Appendix E1

Geotechnical Assessment of the Joint Plant Site

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Geotechnical Assessment of the Joint Plant Site for the PWSC

Final Technical Memorandum

February 16, 2024

Prepared for:

Metropolitan Water District of Southern California

Prepared by:

Converse Consultants

PROFESSIONAL CERTIFICATION

This report has been prepared by the staff of Converse under the professional supervision of the individuals whose seals and signatures appear hereon.

The findings, recommendations, specifications, or professional opinions contained in this geohazard study report were prepared in accordance with generally accepted professional engineering and engineering geologic principles and practice in this area of Southern California. There is no warranty, either expressed or implied.

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EXECUTIVE SUMMARY

The following is a summary of the findings, conclusions, and recommendations of our geohazard study as presented in the body of this report. Please refer to the appropriate sections of the report for complete conclusions and recommendations. In the event of a conflict between this summary and the report, or an omission in the summary, the report shall prevail.

- The Metropolitan Water District of Southern California (MWD) and the Los Angeles County Sanitation District (LACSD) are partnering to implement the Pure Water Southern California (PWSC) project to provide a drought-resistant new water source for MWD's member agencies.

- The project site is not located within a currently designated State of California Earthquake Fault Zone (formerly Alquist-Priolo Special Studies Zones) for surface fault rupture. No known active faults project through or toward the site.

- The northern portion of the project site is not shown to be within a mapped potential liquefaction zone; however, the southern portion of the project site is shown with a northeast trending, low-lying channel feature that is located within a mapped potential liquefaction zone as mapped by the State of California Earthquake Zones of Required Investigation.

- The project site is also not shown with any earthquake-induced landslide areas due to relatively flat the site topography.

- The potential for lateral spreading at the subject site is considered low over most areas of the project site except for the low-lying channel feature mapped as a potential liquefaction zone by the State of California Geologic Survey.

- Historically high groundwater level near the project site ranged from 10 to 20 feet below the ground surface.

- The potential for flooding near the subject site is considered remote.

- Site specific geotechnical investigation is recommended.

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1.0 INTRODUCTION

In accordance with the scope of work in Task Order No. 2, Task 2.1 – "Geotechnical Investigation", this report has been prepared to summarize the findings from the assessment of the geological and geohazard conditions of the Joint Plant Site, which would be used for an advanced water treatment facility associated with Pure Water Southern California (PWSC), formerly the Regional Recycled Water Program (RRWP).

1.1 Program Background and Drivers

The reuse of water from municipal wastewater facilities, including the Los Angeles County Sanitation Districts' (LACSD) Joint Water Pollution Control Plant (JWPCP), is a critical supply component necessary to provide long-term sustainable water supply sources to Metropolitan Water District of Southern California's (Metropolitan) customers. Metropolitan and LACSD are developing a large-scale regional recycled water program (PWSC) to beneficially reuse water currently discharged to the Pacific Ocean. The overall program involves construction of an advanced water treatment facility (AWTF) to treat effluent from the LACSD's JWPCP located in the City of Carson, California, as well as a new regional conveyance system and associated infrastructure to utilize the purified water to augment regional water supplies.

PWSC will purify either primary or secondary wastewater effluent from the JWPCP through advanced water treatment (AWT) processes, producing water suitable for potable reuse in Southern California. Water from the program will principally be used to recharge groundwater basins. This system will also have the flexibility to accommodate industrial users whose needs are consistent with the quality of water produced by the AWTF. Finally, future use of this system for direct potable reuse (DPR) applications appears feasible once applicable regulations are established. As currently envisioned, PWSC will be implemented in a phased approach with the ultimate capacity of the program dependent on both the availability of source water at the JWPCP and the anticipated water demands of member agencies for groundwater replenishment and raw water augmentation. Additionally, non-potable reuse to meet the demands within the JWPCP campus and the City of Carson is also planned.

1.2 Study Objective

The purpose of this study was to provide an assessment of the geological and geohazard conditions of the Joint Plant Site (proposed project site) by performing a desktop geotechnical analysis for the development of Environmental Impact Report. This report contains the results of a geohazard study performed for the proposed Advanced Water Treatment (AWT) Facility, a component of the PWSC project, to be located in the City of Carson, California. Since Metropolitan is still in the planning phase of the program, this desktop study was deemed sufficient. Additional geotechnical work will be performed on site during the preliminary design phase.

2.0 SITE AND PROJECT DESCRIPTION

2.1 Site Description

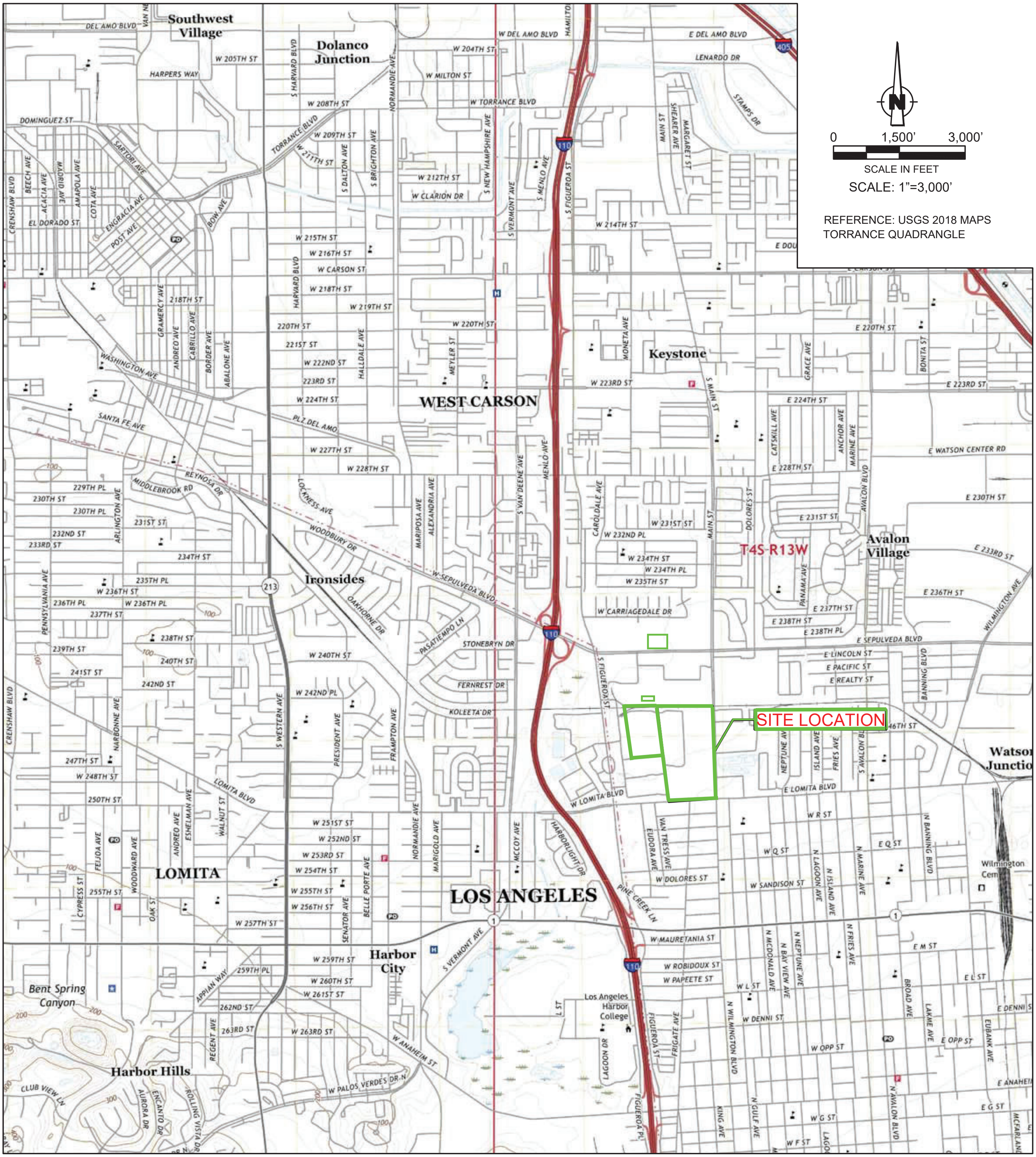
The proposed AWT facility site is planned to be located along the west side of South Main Street, north of Lomita Boulevard, and south of the Atchison, Topeka and Santa Fe railroad tracks in the City of Carson, California, as shown on Figure No. 1, *Site Location Map.* Ground elevations at the site range from approximately 28 and 45 feet relative to mean sea level.

