IV.F GEOLOGY AND SOILS

1. INTRODUCTION

This section describes the existing geology and soil conditions on the Project Site, applicable laws and regulations associated with geology and soils and provides an analysis of the potential effects resulting from implementation of the proposed Project. Information contained in this section is summarized from the *Geohazards Report* for the proposed River Park Residential Development, by Converse Consultants, June 17, 2020 (**Appendix IV.F.1: Geohazards Report),** *Paleontological Resources Analysis* prepared by Los Angeles Natural History Museum dated August 7, 2020 (**Appendix IV.F.2: Paleontological Resources Analysis**), and *Paleontological Resources Assessment* prepared by Los Angeles Natural History Museum dated April 14, 2021 (**Appendix IV.F.3: Paleontological Resources Assessment**).

2. ENVIRONMENTAL SETTING

Existing Conditions

Regional Geologic Setting

The City of Long Beach (City) is located on the coastal margin of the Los Angeles Basin, which is underlain by over 15,000 feet of stratified sedimentary rocks of marine origin. The coastal terrace on which the City lies is flanked by two flood plains on the east and west. Faults associated with the Newport-Inglewood Fault Zone cut diagonally across these features. In general, the City is of low relief,[1] with a lack of significant slopes. The greatest relief is in the Signal Hill, Reservoir Hill, and Bixby Knolls areas, reflecting ancient activity along the Newport-Inglewood Fault Zone. Other areas of moderate relief include sea bluffs along the coast and lesser bluffs along the flood plains.

With the exception of isolated hill areas, the ground surface elevation is generally less than 60 feet. The ground water level is typically less than 60 feet below the ground surface and less than 20 feet below the ground surface in many areas.

The low areas now occupied by the Los Angeles and San Gabriel rivers represent channels that were cut deeply into the marine sediments by ancestral rivers during the lower sea level stand of the last Ice Age in late Pleistocene time. Over the last 17,000 years, the rivers have filled these channels to their present levels with relatively unconsolidated sand, silt, and gravel.

1 "Relief" is typically defined as the difference in height between the high point and the low point on a landscape.

The folding and faulting that has uplifted and deformed the sediments within the City has been mainly concentrated along a nearly continuous row of hills referred to as the Newport-Inglewood Fault Zone, discussed further below.[2]

Local Geologic Setting

The Project area is located in the Peninsular Ranges geomorphic province of southern California, a region bordered to the north by the Transverse Ranges and to the east by the Colorado Desert, and extending south into Baja California, see *Geohazards Report* included as **Appendix IV.F.1**. Stratigraphically the region sits in the Los Angeles sedimentary basin. This basin formed as a result of transrotation[3] of the Transverse Range block and subsequent accommodation by the formation of a sphenochasm[4] in the geographic location of the modern Los Angeles Basin. Basin fill begins in the Miocene. Sediment fill was predominantly Miocene to Pliocene marine sediments with deposition of such units as prolific petroliferous Monterey and Pico Formations. Today the basin is an emergent alluviated coastal plain. Through the Pleistocene with uplift of the region, a number of coastal terraces have formed as well.

Project Site

Extensive environmental studies for soil gas, soil and ground water, site monitoring and site remediation activities have been performed on the Project Site. Wastewater treatment activities have occurred on site since the 1920s. Oil field wastewater treatment facility operations treated oil field brines and wastewater that were direct by-products of crude oil drilling and oil production. Environmental monitoring and remediation activities on the Project Site are ongoing to further clean up the Project Site. Environmental remediation activities on the Project Site are currently being monitored and reviewed by the City and the Regional Water Quality Control Board (RWQCB). Existing ground surface elevations range from approximately 25 feet to 40 feet above mean sea level (msl).

Subsurface Profile

The Project Site is located in the southeast portion of the Los Angeles Basin near the western end of Signal Hill. Previous grading and earthwork has been performed along the edges of the Project Site to create the fill embankments for the Los Angeles River Flood Control Channel to the west of the Site and for support of the San Diego Freeway (Interstate 405) raised freeway level and embankments to the north. The property is reported to be underlain by up to 26 feet of undocumented fill place during previous site grading and earthwork activities. The depth of undocumented fill varies across the Project Site and within

