Appendix C. Preliminary Geotechnical Report

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Preliminary Geotechnical Assessment Report

Anaheim Street and Walnut Avenue Development Project

City of Long Beach, California

January 2019

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Acronyms

ASCE	American Society of Civil Engineers
CDC	California Department of Conservation
CDMG	California Department of Conservation, Division of Mines and Geology
CGS	California Geological Survey
Fa	Short period site coefficient
Fv	Long period site coefficient
g	units of gravity
PGA	Peak Ground Acceleration
PGAM	Geometric Mean PGA
S1	Mapped 5 percent damped spectral response acceleration parameter at one second period
Sd1	design 5 percent damped spectral response acceleration parameter at one second period
Sds	design 5 percent damped spectral response acceleration parameter at short period
SEI	Structural Engineering Institute
Sm1	5 percent damped spectral response acceleration parameter at one second period adjusted for site class effects
Sms	5 percent damped spectral response acceleration parameter at short period adjusted for site class effects
Ss	Mapped 5 percent damped spectral response acceleration parameter at short period
USGS	United States Geological Survey

1 Introduction

1.1 Project Location

The Anaheim Street and Walnut Avenue Development Project (project) site is approximately 1.54 acres and consists of seven parcels located between Hoffman Avenue and Walnut Avenue, south of East Anaheim Street and north of East 11th Street in the central portion of the City of Long Beach. All parcels are currently vacant. A project vicinity map is presented on Figure 1 in Appendix A.

1.2 Project Description

The project consists of a new 116,215-square-foot mixed-use building that is 59.2 feet above ground level (maximum five stories). The building includes an 88-unit, five-story apartment building;18,136 square feet for a medical clinic; and 1,100 square feet of ground-floor commercial office space. The project would also include a four-story attached parking structure with 212 parking spaces. The entrance for the parking structure would be on the west side of the property from an existing alley. The project consists of 100 percent affordable housing units.

1.3 Purpose and Scope

The purpose of our study is to provide preliminary evaluation of geologic and geotechnical hazards at the project site, and provide our preliminary findings and general geotechnical conclusions regarding proposed site development. This report is preliminary in scope and does not include a subsurface field investigation. Our preliminary findings are intended solely for pre-design feasibility study purposes. A final design report must be performed prior to development after a subsurface investigation and laboratory testing has been performed. Our proposed scope of services is based on our experience with geologic/geotechnical conditions at the project site and consists of the following tasks:

- Review geotechnical/geologic maps and reports in our in-house library that are relevant to the project site.
- Review readily available seismic and faulting information, including data for designated earthquake fault zones and our in-house database of faulting in the general site vicinity.
- Conduct a site visit to observe the existing near-surface conditions.
- Prepare this report.

2 Geology, Faulting and Historical Information

2.1 Regional and Site Geology

The City of Long Beach is located in the northwestern portion of the Peninsular Ranges geomorphic province, which includes part of the Inner Continental Borderland of Southern California. Bounded on the north by the east-west trending mountain ranges and valleys of the Transverse Ranges and on the east by the low-lying basin of the Colorado Desert, the Peninsular Ranges of Southern California form a generally northwest-trending geomorphic province that occupies the southwestern corner of California, and extends southeastward to form the Baja California peninsula. In general, the topography of the Peninsular Ranges is comparable to the Coast Ranges, but the geology is more like the Sierra Nevada, with granitic rock intruding the older metamorphic rocks. The Los Angeles basin and the southern Channel Islands (Santa Catalina, Santa Barbara, San Clemente, and San Nicolas islands), together with the adjacent continental shelf, are included in this province.