The full scale AWT facility would be located primarily on unused land on the east side of the existing Joint Water Pollution Control Plant (JWPCP) infrastructure. Anticipated infrastructures associated with the full scale AWT facility include yard piping, electrical substation, electrical building, flow equalization, side stream centrate treatment, drum screens and influent pump station, MBR tanks, membrane filtration, RO feed tank, RO flush tank, RO trains, UV trains, Ozone/BAC for potential DPR applications, pump station for distribution system, major equipment concrete slabs, post treatment system, chemical facilities, administration building with operation control enter and water quality laboratory, maintenance building, public education center, a Workforce Training Center located north of Sepulveda Boulevard, in an approximately 11-acre lot (APN No. 7330-008-902), parking lot and field office areas for construction. The area includes an existing warehouse that supports JWPCP operations which will need to be demolished and vacant land which was formerly used by the Fletcher Oil and Refinery Company (FORCO) for oil development and refining activities.

The project site was operated as an oil refinery from 1939 to 1992, at which time it was decommissioned, and the above ground structures were demolished. Oil development and refining activities consisted of refining and storing petroleum products including crude oil, light distillates such as gasoline and naphtha, and intermediate and heavier distillates such as diesel fuel, heavy fuel oils and asphalt. The area of the refinery was reconfigured multiple times over the course of the operational history and included the addition, removal and replacement of above-ground storage tanks, vessels and equipment. Approximately 50 above ground storage tanks were located on-site and ranged in size from approximately 27,000 gallons to 3,900,000 gallons.

Records provided by the California Division of Oil, and Gas and Geothermal Resources (DOGGER) indicate that at least eight (8) oil production wells have been drilled on the property to extract oil and gas from the Wilmington Oil Field which underlies the project site.

The following geotechnical investigation reports were reviewed in preparation of this proposal:



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SITE LOCATION MAP

Advanced Water Treatment (AWT) Facility - MWDSC
24721 South Main Street
Carson, California

Project No.

21-31-232-01

Figure No.

1

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- LeRoy Crandall and Associates, 04/10/70, Foundation Recommendation Report, Proposed Chlorination Station Building, Joint Water Pollution Control Plant, Los Angeles, California, Project No. A-70052, 6 pages.
- LeRoy Crandall and Associates, 03/22/73, Foundation Investigation Report, Proposed Solids Processing Facilities, Joint Water Pollution Control Plant, Los Angeles County, California, Project No. A-73037, 52 pages.
- Advanced Foundation Engineering Inc., 04/13/73, Foundation Investigation Report, Proposed Tank Additions, Los Angeles County Sanitation District Water Pollution Control Plant, Carson, California, Project No. A73-1435, 19 pages.
- Fugro, 09/11/75, Foundation Investigation Report, Secondary Treatment Facilities, Joint Water Pollution Control Plant, Carson, California, Project No. 75-083-E, 122 pages.
- Converse Ward Davis Dixon Geotechnical Consultants, 06/22/81, Geotechnical Exploration Report, Proposed Waste Activated Sludge Processing Facilities, Carson Plant, Los Angeles, California, Project No. 81-1143-01, 54 pages.
- Earth Technology Corporation, 02/06/84, Geotechnical Investigation Report, Carver-Greenfield Dehydration/Energy Recovery System, Joint Water Pollution Control Plant, Carson, California, Project No. 84-175, 102 pages.
- Dale Hinkle, P.E, Inc., 02/14/91, Geotechnical Investigation Report, Carson Treatment Plant, Carson, California, 17 pages.
- Advanced Earth Sciences, 01/29/99, Geotechnical and Environmental Subsurface Assessment Report, Cryogenic Oxygen Generation Plant, Air Flotation Tank Facilities, Force Main Expansion, and East Side Tunnel, Joint Water Pollution Control Plant, Carson, California, Project No, 98-104, 242 pages.
- Group Delta Consultants, Inc., 11/05/99, Geotechnical Engineering Report, Proposed Environmental Laboratory Building, Joint Water Pollution Control Plant, Carson, California, Project No. L-236, 108 pages.
- Diaz Yourman & Associates, 11/06/02, Geotechnical Investigation, Proposed Entrance Road, Joint Water Pollution Control Plant, Carson California, Project No. 156-04, 77 pages.
- Geo-Environmental Inc., 04/23/07, Geo Environmental Investigation Report, Solids Processing Entrance Soils Profiling, Joint Water Pollution Control Plant, Carson, California, Project No. 107-34, 63 pages.
- AECOM, 09/26/16, Geotechnical Investigation Report, Regional Water Purification Facility Demonstration Plant Project, Joint Water Pollution Control Plant, Carson, California, Project No. 60483957, 159 pages.
- Advanced Earth Sciences, Inc., 02/01/19, Geotechnical Exploration Report, Biogas Pipeline at Figueroa Street, Joint Water Pollution Control Plant, Carson, California, 122 pages.

2.2 Project Description

The project will implement Pure Water Southern California (PWSC) by constructing an advanced water treatment plant to provide a drought resistant new water source for Metropolitan's member agencies. The approximate limits of the project site are shown on Figure No. 2, *Project Site Aerial Photo.*