2 City of Long Beach. Long Beach General Plan–Seismic Safety Element. Accessed April 2021.

3 The rotation of the earth's crust/plate, often in response to pressure from stronger opposite sides of faults.

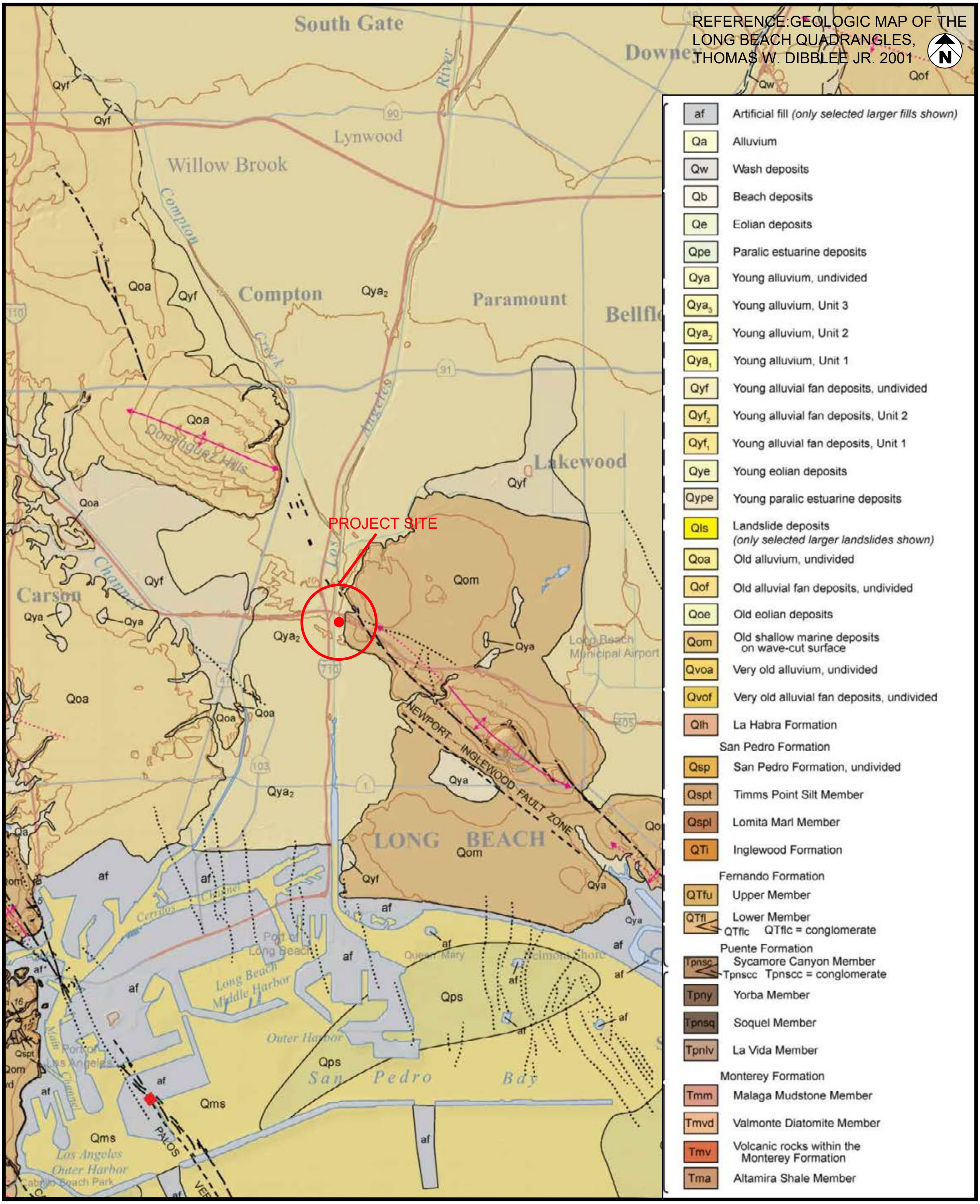
4 The triangular gap of oceanic crust separating two cratonic blocks of continental crust with fault margins converging to a point, and interpreted as having originated by the rotation of one of the blocks with respect to another.

the basins. The fill soils consist of fine-grained silty sand, sandy silts, silts, clayey silts, and silty clays. The fill soils are underlain by non-marine and marine alluvial sediments that have gradually filled the coastal basin over time to form a broad coastal plain. Based on the exploratory soil borings and Cone Penetration Tests (CPTs), the native alluvial site soils consist of fine-grained, interbedded layers of sands, silty sands, sandy silts, silts, clayey silts, and clays to the maximum explored depth of approximately 60 feet below ground surface (bgs).

The Project area is immediately underlain by Holocene and Pleistocene age surficial sediments (Qya2). Holocene-age alluvial deposits, particularly those younger than 5,000 years old, are generally too young to contain fossilized material and are considered to have a low paleontological resource potential in accordance with SVP guidelines. Qya2 is mapped extensively within the Project Site and surrounding area, as shown in **Figure IV.F-1: Geologic Map**. The eastern edge of the Project Site is underlain by Pleistocene, uplifted, shallow marine sediments (Qom). The Qom is poorly sorted, unconsolidated, beach and near shore sediments. Due to the abrasive nature of these environments, fossil preservation is typically poor. Pleistocene age alluvial sediments in the vicinity have preserved Ice Age vertebrate fauna of large land mammals, including mammoth and camel. Due to the intense historical usage of the Project Site for the petroleum industry, in places of the Project area there is fill up to 25 feet deep. Fill is considered to have a low sensitivity for fossil resources.

Seismic Setting

Similar to much of California, the Project Site is located within a seismically active region. **Figure IV.F-2**: **Seismic Hazards Zone Map** shows the regional fault hazards. The seismic and fault hazards relevant to the Project Site are described below. The most significant active faults within the City lie along the Newport-Inglewood Fault Zone. The Palos Verdes Fault is another significant fault near the City. It traverses the northern edge of the Palos Verdes Hills and trends offshore through Los Angeles Harbor then continues just offshore of the City. This fault is also believed to be active and could produce severe seismic shaking within the City. These faults are discussed in further detail below.