Onshore, Long Beach is located in the sediment-filled Los Angeles Basin, which along with the Ventura and San Fernando basins to the northwest and north, were the sites of very thick accumulations of marine sediments in the late Miocene and Pliocene. Sediments extend to a depth of more than 9,000 meters in the deepest part of the Los Angeles Basin, and are located near the convergence of the Los Angeles River and Rio Hondo near the city of South Gate. At present, the basin is an alluviated coastal plain bound on the north by the Santa Monica Mountains and the Elysian Park, Repetto, and Puente hills, and on the east and southeast by the Santa Ana Mountains and San Joaquin Hills. This lowland slopes gently to the south and west toward the Pacific Ocean but is interrupted by a series of elongated low hills and mesas to the south and west and by the Palos Verdes Peninsula at the coast. (California Geological Survey [CGS] 2016)

The site is located on a surficial deposit denoted as Old Lacustrine deposits ([Qol], Bedrossian et al 2010). This deposit is described as slightly to moderately consolidated, moderately dissected fine-grained sand, silt, mud, and clay from lake, playa, and estuarine deposits of various types. Surficial soils may also contain fill and other materials from previous construction and human activity at the site. A local surficial geologic map is presented on Figure 2 in Appendix A.

2.2 Existing Surface Conditions

Existing ground elevation at the site is about +31 feet North American Vertical Datum 88 and is relatively flat. As described in Section 2.5, the site has been developed previously; therefore, artifacts from previous activities on the site are likely.

We performed a field observation on December 28, 2018, and noted gravel areas, some minor debris, short grasses and weeds, abandoned utilities and utility connections, and several homeless tents on the site. Photographs taken during our field observation are available upon request.

2.3 Groundwater

A preliminary review of the California Department of Water Resources (2018) available groundwater well information did not return any available groundwater information within 2 miles of the site.

A preliminary review of the California Water Boards Groundwater Ambient Monitoring and Assessment Program (2018) indicated that three wells existed within approximately 1 mile of the site with depths to groundwater ranging from about 20 to 30 feet below the ground surface.

A preliminary review of the California Department of Conservation ([CDC]1998) Historically Highest Groundwater Contours map does not draw contours in the vicinity of the project site. However by using this map, it can be estimated that the historically highest groundwater levels are likely about 10 feet below ground surface, which may be a reasonable value for design. This preliminary estimate should be updated during final design.

2.4 Faulting

The project area is tectonically and seismically active and includes parts of several major, northwest-trending, oblique, right-lateral, and strike-slip fault zones that characterize the Pacific-North American plate boundary. From east to west, they include the Whittier fault along the northeastern corner of the quadrangle, the Newport-Inglewood-Rose Canyon fault zone, the Palos Verdes fault zone, the Cabrillo fault, the San Pedro Basin fault zone, and the Santa Cruz-Santa Catalina Ridge and San Clemente fault zones. The Newport-Inglewood-Rose Canyon fault zone and the offshore Palos Verdes and San Pedro basin fault zones, as well as other northwesterly trending faults in the Peninsular Ranges Province, appear to be truncated by an east-west zone of interconnected faults. These interconnected faults include the Anacapa-Dume fault along the northwestern edge of the quadrangle and the Santa Monica fault a few miles to the north of the northern boundary of the quadrangle. The Anacapa-Dume fault is also considered to be the southern boundary of Transverse Range structures west of Santa Monica (CGS 2016).

Our review of available in-house literature indicates that there are no known active or potentially active faults that have been mapped at the site, and the site is not located within an Alquist-Priolo Earthquake Fault Zone (California Division of Mines and Geology [CDMG] 1998). The principal seismic hazard that could affect the site is ground shaking resulting from an earthquake occurring along one of several major active or potentially active faults in Southern California. A fault map is presented on Figure 3 in Appendix A.

2.5 Historical Site Usage

A preliminary review of historical aerial imagery and historical topographic maps (Nationwide Environmental Title Research, LLC 2018) indicated that the site has been developed in various forms from at least the 1930s through about 2005. Various structures were erected with the western half of the currently undeveloped lot previously occupied by a large-footprint building and the eastern half previously occupied by smaller buildings and parking areas. Unknowns include the usages, heights, construction style, layout, foundation systems, utilities, and demolition of these buildings. However, abandoned underground and at-grade remnants of these previous constructions should be anticipated.

2.6 Oil Fields and Historical Oil Wells

The City of Long Beach and the surrounding area is the site of many oil and gas field activities. A preliminary search of the available well records (CDC 2018) was performed and indicated that no wells are located at the project site or in the immediate vicinity. A map of oil wells is provided on Figure 4 in Appendix A.