3.0 GEOLOGIC CONDITIONS

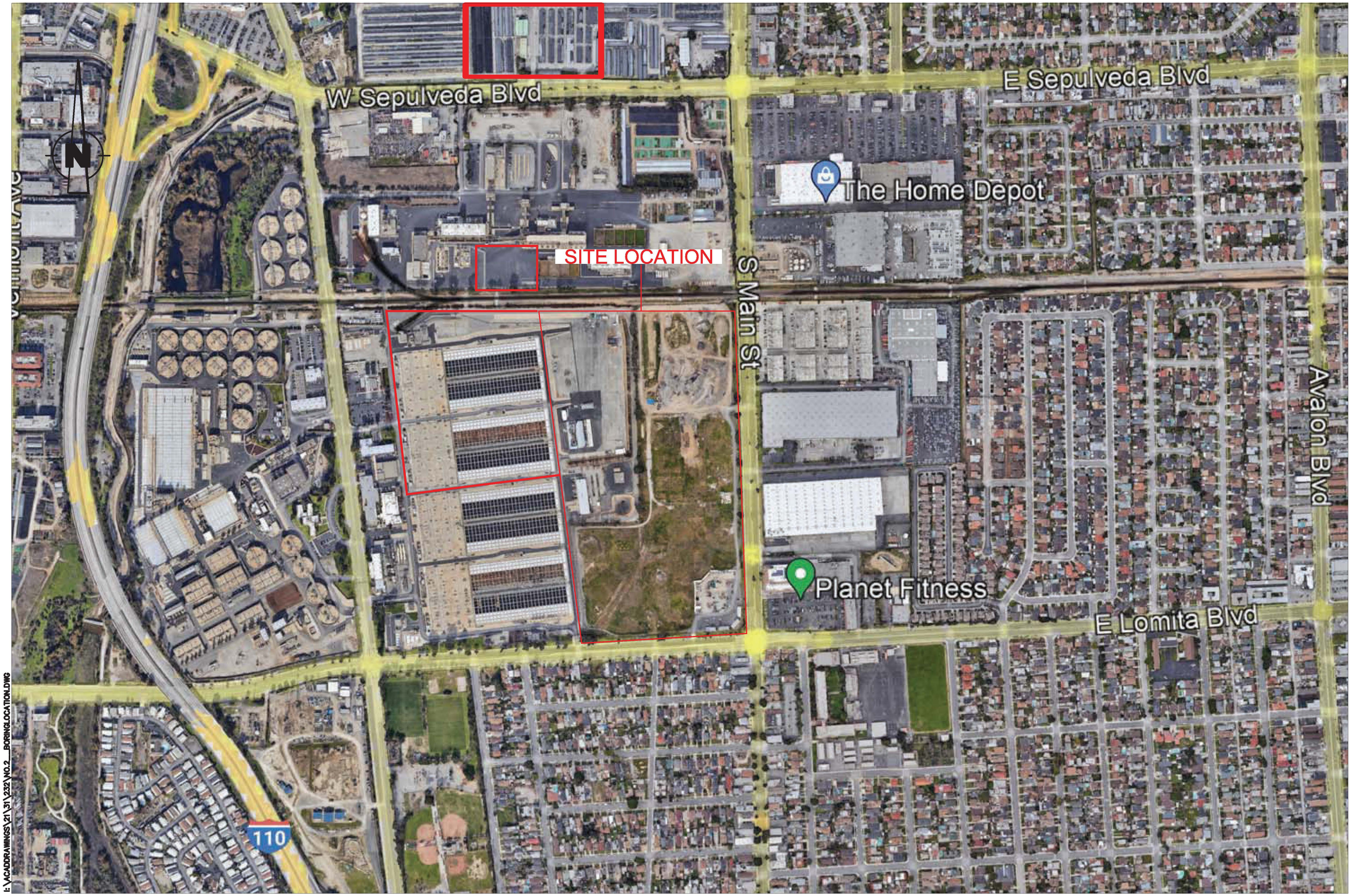
3.1 Regional Geology

The site is located within the southern portion of the Los Angeles Basin, a broad sediment-filled basin located along the northern margin of the Peninsular Ranges geomorphic province near the convergence with the Transverse Ranges geomorphic province of California. The Los Angeles, San Gabriel and Rio Hondo river drainages have deposited stream and flood sediments across the coastal flood plain during Holocene time (0-11,000 years) to form a relatively flat and broad flood plain geomorphic feature along the central portion of the Los Angeles basin. The project site is located on a relatively broad and level flood plain along the east side of the Los Angeles River channel between approximate surface elevations ranging between 28 feet and 45 feet. Soils underlying the project site consist primarily of alluvial sediments including sands, silty sands, silts and clay sediments deposited over time by rivers and local stream tributaries which once drained across the coastal plain to the Pacific Ocean. Most of these natural river, creek and stream channels are now controlled by dams, debris basins and concrete flood control channels that collect surface runoff and convey storm water to the ocean. Figure No. 3, *Regional Geologic Map*, has been prepared to show the project site with respect to regional geology of the Torrance Quadrangle.

The southern portion of the Los Angeles basin is underlain by several oil fields including the Wilmington, Torrance, Long Beach, Dominquez and Rosecrans. The closest oil field to the project site is the Wilmington oil field.

3.2 Subsurface Profile of Subject Site

Based on review of previous soil borings near the project vicinity, the subsurface conditions generally consist of existing fill soils placed during previous site grading operations and natural alluvial sediments. The local fill soils consist primarily of sandy silts, silty clays, sandy clays, clays and silty sands. The alluvial sediments consist of silty sands, silts, sands and clay sediments deposited by rivers, local stream tributaries and flood deposits. Site specific geotechnical investigations are recommended to further define the depths, limits, characteristics and soil classifications of the fill soils and alluvial sediments underlying the project site.



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Project Site Aerial Photo

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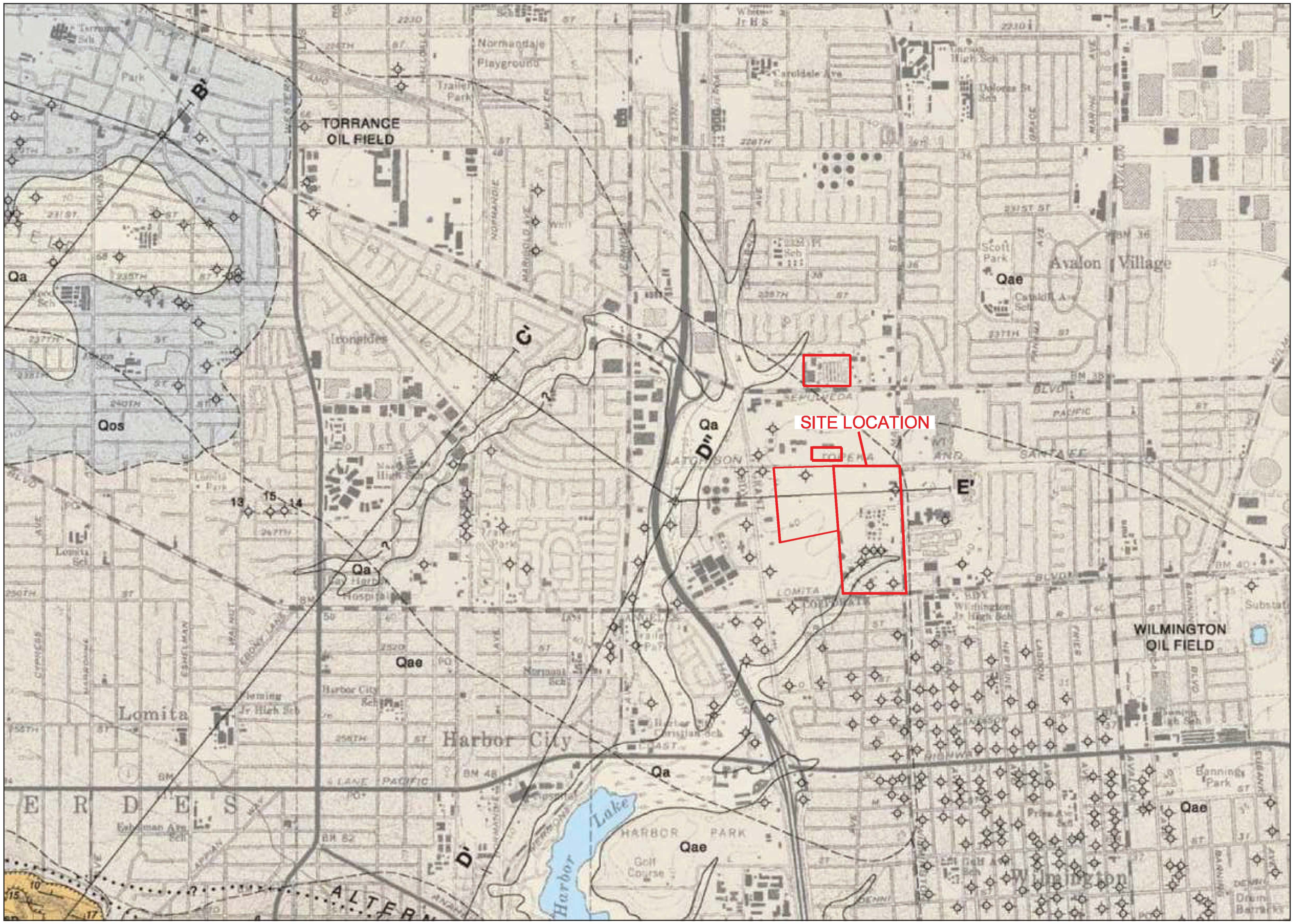
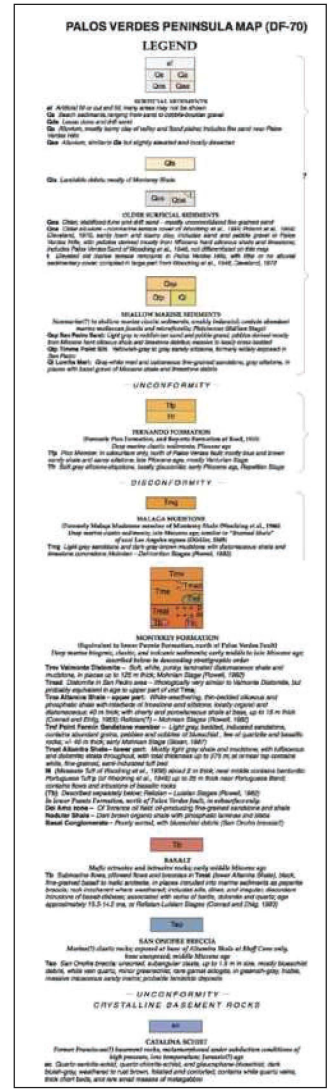
Advanced Water Treatment (AWT) Facility - MWDSC
24721 South Main Street
Carson,California