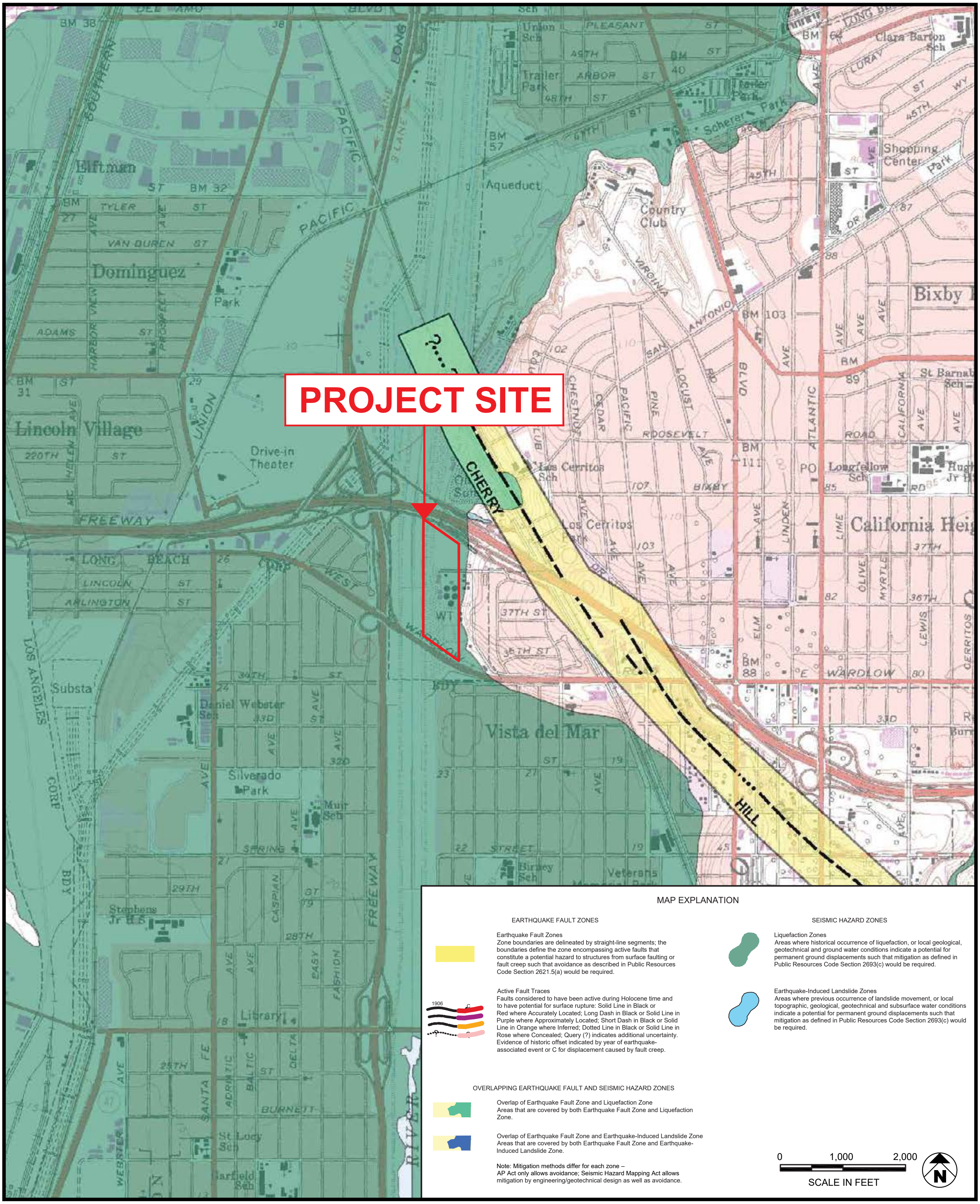
SOURCE: Converse Consultants, 2020

FIGURE **IV.F-1**

Meridian Consultants

Geologic Map

276-001-20



SOURCE: Converse Consultants, 2020

FIGURE **IV.F-2**

Meridian Consultants

Seismic Hazards Zones Map

276-001-20

Active Faults

Newport Inglewood Fault

The Newport-Inglewood fault zone is located approximately 0.18 miles to 0.37 miles east of the Project Site. According to the Seismic Safety Element of the City General Plan, the Newport Inglewood Fault Zone is a right-lateral wrench fault system consisting of a series of echelon fault segments and folds. This zone is visible on the surface as a series of northwest trending elongated hills extending from Newport Beach to Beverly Hills, including Signal and Dominquez Hills. Signal Hill is located approximately 0.50 miles southeast of the Project Site. Topographic highs along the zone are surface expressions of individual faulted anticlinal structures, and these faults and folds act as ground water barriers and, at greater depths, form petroleum traps. Active or potentially active faults of the Newport-Inglewood Fault Zone within the boundaries of Long Beach include the Cherry Hill Fault, the Northeast Flank Fault, and the Reservoir Hill Fault. Subsurface movement on the Newport-Inglewood Zone produced the 1933 Long Beach Earthquake[5] that caused severe damage in the City and the 1920 Inglewood Earthquake[6] that resulted in notable damage in the City of Inglewood. Ground breakage has not been observed along the faults of the Newport-Inglewood Zone in historic times within the City. However, the existence of well-defined fault scarps is suggestive of ground breakage in recent geologic time of approximately the last 10,000 years. An estimated maximum earthquake of magnitude 7 has been assigned to the zone on the basis of its estimated rupture length and its slip rate.[7]

Whittier Fault

The Whittier Fault is located approximately 16 miles northeast of the Project Site. The revised official map for the La Habra Quadrangle, effective November 1, 1991, shows the Whitter Fault northeast of the Project Site in the Puente Hills to be zoned as an active fault with potential for surface fault rupture. The Whitter Fault is part of the Elsinore Fault system, one of the major right-lateral strike slip faults on the Peninsular Range of mountains and hills in Southern California. The Elsinore faults splits northwestward into the Chino fault and westward into the Whittier fault near the City of Corona. The Whitter fault turns northwest at the San Gabriel River and Whittier Narrows and becomes the East Montebello fault. The Whitter Fault a magnitude 6.8 earthquake.

5 Magnitude 6.3.
6 Estimated magnitude 4.9.
7 City of Long Beach. Long Beach General Plan- Seismic Safety Element, https://www.longbeach.gov/globalassets/lbds/media-library/documents/planning/advance/general-plan/seismic-safety-element_reduced, accessed April 2021.

Puente Hills Blind Thrust Fault

Blind thrust faults are low angle reverse faults which generally are not visible at ground surface level and are characterized by traits such as folding and uplifting of ridged hillsides. Examples of blind thrust faults include the Elysian, Repetto, Montebello, and Puente Hills faults. Subsurface movement on Puente Hills Blind Thrust produced the 1987 Whitter Earthquake[8] and the 1994 Northridge Earthquake.[9]

The Puente Hills Blind Thrust is approximately 26 miles long and 12 miles wide and ranges between 1.8 miles and 8 miles below the ground surface. The thrust fault travels from the Montebello Hills and Puente Hills beneath the San Gabriel basin.

