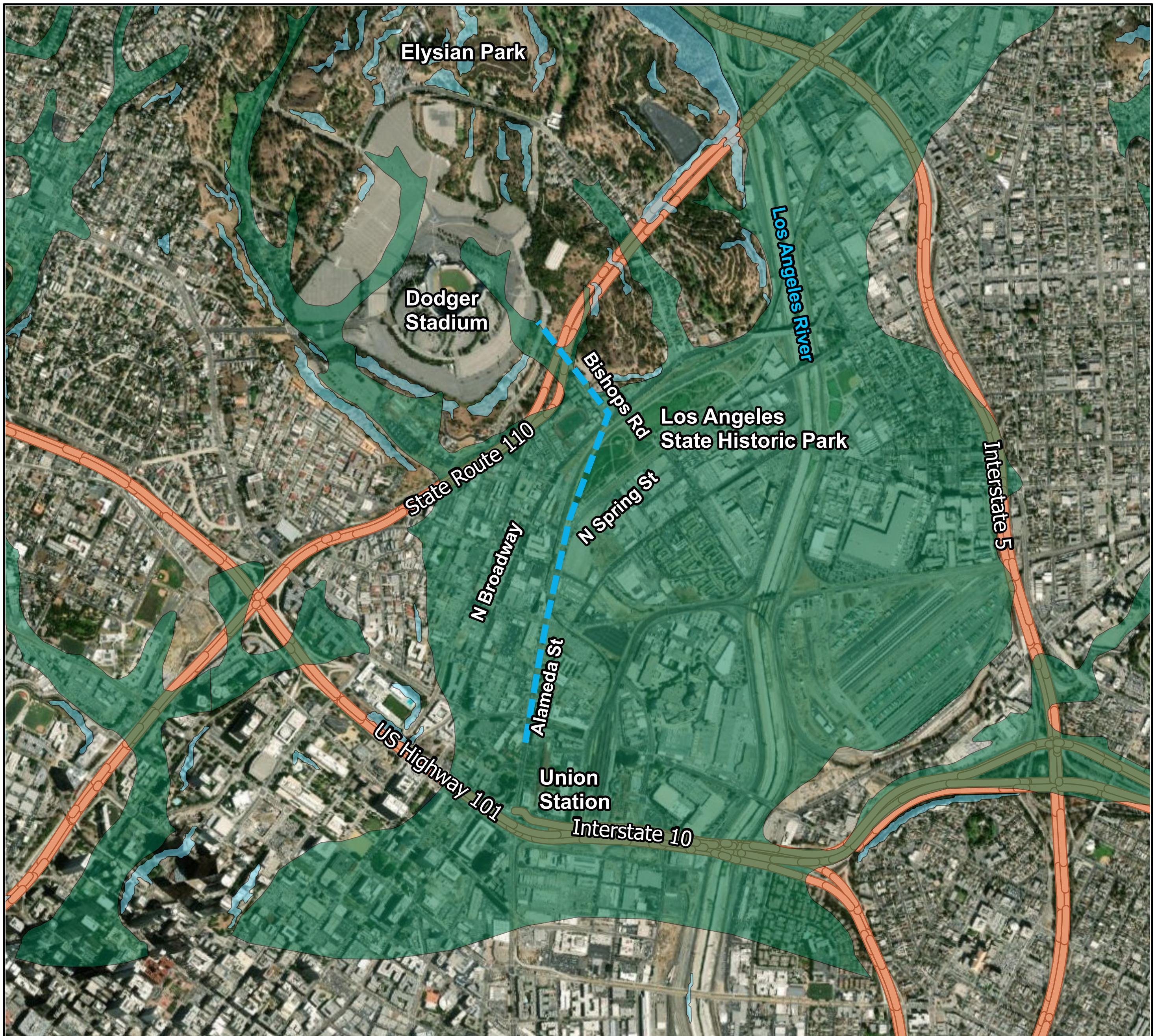

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

PROPOSED PROJECT ALIGNMENT

Earthquake-Induced Landslide Zones
Areas where previous occurence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Liquefaction Zone
Areas where historical occurence of liquefaction, or local geological, geotehnical and ground water conditions indicate a potential l for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required

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BASEMAP SOURCE: ESRI MAPPING SERVICE
CALIFORNIA DEPARTMENT OF CONSERVATION, CALIFORNIA GEOLOGICAL SURVEY

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SEISMIC HAZARDS ZONE MAP
LA AERIAL RAPID TRANSIT PRELIMINARY GEOTECHNICAL REPORT
LOS ANGELES, CALIFORNIA