Project No.	Figure No.
21-31-232-01	2





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REGIONAL GEOLOGIC MAP

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Carson, California

Project No.	Figure No.
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3.3 Groundwater

Review of the Seismic Hazard Zone Report for the Torrance 7.5-Minute Quadrangle (CDMG, 1998) Plate 1.2 indicates the historically highest ground water contour levels in the vicinity of the project site reportedly ranged from approximately 10 feet below ground surface near Interstate Highway 110 on the west end to approximately 20 feet bgs near Avalon Village on the northeast end. A historical high ground water map differs from most ground water maps, which show the actual water table at a particular time.

In general, groundwater levels fluctuate with the seasons and local zones of perched groundwater may be present within the near-surface deposits due to local conditions or during rainy seasons.

3.4 Subsurface Variations

Based on results of the subsurface exploration and our experience with the subject area, some variations in the continuity and nature of subsurface conditions within the project site are anticipated. Because of the uncertainties involved in the nature and depositional characteristics of the earth material at the site, care should be exercised in interpolating or extrapolating subsurface conditions between or beyond the boring locations. If, during construction, subsurface conditions different from those presented in this report are encountered, this office should be notified immediately so that recommendations can be modified, if necessary.

3.5 Expansive Soil Mitigation

Expansive soils are characterized by their ability to undergo significant volume change (shrink or swell) due to variations in moisture content. Based on review of geological maps, the site soils can be anticipated to have low to medium expansion potential. The expansion potential of the site soil should be verified during geotechnical investigations.

To mitigate the expansive soils, on-site clayey soils with an Expansion Index higher than 20 should not be re-used for compaction within 2 feet below the proposed structures. The extent of removal should be determined by the geotechnical representative based on soil observation during grading.

There are several alternative mitigation measures that can be utilized to improve expansive soils at the site. Some mitigation measures include:

- Removing about two (2) feet of the underlying soils throughout areas beneath structures and replacing with imported non-expansive sandy soil materials.
- Reinforce footings and place thicker concrete slabs with moisture barriers.
- Lime treat the upper two (2) feet of the subgrade soils.

4.0 FAULTING AND SEISMIC HAZARDS

Geologic hazards are defined as geologically related conditions that may present a potential danger to life and property. Typical geologic hazards in Southern California include earthquake ground shaking, fault surface rupture, liquefaction and seismically induced settlement, lateral spreading, landslides, earthquake induced flooding, tsunamis and seiches, and volcanic eruption hazard.

Results of a site-specific evaluation for each type of possible seismic hazards are discussed in the following sections.

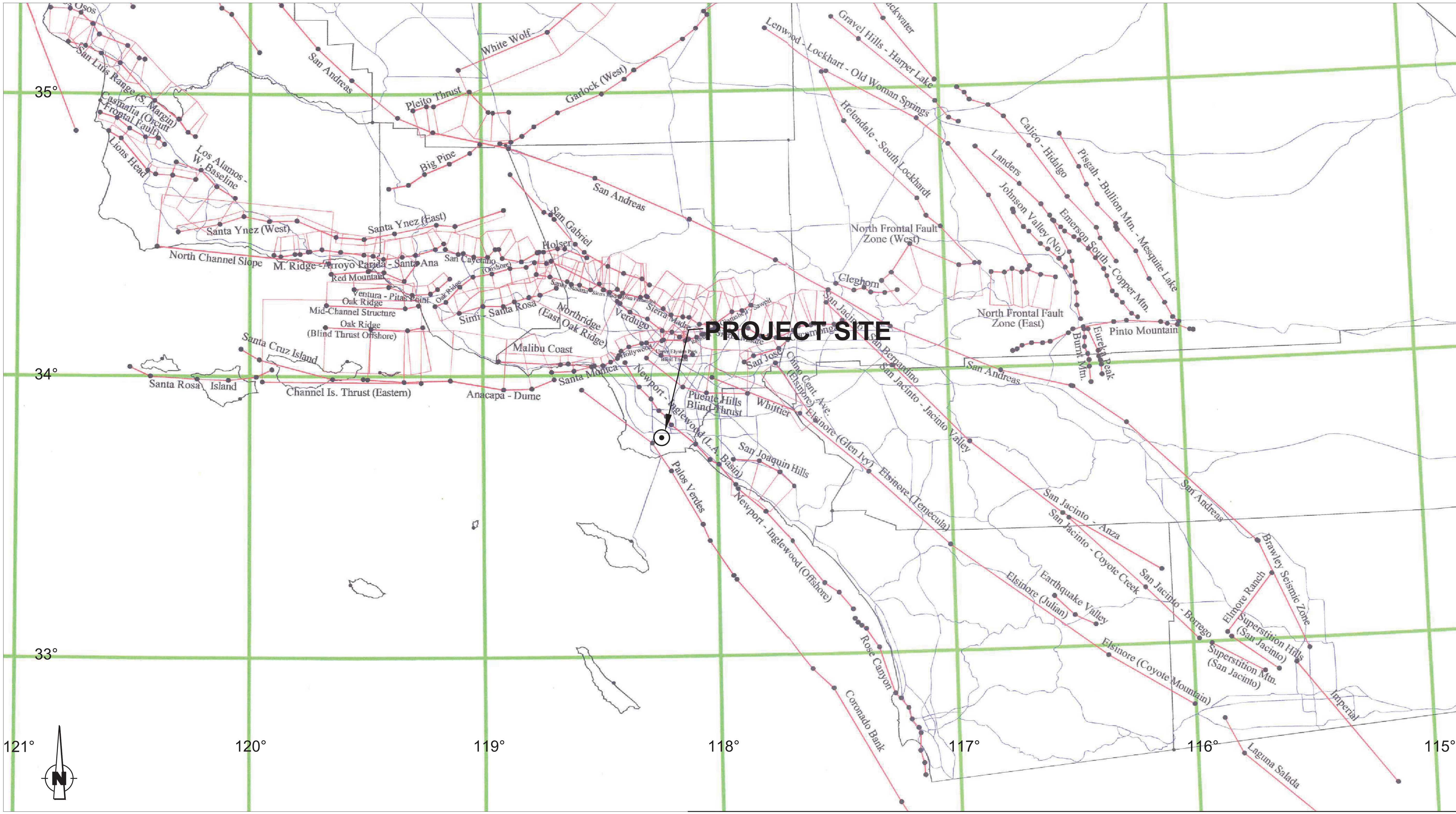
4.1 Seismic Characteristics of Nearby Faults