Geologic Hazards

Faults generally produce damage through ground shaking and surface rupture. Seismically induced ground shaking covers a wide area and is greatly influenced by the distance of a site to the seismic source, soil conditions and depth to groundwater. Surface rupture is limited to very near the fault line. Other hazards associated with seismically induced ground shaking include landslides, liquefaction, lateral spreading, seismically induced slope instability, earthquake-induced flooding, and tsunami and seiches.

Fault Surface Rupture

Ground rupture or displacement occurs as a fault breaks the ground surface during a seismic event, this hazard is usually anticipated to occur along pre-existing faults during an earthquake.

The Project Site is not located within Stat Earthquake Fault Zone (formerly Alquist-Priolo Special Studies Zones) for surface fault rupture (see **Appendix IV.F.1)**. The Alquist Priolo Earthquake Fault Zoning Act requires the California Geologic Survey to zone “active faults” within the State. An “active fault” refers to faults that has exhibited surface displacement within Holocene time or within the last 11,700 years. Surface displacement within this timeframe displays the active nature of the fault, hence constituting a potential hazard to structures that may be located across it. Essential service 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 review of existing geologic information, no known active faults project through or toward the Site. The nearest mapped active fault trace is the Newport-Inglewood fault zone located approximately 0.18 mile to 0.37 mile east of the Project Site. The potential for surface rupture resulting from the movement of nearby major faults, or currently unknown faults, is considered low.

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8 Magnitude 5.9.
9 Magnitude 6.7.

Landslides

Topography on the Project Site and surrounding areas is relatively flat. Fill slope embankments for the Los Angeles River channel embankment are located along the west side of the Project Site and along the north side of the property along the San Diego Freeway (Interstate 405). These engineered fill slope embankments range from 20 to 25 feet in vertical height. No earthquake-induced landslide areas are shown on the Earthquake Zones of Required Investigation – Long Beach Quadrangle by the California Geologic Survey for the Project Site. In the absence of significant ground slopes, the potential for seismically induced landslides to affect the Project Site is very low (see **Appendix IV.F.1**).

Liquefaction

A portion of the Project Site is in a liquefaction potential moderate area as identified in the California Geologic Survey (CGS) and the City's General Plan Seismic Safety Element.[10,11] The Project Site is underlain by alluvial sediments that are identified within a mapped potential liquefaction zone (see **Appendix IV.F.1**). 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 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. Soil liquefaction generally occurs in submerged sandy soils and non-plastic silts during or after strong ground shaking.

Lateral Spreading

Seismically induced lateral spreading involves primarily lateral movement of the earth 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 ground surface. Lateral spreading is characterized by near-vertical cracks with predominantly horizontal movement of the soil involved. The topography at the Project Site is relatively flat. Fill slope embankments for the Los Angeles River channel are located along the west side of the Project Site and for the San Diego Freeway along the north side of the Site. The fill slopes were engineered to provide support for their respective structures. Under these circumstances, the potential for lateral spreading on these fill slope embankments are considered low.

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10 California Geologic Survey, Earthquake Zones of Required Investigation, https://maps.conservation.ca.gov/cgs/EQZApp/app/, accessed April 2021.

11 City of Long Beach. Long Beach General Plan- Seismic Safety Element, https://www.longbeach.gov/globalassets/lbds/media-library/documents/planning/advance/general-plan/seismic-safety-element_reduced, accessed April 2021.

Seismically Induced Slope Instability

Seismically induced landslides and other slope failures are common occurrences during or soon after earthquakes. The Project Site is not shown with any earthquake-induced landslide areas due the relatively flat ground conditions of the Site topography (see **Appendix IV.F.1**). In the absence of significant ground slopes, the potential for seismically induced landslides to affect the Project Site is considered to be very low.

Flooding

The Flood Insurance Rate Map (FIRM) indicates that the Project Site is in an area designated as Zone X, an area of minimal flood hazard (see **Appendix IV.F.1**). The area along the west side of the Project Site at the base of the Los Angeles River channel embankment is mapped as an area with reduced flood risk due to levee. The Los Angeles River flood channel located west of the Project Site was built with a low flow central channel and lined with concrete on the bottom and embankment sidewalls to control erosion. Due to the absence of groundwater at shallow depths, proximity of the Los Angeles River channel that serves as a regional flood control structure, and freeway embankments located along the north side of the Project Site, the potential for earthquake induced flooding at the Project Site is considered low.

Tsunami and Seiches

Tsunamis are seismic sea waves generated by major ground movement. Based on the location of the Project Site from the Pacific Ocean, approximately 3.1 miles, and review of the Tsunami Inundation Map for Emergency Planning – Long Beach Quadrangle, tsunamis do not pose a hazard. The mapped tsunami inundation run up area extends northward up the Los Angeles River flood channel to approximately 1.4 miles south of the Project Site to an area south Willow Street. Seiches are large waves generated in enclosed bodies of water in response to ground shaking. Based on Project Site location away from lakes and reservoirs, seiches do not pose a hazard (see **Appendix IV.F.1**).

Paleontological Resources

The Natural History Museum of Los Angeles County (NHMLAC) records five fossil localities from the vicinity of the proposed Project, two invertebrate locations and three vertebrate locations. All of these come from similar geologic units as those that underlay the Project area, but none are found from within the Project boundary (see **Appendix IV.F.3**).

3. REGULATORY SETTING

Earthquake Hazards Reduction Act

In October 1977, the U.S. Congress passed the Earthquake Hazards Reduction Act to reduce the risks to life and property from future earthquakes in the U.S. through the establishment and maintenance of an effective earthquake hazards reduction program. To accomplish this goal, the act established the National Earthquake Hazards Reduction Program, which was further refined by the National Earthquake Hazards Reduction Program Act.