3 Geotechnical Assessment

3.1 Seismic Hazards

3.1.1 Fault Rupture

Based on available literature and reports, no active faults are known to traverse the project site, and the site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone. Based on the Alquist-Priolo Special Studies Zone Map (CDMG 1998), the nearest special study zone is approximately 3.2 miles southwest from the site. California Department of Transportation (2013) map show a buried, blind thrust fault ending just east of the site. However, the location of the fault is uncertain, because it does not have surface manifestation, and the fault is not considered active by CGS (2006). Therefore, the likelihood of a surface fault rupture is considered low. A map of the nearest Alquist-Priolo Special Studies Zones is presented on Figure 5, Seismic Hazard Map, in Appendix A.

3.1.2 Liquefaction

The term liquefaction describes a phenomenon in which saturated, cohesionless soils temporarily lose shear strength (liquefy) due to increased pore water pressures induced by strong, cyclic ground motions during an earthquake. Structures founded on or above potentially liquefiable soils may experience bearing capacity failures due to the temporary loss of foundation support, vertical settlements (both total and differential), and/or undergo lateral spreading. The factors known to influence liquefaction potential include soil type, relative density, grain size, confining pressure, depth to groundwater, and the intensity and duration of the seismic ground shaking. Liquefaction is most prevalent in loose to medium dense, silty, sandy, and gravelly soils below the groundwater table.

The site is located outside but relatively near an area mapped as liquefiable (CDMG 1998) as shown on Figure 5, Seismic Hazard Map, in Appendix A. Due to relatively shallow groundwater and deep alluvial soil deposits, the site is considered moderately susceptible to liquefaction. Liquefaction analysis should be performed during final design to confirm whether or not the site is susceptible to liquefaction. If the site is found to be susceptible to liquefaction, appropriate mitigation to its effects should be incorporated during final design.

3.1.3 Seismically-Induced Settlement

Seismically-induced settlement consists of dry dynamic settlement (above groundwater) and liquefaction-induced settlement (below groundwater). This settlement occurs primarily within loose to moderately dense sandy soil due to a reduction in volume during and shortly after an earthquake event. Seismic settlement analysis should be performed during final design. If the site is found to be susceptible to seismic settlement, appropriate mitigation to its effects should be incorporated during final design

3.1.4 Lateral Spreading

Liquefaction-induced lateral spreading is defined as the finite lateral displacement of ground as a result of pore pressure build-up or liquefaction in shallow underlying soils during an earthquake. Lateral spreading can occur on sloping ground or where nearby steep banks are present. Based on the site configuration (relatively flat terrain), the potential for lateral spreading susceptibility is considered to be low.

3.1.5 Seiches and Tsunamis

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. Tsunamis are waves generated in large bodies of water by fault displacement or major ground movement. Based on our review of Long Beach's Tsunami Inundation Map (County of Los Angeles 2009), the site is not in or near an area susceptible to a tsunami. Based on the above referenced map and the absence of other enclosed bodies of water near the site, seiche and tsunami risks at the site are considered negligible.

3.1.6 Earthquake-Induced Flooding

Earthquake-induced flooding is caused by dam failures or other water-retaining structure failures as a result of seismic shaking. A review of the City of Long Beach (2017) Hazard Mitigation Plan indicates that the site is not located within a dam failure inundation area. Therefore, the susceptibility of the site to earthquake-induced flooding is considered low.

3.2 Flooding

The site is not mapped within an area designated as either a 100-year or 500-year flood zone by the City of Long Beach (2017) Hazard Mitigation Plan. Therefore, the likelihood of flooding at the site is considered low.

3.3 Landslides

The site is located in a relatively flat area with no local slopes. Additionally, the area was not mapped by CGS (CDMG 1998) as being within a landslide zone as shown on Figure 5, Seismic Hazard Map, in Appendix A. Therefore, the risk of landslides at the site is considered low.

3.4 Expansive/Collapsible Soils

Soil expansion describes the tendency of the soil to expand when wet or contract when dried. Soil collapse indicates the tendency for soil to contract suddenly when loaded and wetted. Although the immediate area is not known to contain soils exhibiting these behaviors, testing of samples obtained from the site should be performed to confirm that these hazards are not present on the site. If they are found to be present, the final design of the structure should incorporate recommendations to mitigate their effects.