No surface faults are known to project through or towards the site. The closest known fault to the project site with mappable surface expressions is the Newport-Inglewood Fault located approximately 9 miles east-northeast in north Long Beach. The concealed Puente Hills Blind Thrust Fault and Upper Elysian Park Blind Thrust Fault along with other regional faults were included as active fault sources for the probabilistic seismic hazard analysis for the site. The approximate locations of these local active faults with respect to the project site are tabulated on Table No. 1, *Summary of Regional Faults,* and are shown on Figure No. 4, Southern *California Regional Fault Map*.

4.1.1 Newport-Inglewood Fault

The active Newport-Inglewood Fault dominates the geologic structure in the northern Long Beach Quadrangle. The mapped fault trace of the Newport-Inglewood fault zone is located approximately 9 miles east of the project site. The northwest-trending Newport-Inglewood fault zone exhibits surface geomorphic features including low eroded scarps alongside-steeping fault segments and a series of northwest trending elongated low hills and mesas that extend from Newport Bay in Orange County northwestward to Beverly Hills. Signal Hill and Dominquez Hills are hillside geomorphic features that have been uplifted by tectonic movement along the Newport-Inglewood fault zone. The major fault segments of the Newport-Inglewood fault zone in the Long Beach area include the Cherry Hill fault, Pickler fault, Northeast Flank fault, Reservoir Hill fault and Seal Beach fault. The orientation of these fault segments is generally attributed to right-lateral, strike-slip faulting at depth.

Several earthquakes have occurred along the fault zone including the March 10, 1933 “Long Beach” earthquake of Mw 6.4, with its epicenter off Newport Beach, and smaller earthquakes at Inglewood on June 20, 1920 (Mw 4.9) and May 17, 2009 (Mw 4.7), Torrance on October 21, 1941 (Mw 4.8), Gardena on November 14, 1941 (Mw 4.8) and



REFERENCE: PORTION OF CGS 2002 CALIFORNIA FAULT MODEL MODIFIED FOR USE WITH FRISKSP AND EQFAULT BY THOMAS F. BLAKE, AUGUST 2004

FAULT SOURCES

BLIND THRUST FAULT, POLYGONS INDICATE RUPTURE PLANES AND DIP DIRECTION

SOUTHERN CALIFORNIA REGIONAL FAULT MAP

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24721 South Main Street
Carson, California

Project No. 21-31-232-01

Figure No. 4

Date JUNE 2022

Newport Beach on April 7, 1989 (Mw 4.7). These historic earthquakes show evidence of right-lateral strike slip focal mechanisms.

The Newport-Inglewood fault is considered to be active and capable of producing a maximum moment magnitude (Mw) 7.1 earthquake. The slip rate is considered to be about 1.0 mm/year but may range up to 2 to 3 mm/year along isolated fault segments.

4.1.2 Puente Hills Blind Thrust Fault

The potential for damage from earthquakes along a zone of north dipping blind thrust faults in the northern Los Angeles basins was illustrated by the M5.9 Whittier earthquake on October 1, 1987 and the M6.8 Northridge earthquake on January 17, 1994.

Blind thrust faults are low angle reverse faults which generally have no surface trace. Conventional fault-finding trenches, boreholes and paleoseismic dating methods used at the surface have limited use for investigation of these deeply buried thrust fault structures. The geometry and location of the blind thrust fault structures and thrust ramps are based on interpretation of oil well data, seismic and strong motion data solutions, high resolution geophysical data, paleoseismic studies and structural model analyses. Examples of blind thrust fault landforms include the folded and uplifted areas such as the Santa Monica Mountains, and the Hollywood, Elysian, Repetto, Montebello and Puente Hills.

The nearest subsurface projection interpretation of the Puente Hills Thrust Fault is located approximately 10.7 miles from the project site. The Puente Hills Blind Thrust Fault has been interpreted to include three segments with a combined length of approximately 42 kilometers and depth range of 3 kilometers to 13 kilometers below ground surface and ramping down toward the east and northeast direction. Studies of the Puente Hills Blind Thrust have indicated the occurrence of at least four large (M7.0 to M7.5) earthquakes for this fault system during the past 11,000 years.

4.1.3 Upper Elysian Park Blind Thrust Fault

Details concerning the Upper Elysian Park Blind Thrust are limited by the fact that the thrust fault is buried below ground surface, thus the term “blind” thrust fault. The Upper Elysian Park Blind Thrust Fault has been interpreted to be about 18 miles with a depth range of 3 kilometers to 15 kilometers below ground surface and is inclined approximately 50 degrees to the northeast below the San Gabriel Basin.

Seismic hazard fault models for the Los Angeles basin and vicinity will continue to be refined as new information and technology develops and becomes available through time. As is the case for most areas of Southern California, ground-shaking resulting from earthquakes associated with nearby and more distant faults may occur at the project site. During the life of the project, seismic activity associated with active faults can be expected to generate moderate to strong ground shaking at the site.

Effects of the associated seismic activities are considered in the seismic design parameters presented in section 5 of this report. Site-specific seismic studies are required if the requirements of section 11.4.3 and 11.4.4 of ASCE 7-16/22 are not met. In such a case, site-specific acceleration parameters shall be evaluated in accordance with the seismic provisions in Section 21 of ASCE 7-16/22 guidelines. Site-specific geotechnical investigations shall consider development of site-specific acceleration parameters.

Table No. 1, *Summary of Regional Faults,* shows the location of the known most capable faults with respect to the site within 50 kilometers. The data presented below are based on updated fault data from "2008 National Seismic Hazard Maps" from U.S. Geological Survey (USGS) website.