Uniform Building Code

The Uniform Building Code is published by the International Conference of Building Officials and forms the basis for CBC, as well as approximately half of the State building codes in the U.S. The California Legislature has adopted the Uniform Building Code to address the specific building conditions and structural requirements for California, as well as provide guidance on foundation design and structural engineering for different soil types.

Alquist-Priolo Earthquake Fault Zone Act

The Alquist-Priolo Earthquake Fault Zone Act (California PRC Sections 2621–2630) was passed into law following the destructive February 9, 1971, San Fernando earthquake, which was associated with extensive surface fault ruptures that damaged numerous structures. The act provides a mechanism for reducing losses from surface fault rupture on a Statewide basis. The intent of the act is to ensure public safety by prohibiting the siting of most structures for human occupancy across traces of active faults that constitute a potential hazard to structures from surface faulting or fault creep.

California Building Standards Code (CBC)

California provides minimum standards for building design through the CBC (Title 24). The 2019 California codes became effective January 1, 2020. With the shift from seismic zones to seismic design, the CBC philosophy has shifted from “life safety design” to “collapse prevention,” meaning that structures are designed for prevention of collapse for the maximum level of ground shaking that could reasonably be expected to occur at a site.

Public Resources Code (PRC)

The PRC includes regulations for paleontological resources as described below:

- PRC Section 5097.5: Provides for the protection of paleontological resources and prohibits the removal, destruction, injury, or defacement of paleontological features on any lands under the jurisdiction of State or local authorities.

- PRC Section 30244: Requires reasonable mitigation for impacts on paleontological resources that occur as a result of development.

Seismic Hazard Mapping Act

The California Department of Conservation provides guidance to the Seismic Hazards Mapping Act, which aims to reduce the threat of seismic hazard to public health and safety by identifying and mitigating seismic hazards. State, county, and city agencies are directed to utilize such maps in land use and permitting processes. The act also requires geotechnical investigations particular to the Site be conducted before permitting occurs on sites within seismic hazard zones.

State Water Resources Control Board Construction Storm Water Program

Created in 1972 by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program is authorized to State governments by the U.S. Environmental Protection Agency (USEPA) to perform permitting, administrative, and enforcement aspects of the program. Construction activities that disturb 1 acre or more of soil are required to obtain coverage under the General Permit for Discharges of Storm Water Associated with Construction Activity Construction General Permit Order 2009-0009-DWQ (as amended by Order 2010-0014-DWQ and Order 2012-0006-DWQ). Construction activities subject to compliance include clearing, grading, and excavating. Applicants of regulated construction activities are required to file Notice of Intent and Permit registration Documents with the State Water Resources Control Board. Applicants must prepare a Storm Water Pollution Prevention Plan and demonstrate conformance with applicable construction best management practices (BMPs).

Society of Vertebrate Paleontology

Professional paleontologists in California adhere to the guidelines set forth by the Society of Vertebrate Paleontology (SVP) to determine the course of paleontological mitigation for a given project. These guidelines establish protocols for the assessment of the paleontological resource potential of underlying geologic units and outline measures to mitigate adverse impacts that could result from project development. Using baseline information gathered during a paleontological resource assessment, the paleontological resource potential of the geologic unit(s) (or members thereof) underlying a Project area can be assigned to one of four categories defined by SVP. These categories include high, low, undetermined, and no paleontological resource potential (see **Table IV.F-1: Paleontological Sensitivity Categories** below):

Table IV.F-1
Paleontological Sensitivity Categories

Resource Potential	Criteria
High Potential (sensitivity)	Rock units from which significant vertebrate or significant invertebrate fossils or significant suites of plant fossils have been recovered are considered to have a high potential for containing significant non-renewable fossiliferous resources. These units include but are not limited to, sedimentary formations and some volcanic formations which contain significant nonrenewable paleontological resources anywhere within their geographical extent, and sedimentary rock units temporally or lithologically suitable for the preservation of fossils. Sensitivity comprises both (a) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, or botanical and (b) the importance of recovered evidence for new and significant taxonomic, phylogenetic, ecologic, or stratigraphic data. Areas which contain potentially datable organic remains older than Recent, including deposits associated with nests or middens, and areas which may contain new vertebrate deposits, traces, or trackways are also classified as significant.
Low Potential (sensitivity)	Sedimentary rock units that are potentially fossiliferous, but have not yielded fossils in the past or contain common and/or widespread invertebrate fossils of well documented and understood taphonomic, phylogenetic species and habitat ecology. Reports in the paleontological literature or field surveys by a qualified vertebrate paleontologist may allow determination that some areas or units have low potentials for yielding significant fossils prior to the start of construction. Generally, these units will be poorly represented by specimens in institutional collections and will not require protection or salvage operations. However, as excavation for construction gets underway it is possible that significant and unanticipated paleontological resources might be encountered and require a change of classification from Low to High Potential and, thus, require monitoring and mitigation if the resources are found to be significant.
Undetermined Potential (sensitivity)	Specific areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potentials. Field surveys by a qualified vertebrate paleontologist to specifically determine the potentials of the rock units are required before programs of impact mitigation for such areas may be developed.
No Potential	Rock units of metamorphic or igneous origin are commonly classified as having no potential for containing significant paleontological resources.

City of Long Beach

The Long Beach Development Services (LBDS) Department has a list of Best Management Practices that pertain to construction activities, primarily covering ways to reduce pollution form construction activity, compliance with stormwater regulations, prevention of soil erosion, general site maintenance, proper disposal of cleared vegetation, and demolition waste management.[12]

12 City of Long Beach, Best Management Practices, Development Services Department, http://www.longbeach.gov/lbds/building/inspection/best-management-practices/, accessed April 2021.