3.5 Subsidence

Ground subsidence is a process characterized by downward displacement of surficial materials caused by natural phenomena such as removal of underground fluids, natural consolidation, or dissolution of underground minerals or by man-made phenomena such as underground mining or tunneling. Due to historical oil extraction in the Long Beach area, the site is estimated to have experienced subsidence on the order of about 2 feet (City of Long Beach 2018). However, the subsidence due to oil extraction has generally been halted due to improved drilling and pumping techniques and policy. The risk of future subsidence at the site is generally considered low.

3.6 Seismicity and Preliminary Seismic Design Criteria

To reduce the effects of ground shaking produced by regional seismic events, seismic design should be performed in accordance with the applicable building codes. Preliminary seismic parameters were calculated using United States Geological Survey (USGS) U.S. Design Maps Application (USGS 2018a) and user interface by the California's Office of Statewide Health Planning and Development [OSHPD] (2018) and in accordance with the 2016 California Building Code and the American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) (2017) 7-16. Site Class D was assumed for preliminary design and must be confirmed prior to final design.

Table 1. Preliminary Seismic Design Parameters

Category	Coefficient
Site Class	D
Latitude	33.78218
Longitude	-118.17373
Mapped (5% damped) spectral response acceleration parameter at short period (0.2 sec), Ss	1.624
Mapped (5% damped) spectral response acceleration parameter at long period (1.0 sec), S1	0.588
Short period (0.2 sec) site coefficient, Fa	1
Long period (1.0 sec) site coefficient, Fv	1.71[(1)]
Spectral response acceleration parameter at short period (0.2 sec), SMS	1.624
Spectral response acceleration parameter at long period (1.0 sec), SM1	1.01[(1)]
Design (5% damped) spectral response acceleration parameter at short period (0.2 sec), SDS	1.083
Design (5% damped) spectral response acceleration parameter at long period (1.0 sec) SD1	0.671[(1)]
Peak Ground Acceleration (PGA) (g)	0.715
Geometric Mean PGA (PGAM) (g)	0.787

Note: [(1)] See the commentary in ASCE/SEI 7-16, Section 11.4.8 "Exception note" 2.
Ss = mapped 5 percent damped spectral response acceleration parameter at short period
S1 = mapped 5 percent damped spectral response acceleration parameter at one second period
Fa = short period site coefficient
Fv = long period site coefficient
Sms = 5 percent damped spectral response acceleration parameter at short period adjusted for site class effects
Sm1 = 5 percent damped spectral response acceleration parameter at one second period adjusted for site class effects
Sds = design 5 percent damped spectral response acceleration parameter at short period
Sd1 = design 5 percent damped spectral response acceleration parameter at one second period
g = units of gravity

4 Limitations

This report has been prepared for the use of HDR and the City of Long Beach for the proposed Anaheim Street and Walnut Avenue Development Project. This report may not be used by others without the written consent of our client and our firm. The conclusions and recommendations presented in this report are based upon the generally accepted principles and practices of geotechnical engineering utilized by other competent engineers at this time and place. No other warranty is either expressed or implied.

Additionally, the preliminary conclusions presented in this report are based on the data available for review. Subsurface investigation was not performed and our preliminary findings and conclusions pertaining to the project site will be developed for a pre-design feasibility study purposes only. Additional detailed geotechnical investigation should be performed during the planning process for the proposed site development to provide design level recommendations for the specific foundation designs and the earthwork construction being considered for this project.

5 References

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Appendix A

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VICINITY MAP

Anaheim Street and Walnut Avenue Development Project

City of Long Beach

Figure 1

Reference: Bedrossian Trinda L., Roffers, Peter D., 2010

Qol — Old Lacustrine, Playay, and Estuarine Deposits - Slightly to moderately consolidated, moderately dissected fine-grained sand, silt, mud, and clay from lake, playa, and estuarine deposits of various types.