Table No. 1, Summary of Regional Faults

Fault Name and Section	Closest Distance (km)	Slip Sense	Length (km)	Slip Rate (mm/year)	Maximum Magnitude
Newport-Inglewood, alt 1	6.22	strike slip	65	1	7.20
Newport Inglewood Connected alt 1	6.22	strike slip	208	1.3	7.50
Newport Inglewood Connected alt 2	7.58	strike slip	208	1.3	7.50
Puente Hills (Santa Fe Springs)	17.33	thrust	11	0.7	6.70
Puente Hills (LA)	18.69	thrust	22	0.7	7.00
Puente Hills (Coyote Hills)	23.83	thrust	17	0.7	6.90
Elysian Park (Upper)	29.73	reverse	20	1.3	6.70
Elsinore;W	30.12	strike slip	46	2.5	7.03
Santa Monica Connected alt 2	30.65	strike slip	93	2.4	7.40
Santa Monica, alt 1	31.39	strike slip	14	1	6.60
Santa Monica Connected alt 1	31.39	strike slip	79	2.6	7.30
Hollywood	33.53	strike slip	17	1	6.70
San Joaquin Hills	33.97	thrust	27	0.5	7.10
Malibu Coast, alt 1	34.07	strike slip	38	0.3	6.70
Malibu Coast, alt 2	34.07	strike slip	38	0.3	7.00
Anacapa-Dume, alt 2	35.16	thrust	65	3	7.20
Raymond	35.83	strike slip	22	1.5	6.80
Verdugo	38.28	reverse	29	0.5	6.90
Newport-Inglewood (Offshore)	40.91	strike slip	66	1.5	7.00
Anacapa-Dume, alt 1	43.62	thrust	51	3	7.20
San Jose	45.24	strike slip	20	0.5	6.70
Sierra Madre	45.76	reverse	57	2	7.20
Sierra Madre Connected	45.76	reverse	76	2	7.30
Clamshell-Sawpit	48.95	reverse	16	0.5	6.70

(Source: https://earthquake.usgs.gov/cfusion/hazfaults_2008_search/)

4.2 Seismic History

An analysis of the seismic history of the site was conducted using the USGS Earthquake Catalog. Based on the analysis of seismic history, the number of earthquakes with a moment magnitude of 4.0 or greater occurring within a distance of 100 kilometers was 339, since the year 1930. Based on the analysis, the largest earthquake-induced ground acceleration affecting the site since the year 1930 is a 6.7 magnitude earthquake in 1994 which occurred at a distance of approximately 11 miles from the site.

Review of recent seismological and geophysical publications indicates that the seismic hazard for the Los Angeles basin is high. The Los Angeles basin is bounded by active regional faults on all sides and underlain by alluvial sediments and buried thrust faults. The seismic hazard for the Los Angeles basin was illustrated by the 1971 San Fernando, 1987 Whittier Narrows, 1991 Sierra Madre and 1994 Northridge earthquakes. The epicenters for these earthquakes are shown on Figure No. 5, *Epicenter Map of Southern California Earthquakes (1800-1999).*

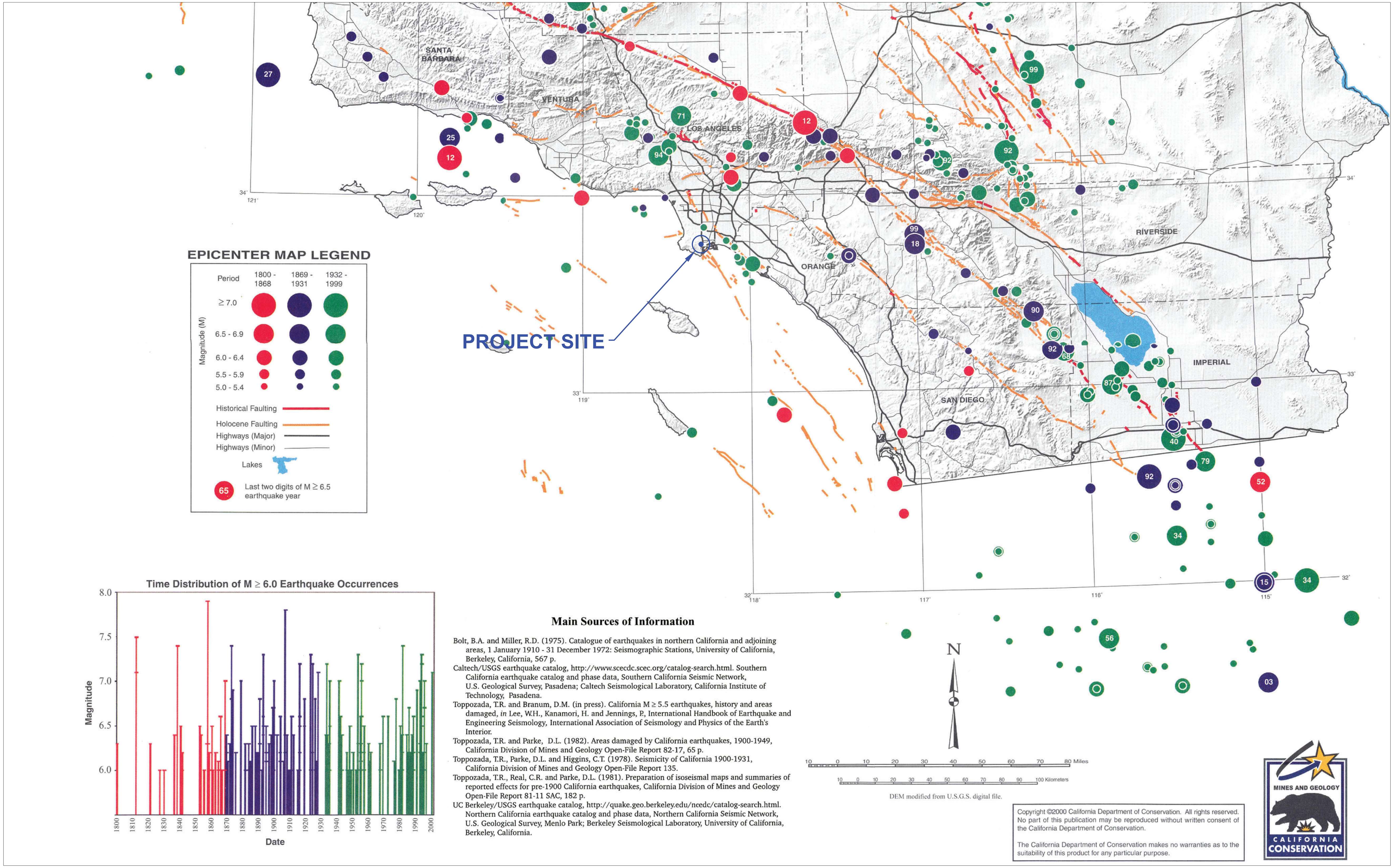
4.3 Surface Fault Rupture

The project site is not located within a currently designated State of California Earthquake Fault Zone (formerly Alquist-Priolo Special Studies Zones) for surface fault rupture. The Alquist-Priolo Earthquake Fault Zoning Act requires the California Geological Survey to zone “active faults” within the State of California. An “active fault” has exhibited surface displacement with Holocene time (within the last 11,000 years) hence constituting a potential hazard to structures that may be located across it. Public school structures are required to be set-back at least 50 feet from an active fault. The active fault set-back distance is measured perpendicular from the dip of the fault plane. Based on a review of existing geologic information, no known active faults project through or toward the site. The potential for surface rupture resulting from the movement of the nearby major faults is considered remote.

4.4 Liquefaction and Seismically-Induced Settlement

Liquefaction is the sudden decrease in the strength of cohesionless soils due to dynamic or cyclic shaking. Saturated soils behave temporarily as a viscous fluid (liquefaction) and, consequently, lose their capacity to support the structures founded on them. The potential for liquefaction decreases with increasing clay and gravel content but increases as the ground acceleration and duration of shaking increase. Liquefaction potential has been found to be the greatest where the groundwater level and loose sands occur within 50 feet of the ground surface.