Long Beach Municipal Code (LBMC)

Chapter 18.04 Permits outlines the various permit requirements within the City.

Section 18.04.010 describes the permits required to be obtained from the city prior to construction, including building permits, grading permits, electrical permits, plumbing permits, and mechanical permits.

Chapter 18.05 Submittal Documents outlines the various document requirements before permit issuance including construction documents, written record of computations, statement of special inspections, and a geotechnical report.

Chapter 18.40 Building Code outlines the City Council adopted building codes and describes the reinforcement of the California Building Code within the City and any exceptions to the CBC. Chapter 18.68 Earthquake Hazard Regulations defines a systematic procedure for identifying and assessing earthquake generated hazards associated with certain existing structures within the city and to develop a flexible, yet uniform and practical procedure for correcting or reducing those hazards to tolerable hazard levels. This chapter also identifies the minimum standards for structural seismic resistance established primarily to reduce the risk of life loss or injury.

Long Beach General Plan

The General Plan Seismic Safety Element includes advance planning recommendations for land use including giving priority to low risk type projects such as low-rise buildings and open space in areas of known seismic hazards.[13] Additionally, the Seismic Safety Element also includes immediate action recommendations for structure and design, including discouragement of new unfavorable site/structure combinations and no structures for human occupancy within the Alquist-Priolo Special Studies Zones.

The Conservation Element includes soils management goals including minimizing activities which would have a critical or detrimental effect on geologically unstable areas and soils subject to erosion.[14]

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13 City of Long Beach. Long Beach General Plan–Seismic Safety Element, October 1988 https://www.longbeach.gov/globalassets/lbds/media-library/documents/planning/advance/general-plan/seismic-safety-element_reduced. Accessed April 2021.

14 City of Long Beach. Conservation Element, April 1973, http://www.longbeach.gov/globalassets/lbds/media-library/documents/planning/advance/general-plan/1973-conservation-element. Accessed April 2021.

4. ENVIRONMENTAL IMPACTS

Thresholds of Significance

In order to assist in determining whether a project would have a significant effect on the environment, the City finds a project may be deemed to have a significant impact to geology and soils, if it would:

Threshold GEO-1: **Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:**

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

Threshold GEO-2: **Be located on a geologic unit or soil that is unstable, or that would become unstable as result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.**

Threshold GEO-3: **Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.**

As discussed in the IS (**Appendix I.1**), criteria (7-a.iv.), (7-b), (7-d) and (7-e) would result in no impact or a less than significant impact and therefore are not included in the analysis below.

5. METHODOLOGY

To evaluate potential hazards related to geologic and soils conditions, Converse Consultants prepared a Geohazards Report.[15] Relevant maps, literature and materials were reviewed as part of the Geotechnical Report, which is included as **Appendix IV.F.1** of this Draft EIR.

15 Geohazards Report for the proposed River Park Residential Development, Converse Consultants, June 17, 2020.

6. PROJECT IMPACTS

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

a. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map, issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.

The City is located in a seismically active region (as is the entire Los Angeles Basin). In 1972, the Alquist-Priolo Earthquake Zoning Act was passed in response to the damage sustained in the 1971 San Fernando Earthquake.[16] The Alquist-Priolo Earthquake Fault Zoning Act was adopted to prevent the construction of buildings used for human occupancy on the surface trace of active faults.[17] A list of cities and counties subject to the Alquist-Priolo Earthquake Fault Zones is available on the California Department of Conservation's website. The City is located in an area that is surrounded by active and blind thrust faults, however, none of these faults intersect the Project Site, as shown in **Figure IV.F-1: Geologic Map**. The nearest mapped active fault trace is the Newport Inglewood fault zone located approximately 0.18 mile to 0.37 mile east of the Project Site. Other faults located near the City include the Whittier Fault and the Puente Hills Blind Thrust Fault. The Applicant is required to comply with the California Building Code and LBMC Section 18.40 regarding the construction of earthquake resistant buildings which would mitigate foreseeable effects of strong seismic activities in the region. Based on this information, the proposed Project would have a less than significant impact exposing people or structures to adverse effects involving rupture of a known earthquake fault.

b. Strong seismic ground shaking?

As described above, the City lies within a region with several active faults and several blind thrust faults. These faults are capable of producing ground shaking from an earthquake. However, there are no active faults known to exist within the Project Site. Since the City lies within a region with several active faults and several blind thrust faults, earthquakes capable of producing ground shaking are anticipated. A major earthquake produced along any of the regional fault systems has the potential to produce strong ground

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16 California Department of Conservation, Earthquake Fault Map, https://earthquake.usgs.gov/education/geologicmaps/apfaults.php. Accessed April 2021.

17 California Department of Conservation, Earthquake Fault Map, https://earthquake.usgs.gov/education/geologicmaps/apfaults.php. Accessed April 2021.

shaking in the City. The Project Site would likely experience strong seismic ground shaking during its design life, given the proximately to major faults in the Southern California Region.

The proposed Project would increase the amount of development on site, thereby increasing the number of residents residing in a seismically active region. Since the State is generally located in a seismically active region, all new developments in the State are required to conform to the current seismic design provisions of the California Building Code. The 2019 California Building Code incorporates the latest seismic design standards for structural loads and materials as well as provisions from the National Earthquake Hazards Reduction Program to reduce potential loss from earthquakes and ensure safety of residents on site. Incorporation of seismic design standards would strengthen the structural integrity of the proposed residential buildings and reduce the seismic ground shaking impacts to residents.