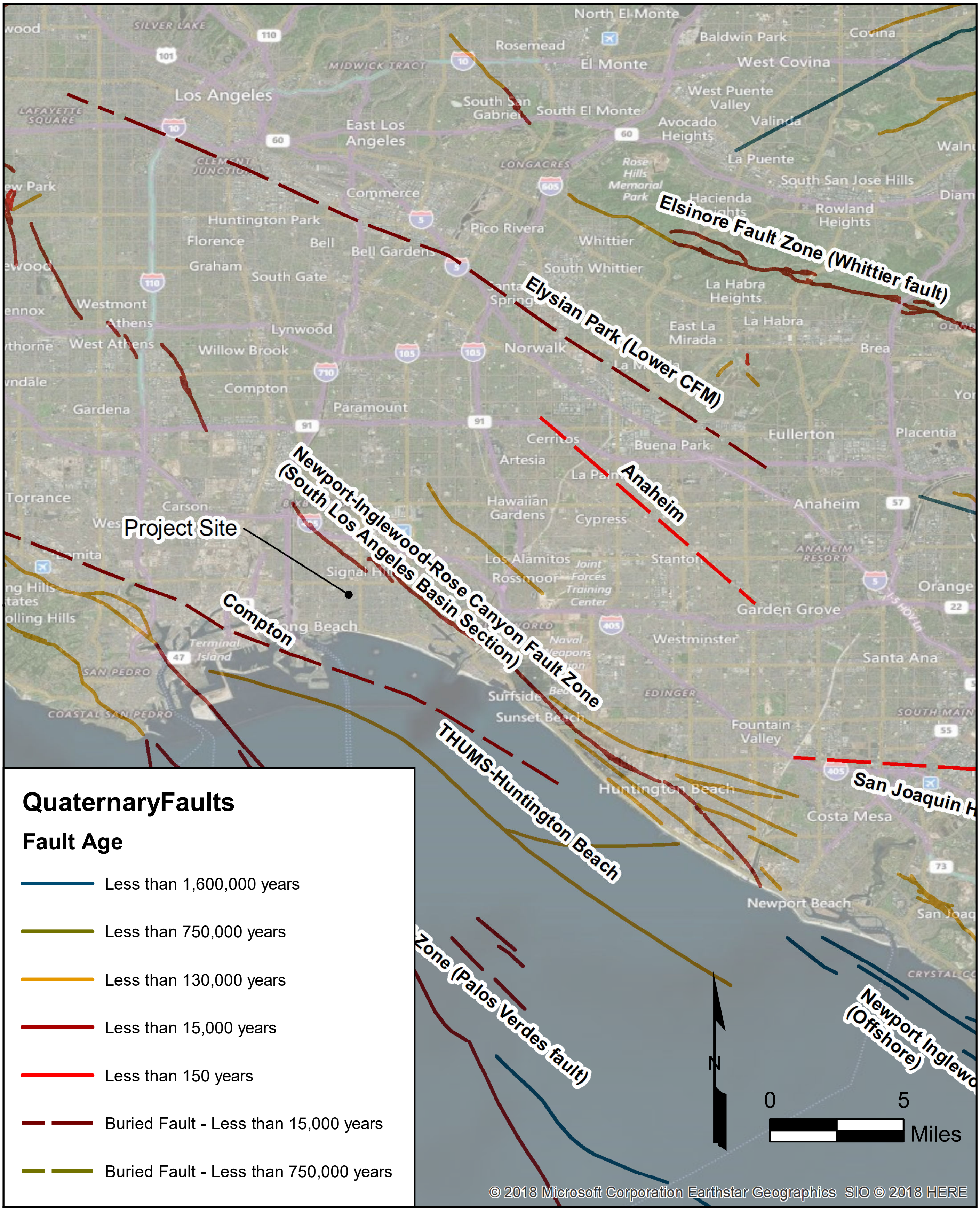
Qya — Young Alluvial Depostis - Unconsolidated to slightly consolidated, undissected to slightly dissected clay, silt, sand, and gravel along stream valleys and alluvial flats of larger rivers.

af — Artificial Fill - Deposits of fill resulting from human construction, mining, or quarrying activities; includes engineered and non engineered fill.