The northern portion of the project site is not shown to be within a mapped potential liquefaction zone as mapped by the State of California Earthquake Zones of Required Investigation, however, the southern portion of the project site is shown with a northeast



REFERENCE: PORTION OF EPICENTERS AND AREAS DAMAGED BY M≥5 CALIFORNIA EARTHQUAKES, 1800-1999 CALIFORNIA DEPARTMENT OF CONSERVATION, MAP SHEET 49 DATED 2000.

EPICENTER MAP OF SOUTHERN CALIFORNIA EARTHQUAKES (1800–1999)

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Carson, California

Project No.	Figure No.
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trending, low-lying channel feature that is located within a mapped potential liquefaction zone per the State of California Earthquake Zones of Required Investigation maps for the Torrance Quadrangle (1999). The approximate limits of the potential liquefaction zone are shown in Figure No. 6, *Seismic Hazard Zones Map*.

Site-specific geotechnical investigations are recommended to further define the liquefaction potential at the project site. Geotechnical investigation should include soil borings up to maximum depths of 50 feet. The number of borings will be based on the type and size of improvements.

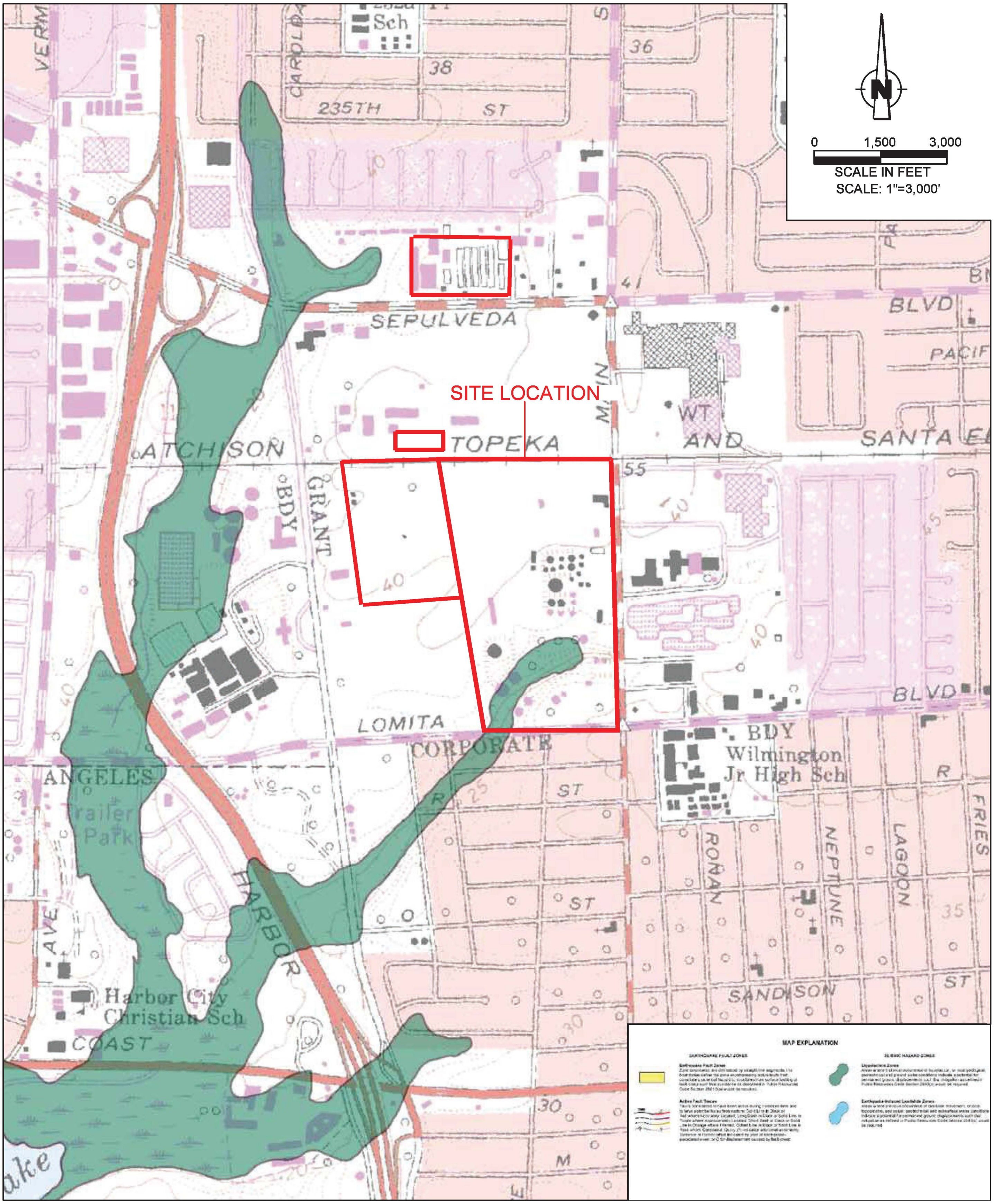
Possible remediation for liquefaction and seismically induced settlements are:

1) Using pile foundations bypassing the upper liquefaction zone for sufficient structural support.
2) The liquefaction hazard may be mitigated by soil improvement techniques. Ground improvement is one of the mitigation options to reduce the ground settlement at the project site besides deep foundations. We recommend implementation of one of the following options: 1) Compaction Grouting, 2) Rammed Aggregate Piers 3) Stone Columns, or 4) Wet Soil Mix Columns. Ground improvement utilizing compaction grouting or rammed aggregate piers to densify the subsurface liquefiable soils is considered geotechnical feasible to alleviate the seismically induced settlement. After completion of ground improvement as well as any necessary remedial grading, the proposed buildings or structures can be supported on shallow foundations.
3) Using mat foundations to mitigate possible differential settlements.

The remediation may be chosen based on the data collected during site-specific geotechnical investigations and structural design requirement considerations.

4.5 Lateral Spreading

Seismically induced lateral spreading involves primarily lateral movement of earth materials due to ground shaking. It differs from the slope failure in that complete ground failure involving large movement does not occur due to the relatively smaller gradient of the initial ground surface. Lateral spreading is demonstrated by near-vertical cracks with predominantly horizontal movement of the soil mass involved. The topography at the project site and in the immediate vicinity of the site is relatively flat and has no significant nearby slopes or embankments. Under these circumstances, the potential for lateral spreading at the subject site is considered low over most areas of the project site except for the low-lying channel feature mapped as a potential liquefaction zone by the State of California Geologic Survey.



Reference: Torrance, 1999

SEISMIC HAZARD ZONES MAP

Converse Consultants

Advanced Water Treatment (AWT) Facility, MWDSC
24721 South Main Street
Carson, California

Project No.	Figures No.
21-31-232-01	6

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Site-specific geotechnical investigations are recommended to further define the extent and limits of lateral spreading potential at the project site. Geotechnical investigation should include soil borings up to maximum depths of 30 feet. Additionally, cone penetration testing (CPT) can also be conducted.

Possible remediations for seismically induced lateral spreading are:

1) Ground Improvement, which involves densification, reinforcement, or cementation of the liquefaction-susceptible soil.
2) Supporting the affected structures from surrounding spreading deformations. In-ground retaining walls, installation of piles, and ground improvements around the structures.
3) Design structures capable of withstanding the anticipated soil displacements.

4.6 Seismically Induced Slope Instability

Seismically induced landslides and other slope failures are common occurrences during or soon after earthquakes. The project site is also not shown with any earthquake-induced landslide areas due to relatively flat site topography. In the absence of significant ground slopes, the potential for seismically induced landslides to affect the proposed site is considered to be very low.