Local seismic safety requirements contained in the Long Beach Building Standards Code, as well as the applicable recommendations provided in the geotechnical investigations are required by LBMC 18.05.010 prior to the issuance of construction permits. All building construction associated with the proposed Project would be subject to the City's existing construction regulations, including the California Building Code as adopted by LBMC and the Long Beach Building Standards Code in order to minimize any potential impacts from strong seismic ground shaking. Building designs aligned with existing regulations, codes, and the incorporation of recommendations from the geotechnical investigations' report during City's plan check would reduce seismic shaking impacts to future residents to less than significant.

c. Seismic-related ground failure, including liquefaction?

Liquefaction is a process by which sediments below the water table temporarily lose strength and behave as a viscous liquid rather than a solid. Liquefaction typically occurs in areas where the soils below the water table are composed of poorly consolidated, fine to medium-grained, primarily sandy soil. In addition to the requisite soil conditions, the ground acceleration and duration of the earthquake must also be of a sufficient level to induce liquefaction.

The southwest corner of the Project Site lies within a liquefaction potential moderate area as found in the CGS and the City's General Plan Seismic Safety Element, however, majority of the Site, including the north, central and east portions of the Project Site are within an area with minimal liquefaction potential. [18,19] As mentioned previously, developments in California are required to conform to the current seismic design

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18 California Geologic Survey, Earthquake Zones of Required Investigation, https://maps.conservation.ca.gov/cgs/EQZApp/app/, accessed April 2021.

19 City of Long Beach. Long Beach General Plan- Seismic Safety Element, https://www.longbeach.gov/globalassets/lbds/media-library/documents/planning/advance/general-plan/seismic-safety-element_reduced, accessed May 2021.

provisions of the California Building Code. The 2019 California Building Code incorporates the latest seismic design standards for structural loads and materials as well as provisions from the National Earthquake Hazards Reduction Program to reduce potential loss from earthquakes and ensure safety of residents on site. Local seismic safety requirements contained in the Long Beach Building Standards Code, as well as the applicable recommendations provided in the geotechnical investigations required by the City's plan check review process would minimize seismic-related hazards such as liquefaction. Compliance with existing building codes and required studies during design and construction of the proposed Project would reduce seismic-related hazards such as liquefaction for future residents to a less than significant level.

Threshold GEO-2: Would the project be located on a geologic unit or soil that is unstable, or that would become unstable as result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?

As discussed above under Threshold GEO-1(c), the Project would be located in an area susceptible to seismic-related ground failure, including liquefaction and lateral spreading. The Project Site is not located in an area designated by the City or State as being prone to landslides. The Project Site is within a land subsidence area caused by oil extraction.[20]

Landslides (On- or Off-Site)

A landslide is defined as the movement of a mass of rock, debris, or earth down a slope. Landslides are a type of mass wasting, which denotes any down-slope movement of soil and rock under the direct influence of gravity.[21] Topography on the Project Site and surrounding areas is relatively flat. Fill slope embankments for the Los Angeles River channel embankment are located along the west side of the Project Site and along the north side of the property along the San Diego Freeway (Interstate 405). These engineered fill slope embankments range from 20 to 25 feet in height. No earthquake-induced landslide areas are shown on the Earthquake Zones of Required Investigation – Long Beach Quadrangle by the California Geologic Survey for the Project Site. In the absence of significant ground slopes, the potential for seismically induced landslides to affect the Project Site is very low (see **Appendix IV.F.1**) Local seismic safety requirements contained in the Long Beach Building Standards Code, as well as the applicable recommendations provided in the geotechnical investigations required by the City's plan check review process would minimize seismic-related hazards such as on- or off-site landslides prior to issuance of construction permits. Compliance with existing building codes and required studies during design and construction of the Project would

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20 USGS, Areas of Land Subsidence in California, https://ca.water.usgs.gov/land_subsidence/california-subsidence-areas.html, accessed April 2021.

21 USGS, Natural Hazards, https://www.usgs.gov/faqs/what-a-landslide-and-what-causes-one?qt-news_science_products=0#qt-news_science_products, accessed May 2021.

reduce seismic-related hazards such as on- or off-site landslides for future residents to a less than significant level.

Lateral Spreading

Seismically induced lateral spreading involves primarily lateral movement of the earth due to ground shaking. The topography at the Project Site is relatively flat. Fill slope embankments for the Los Angeles River channel are located along the west side of the Project Site and for the San Diego Freeway along the north side of the Site. The fill slopes were engineered to provide support for their respective structures. Under these circumstances, the potential for lateral spreading on these fill slope embankments are considered low. Local seismic safety requirements contained in the Long Beach Building Standards Code, as well as the applicable recommendations provided in the geotechnical investigations required by the City's plan check review process would minimize seismic-related hazards such as lateral spreading prior to issuance of construction permits. Compliance with existing building codes and required studies during design and construction of the Project would reduce seismic-related hazards such as lateral spreading for future residents to a less than significant level.

Subsidence and Liquefaction

As discussed under threshold GEO-1(c), the majority of the Project Site lies within a potential liquefaction minimal area with the southwest corner of the Project Site within a liquefaction potential moderate area as found in the CGS and the City's General Plan Seismic Safety Element.[22,23] As mentioned previously, developments in California are required to conform to the current seismic design provisions of the California Building Code. The 2019 California Building Code incorporates the latest seismic design standards for structural loads and materials as well as provisions from the National Earthquake Hazards Reduction Program to reduce potential loss from earthquakes and ensure safety of residents on site. Local seismic safety requirements contained in the Long Beach Building Standards Code, as well as the applicable recommendations provided in the geotechnical investigations required by the City's plan check review process would minimize seismic-related hazards such as subsidence and liquefaction prior to issuance of construction permits. Compliance with existing building codes and required studies during design and construction of the Project would reduce seismic-related hazards such as subsidence and liquefaction for future residents to a less than significant level.

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22 California Geologic Survey, Earthquake Zones of Required Investigation, https://maps.conservation.ca.gov/cgs/EQZApp/app/, accessed April 2021.