GEOLOGIC MAP

Anaheim Street and Walnut Avenue Development Project
City of Long Beach

Figure 2

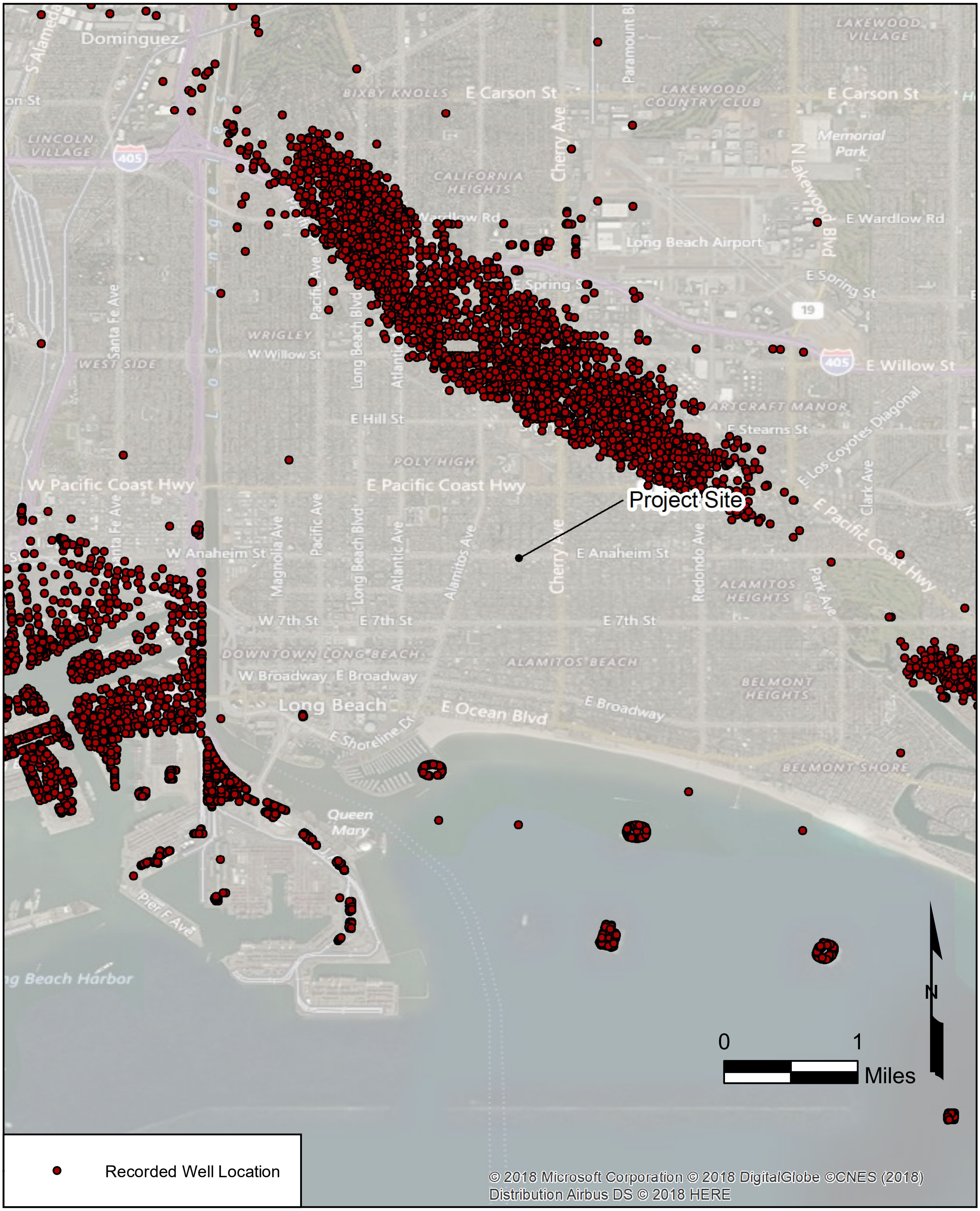


Reference: USGS and CGS, 2006, Quaternary Fault and Fold Database for the United States and Caltrans, 2013