PROJECT NO. : 16037.000.000		FIGURE NO.
SCALE: AS SHOWN		5
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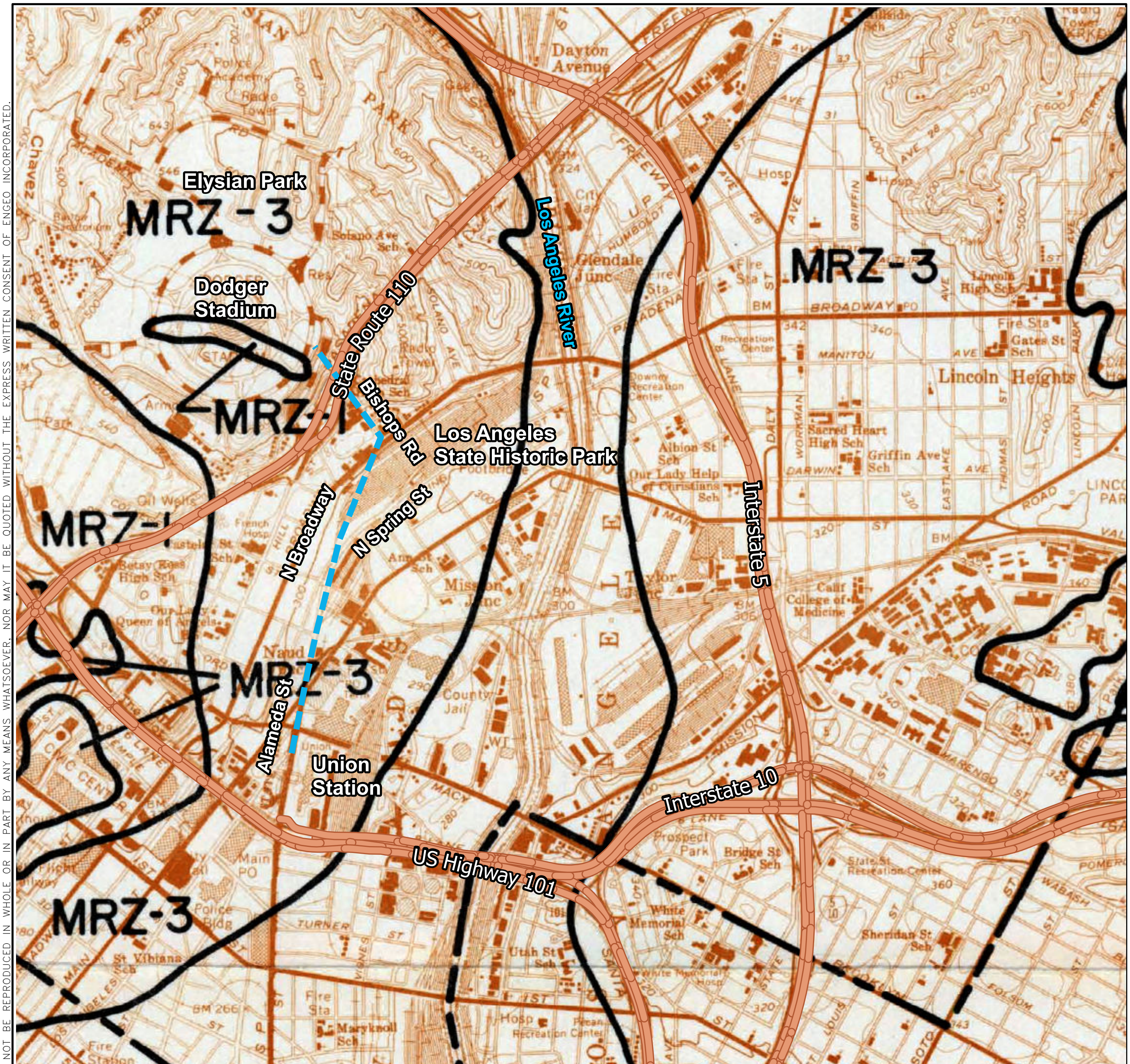

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

- PROPOSED PROJECT ALIGNMENT
- PRODUCTION-CONSUMPTION REGION BOUNDARY
- MRZ-1: AREAS WHERE ADEQUATE INFORMATION INDICATES THAT NO SIGNIFICANT MINERAL DEPOSITS ARE PRESENT, OR WHERE IT IS JUDGED THAT LITTLE LIKELIHOOD EXISTS FOR THEIR PRESENCE
- MRZ-3: AREAS CONTAINING MINERAL DEPOSOTS THE SIGNIFICANCE OF WHICH CANNOT BE EVALUATED FROM AVAILABLE DATA

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BASEMAP SOURCE: STATE OF CALIFORNIA THE RESOURCES AGENCY DEPARTMENT OF CONSERVATORY

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REGIONAL MINERAL RESOURCE MAP
LA AERIAL RAPID TRANSIT PRELIMINARY GEOTECHNICAL REPORT
LOS ANGELES, CALIFORNIA