4.7 Earthquake-Induced Flooding

Review of the Flood Insurance Rate Map (FIRM), Map Number 0637C1942G, dated April 21, 2021, from the FEMA Map Service Center Viewer, indicates that the site is in an area designated as Zone X, “Area of minimal flood hazard”. Due to the distance of the subject site from large bodies of water and regional flood control structures, the potential for flooding at the subject site is considered remote. The potential of earthquake induced flooding of the subject site is considered to be remote.

4.8 Tsunami and Seiches

Tsunamis are seismic sea waves generated by fault displacement or major ground movement. Based on the location of the site from the ocean (over 10 miles), tsunamis do not pose a hazard. Seiches are large waves generated in enclosed bodies of water in response to ground shaking. Based on site location away from lakes and reservoirs, seiches do not pose a hazard.

4.9 Volcanic Eruption Hazard

There are no known volcanoes near the site. According to Jennings (1994), the nearest potential hazards from future volcanic eruptions is the Amboy Crater-Lavic Lake area located in the Mojave Desert more than 120 miles east/northeast of the site. Volcanic eruption hazards are not present.

4.10 Hazardous Materials

Hazardous materials assessment is presented under a different cover.

5.0 SEISMIC ANALYSIS

5.1 CBC Seismic Design Parameters

Seismic parameters based on both 2019 California Building Code and 2022 California Building Code are calculated using the United States Geological Survey *U.S. Seismic Design Maps* website application and the site coordinates for (33.801806 degrees North Latitude, 118.277562 degrees West Longitude). These coordinates are in reference to the project area. Review of the California Geologic Survey (CGS) publication Engineering Geology and Seismology for Public Schools, Colleges, and Hospitals in California, dated August 9, 2005 (page 32) indicates that accuracy to within a few hundred meters of these coordinates is sufficient for the computation of the earthquake ground motion of the project site. The seismic parameters are presented below.

Table No. 2, CBC 2019 Seismic Design Map Parameters

Seismic Parameters	ASCE7-16
Site Class	D
Mapped Short period (0.2-sec) Spectral Response Acceleration, S_S	1.733 g
Mapped 1-second Spectral Response Acceleration, S_1	0.632 g
Site Coefficient (from Table 1613.5.3(1)), F_a	1.0
Site Coefficient (from Table 1613.5.3(2)), Fv*	1.7
(1) MCE 0.2-sec period Spectral Response Acceleration, S_{MS}	1.733 g
(1) MCE 1-second period Spectral Response Acceleration, S_{M1}*	1.074 g
Design Spectral Response Acceleration for short period, S_{DS}*	1.155 g
Design Spectral Response Acceleration for 1-second period, S_{D1}	0.716 g
(2)PGA_M	0.845
Seismic Design Category	D

Notes:
(1) MCE_R stands for Risk-Targeted Maximum Considered Earthquake.
(2) MCE_G PGA stands for Maximum Considered Earthquake Geometric Mean Peak Ground Acceleration.
* See requirements of ASCE 7-16 Section 11.4.8

Table No. 3, CBC 2022 Seismic Design Map Parameters

Seismic Parameters	ASCE7-22
Site Class	D
Mapped Short period (0.2-sec) Spectral Response Acceleration, S_S	1.95 g
Mapped 1-second Spectral Response Acceleration, S_1	0.77 g
(1) MCE 0.2-sec period Spectral Response Acceleration, S_{MS}	2.02 g
(1) MCE 1-second period Spectral Response Acceleration, S_{M1}*	1.69 g
Design Spectral Response Acceleration for short period, S_{DS}*	1.35 g
Design Spectral Response Acceleration for 1-second period, S_{D1}	1.13 g
(2)PGA_M	0.79
Seismic Design Category	E

Notes:
(1) MCE_R stands for Risk-Targeted Maximum Considered Earthquake.
(2) MCE_G PGA stands for Maximum Considered Earthquake Geometric Mean Peak Ground Acceleration.
* See requirements of ASCE 7-22 Section 11.4.3

6.0 CONSTRUCTION CONSIDERATIONS

6.1 General

The recommendations contained in this section are based on desktop analysis for Environmental Documentation purposes. Geotechnical investigation needs to be conducted to assess actual field soil characteristics.

Site soils should be excavatable using conventional heavy-duty excavating equipment. Temporary sloped excavation is feasible if performed in accordance with the slope ratios provided in Section 6.2, *Temporary Excavations*. Existing utilities should be accurately located and either protected or removed as required.

6.2 Temporary Excavations

Sloped temporary excavations (if necessary) may be constructed according to the slope ratios presented in Table No. 4, *Slope Ratios for Temporary Excavations*. Any loose utility trench backfills, or other fill encountered in excavations will be less stable than the native soils. Temporary cuts encountering loose fill or loose dry sand may have to be constructed at a flatter gradient than presented in the following table:

Table No. 4, Slope Ratios for Temporary Excavations

Maximum Depth of Cut (feet)	Maximum Slope Ratio* (Horizontal: vertical)
0 – 4	vertical
4 – 8	1:1

*Slope ratio assumed to be uniform from top to toe of slope.

Surfaces exposed in slope excavations should be kept moist but not saturated to minimize raveling and sloughing during construction. Adequate provisions should be made to protect the slopes from erosion during periods of rainfall. Surcharge loads, including construction, should not be placed within five (5) feet of the unsupported trench edge. The above maximum slopes are based on a maximum height of six (6) feet of stockpiled soils placed at least five (5) feet from the trench edge.

All applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health Act of 1987 and current amendments, and the Construction Safety Act should be met. The soils exposed in cuts should be observed during excavation by the project's geotechnical consultant. If potentially unstable soil conditions are encountered, modifications of slope ratios for temporary cuts may be required.

6.3 Slot Cut Recommendations

Temporary excavations during possible improvements should not extend below a 1:1 horizontal: vertical (H:V) plane extending beyond and down from the bottom of the existing foundations, utility lines or structures. The remedial grading excavations should not cause loss of bearing and/or lateral support for adjacent foundations, utilities, or structures.

If remedial grading excavations extend below a 1:1 horizontal: vertical (H:V) plane extending beyond and down from the bottom of adjacent off-site utility lines or structure foundations, shoring or slot cutting shall be employed. The ABC slot cutting method for over-excavation could be a possible option as an alternative to shoring for excavation less than 8 feet in width and depth or with cohesive soils. In general, for structures it is not recommended for slot cutting if the height of excavation exceeds more than 8 feet or into sandy soils and with surcharging load. Backfill should be accomplished in the shortest period of time possible and in alternating sections.

7.0 CLOSURE

The information and findings of the geohazard assessment report were prepared in accordance with generally accepted engineering geologic principles and practice. This assessment report was prepared without the benefit of subsurface investigation and laboratory testing. We make no warranty, either expressed or implied. Our opinions and conclusions are based on review of available published maps, documents and information. Site-specific geotechnical and environmental investigations are recommended to further define the depths, limits, characteristics, and soil classifications of the fill soils and alluvial sediments underlying the project site.

Our services are for the sole benefit and exclusive use of Stantec Consulting Services, Inc. and their design team. If conditions encountered during construction appear to be different from those presented in the report, this office should be notified. Additional consultation may be prudent to interpret Converse's findings for contractors, to possibly refine our recommendations based upon the review of the final site plans and actual site conditions encountered during grading.

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