FAULT MAP

Anaheim Street and Walnut Avenue Development Project
City of Long Beach

Figure 3

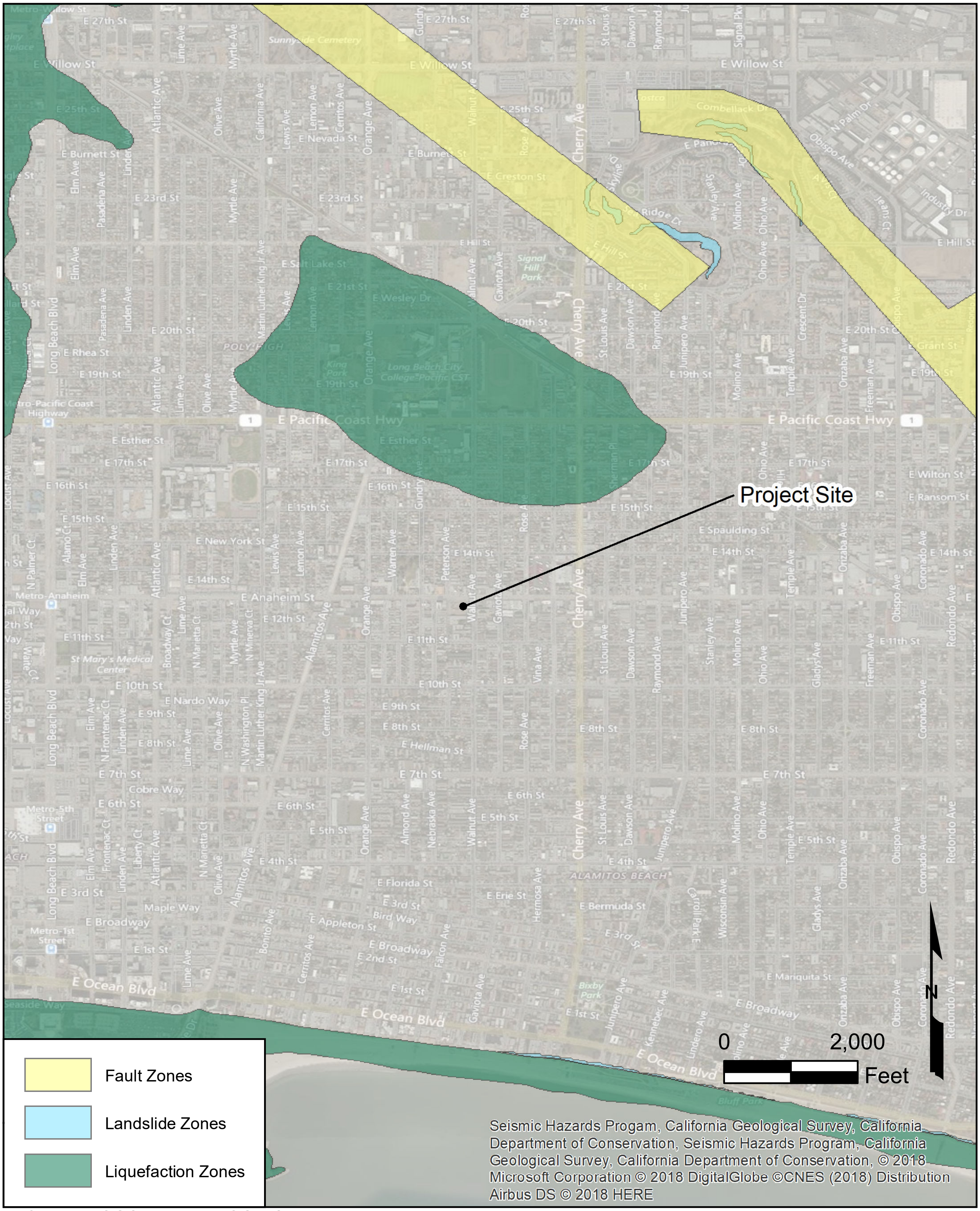


Reference: California Department of Conservation, Division of Oil, Gas and Geothermal Resources, 2018 ArcGIS Data

OIL AND GAS WELL MAP

Anaheim Street and Walnut Avenue Development Project
City of Long Beach

Figure 4



Reference: CGS, 2018, ARCGis Online database

SEISMIC HAZARD MAP

Anaheim Street and Walnut Avenue Development Project
City of Long Beach

Figure 5

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