PROJECT NO.: 16037.000.000	FIGURE NO. 6
SCALE: AS SHOWN	
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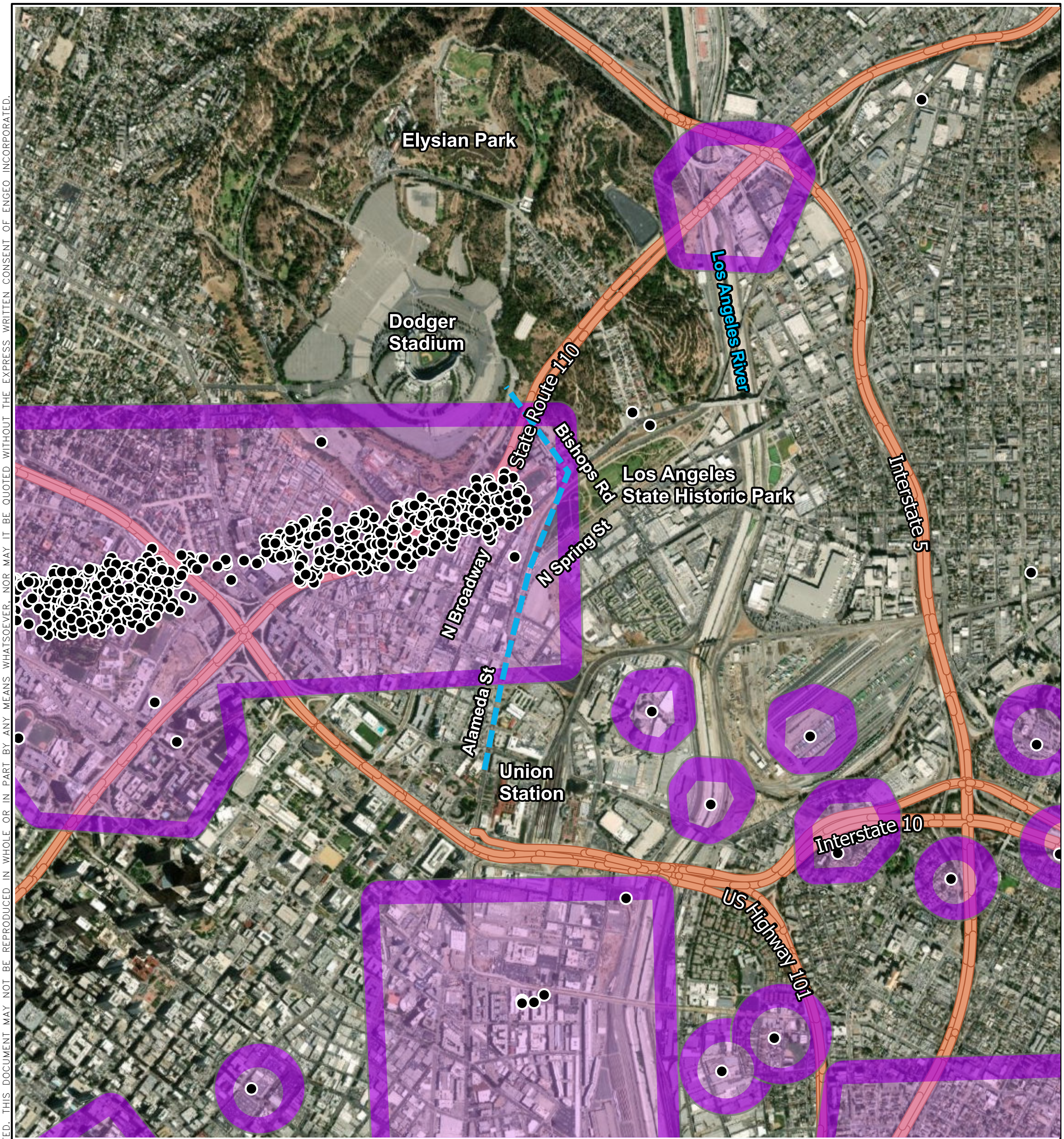

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

- METHANE ZONES
- METHANE BUFFER ZONES
- PROPOSED PROJECT ALIGNMENT
- OIL WELLS

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FEET

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BASEMAP SOURCE: ESRI MAPPING SERVICE 2018
CITY OF LOS ANGELES OPEN DATA

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REGIONAL OIL WELLS AND METHANE ZONES

LA AERIAL RAPID TRANSIT PRELIMINARY GEOTECHNICAL REPORT
LOS ANGELES, CALIFORNIA

PROJECT NO. : 16037.000.000	FIGURE NO. 7
SCALE: AS SHOWN	
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BASEMAP SOURCE: CALIFORNIA DEPARTMENT OF CONSERVATION, CALIFORNIA GEOLOGICAL SURVEY

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HISTORIC HIGH GROUNDWATER MAP
LA AERIAL RAPID TRANSIT PRELIMINARY GEOTECHNICAL REPORT
LOS ANGELES, CALIFORNIA

PROJECT NO.: 16037.000.000		FIGURE NO. 8
SCALE: AS SHOWN		
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