23 City of Long Beach. Long Beach General Plan–Seismic Safety Element, https://www.longbeach.gov/globalassets/lbds/media-library/documents/planning/advance/general-plan/seismic-safety-element_reduced, accessed May 2021.

Seismically Induced Slope Instability and Collapse

Seismically induced landslides or slope collapse are common occurrences during or soon after earthquakes. As mentioned previously, the Project Site is not shown within any earthquake-induced landslide areas due the relatively flat ground conditions of the Site topography (see **Appendix IV.F.1**). In the absence of significant ground slopes, the potential for seismically induced landslides and collapse to affect the Project Site is considered to be very low; and local seismic safety requirements contained in the Long Beach Building Standards Code, as well as the applicable recommendations provided in the geotechnical investigations required by the City's plan check review process, would minimize seismic-related hazards, such as seismically induced slope instability or collapse prior to issuance of construction permits. Compliance with existing building codes and required studies during design and construction of the Project would reduce seismic-related hazards such as seismically induced slope instability and collapse for future residents to a less than significant level.

In conclusion, local seismic safety requirements contained in the Long Beach Building Standards Code, as well as the applicable recommendations provided in the geotechnical investigations required by the City's plan check review process, would minimize seismic-related hazards prior to issuance of construction permits. Compliance with existing building codes and required studies during design and construction of the Project would reduce seismic-related hazards such as on- or off-site landslides, lateral spreading, subsidence, liquefaction, or collapse for future residents to a less than significant level.

Threshold GEO-3: Would the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

Paleontological resources are the fossilized remains of organisms that have lived in a region in the geologic past and whose remains are found in the accompanying geologic strata. This type of fossil record represents the primary source of information on ancient life forms, since the majority of species that have existed on earth from this era are extinct. PRC Section 5097.5 specifies that any unauthorized removal of paleontological remains is a misdemeanor. Furthermore, California Penal Code Section 622.5 includes penalties for damage or removal of paleontological resources.

Based on a records search conducted by the NHMLA (see **Appendix IV.F.2**), there are no fossil localities that lie directly within the boundaries of the Project Site. However, the records search indicates that within the Project area, there are fossil localities nearby from the same sedimentary deposits that occur in the proposed Project area, either at the surface or at depth.

The nearest fossil locality from these deposits is from LACM IP 424, located near Interstate 405 and Atlantic Boulevard, approximately 1.1 miles southeast of the Project Site. This location produced invertebrates at unknown depths. The next closest fossil locality, LACM VP 4129, located near 223rd Street and Alameda Street, approximately 1.3 miles west of the Project Site, produced fossil specimens of proboscidea and camelidae, at depths of approximately 24 feet bgs. Further to the west, near Carson Street and Alameda Street, approximately 1.4 miles northwest of the Project Site, LACM VP 3319 produced a specimen of a fossil mammoth at a depth of 30 feet bgs. The furthest fossil locality, LACM VP 3660, located near Clover Street and Pixie Avenue, approximately 2.4 miles northeast of the Project Site, produced a specimen of a fossil mammoth at a depth of 19 feet bgs.

Shallow excavations in the Project area are unlikely to yield any significant paleontological resources because younger Quaternary deposits are void of fossils and near-surface alluvium is usually too young to contain fossils, and therefore possesses low sensitivity. In addition, the Project area has undergone significant surficial disturbance. However, deeper excavations approaching 19 feet below ground surface in undisturbed sediment, which may extend down into older Quaternary (Pleistocene) alluvial deposits are more likely to unearth fossil vertebrate remains. Older Quaternary deposits underlying the Project area are considered to have a high paleontological sensitivity because they have proven to yield significant paleontological resources (i.e., identifiable vertebrate fossils). Generally, ground-disturbing activities exceeding depths beyond Holocene soils and younger Quaternary alluvium would encounter older Quaternary alluvium (see **Appendix IV.F.3**).

Since the proposed Project requires excavations for a housing development, new ground disturbances are anticipated. Sediments in the Project area have a low-to-high paleontological sensitivity, being too young and disturbed at the surface to preserve fossil resources but increasing in age and sensitivity with depth. Ground disturbing activities in previously undisturbed portions of the Project deeper than 19 feet may result in significant impacts to paleontological resources, such as destruction, damage, or loss of scientifically important paleontological resources. Mitigation measures are recommended below to reduce and minimize the project impacts to paleontological resources to a less than significant level.

7. CUMULATIVE IMPACTS

Geotechnical impacts related to future development in the City would involve hazards related to site-specific soil conditions, erosion, and ground-shaking during earthquakes. These impacts would be site-specific and would not be common to (nor shared with, in an additive sense) the impacts on other sites. Cumulative development in the area would increase the overall population for exposure to seismic hazards by increasing the number of people potentially exposed. However, with adherence to applicable State and federal regulations, building codes and sound engineering practices, geologic hazards could be reduced to less-than-significant levels for the future residents at the Project Site. Furthermore, development of each of the related projects and the proposed Project would be subject to existing building codes, uniform site development and construction review standards that are designed to protect public safety. Based on the existing related projects' list in **Section 3: Environmental Setting**, no related projects are directly adjacent to the Project Site. Therefore, cumulative geotechnical impacts would not be cumulatively considerable.

Impacts to paleontological resources related to future development in the City would have the potential to damage paleontological resources. However, there are no known paleontological resources in existence on the Project Site and implementation of mitigation measures would prevent the destruction of any unforeseen paleontological discoveries. Additionally, all future development projects would be required to conduct paleontological surveys to determine an individual project's potential to impact paleontological resources and reduce such impacts to the extend feasible. Given no known paleontological resources are known to exist on the Project Site, the localized nature of most paleontological finds, and the implementation of mitigation measures which reduce the construction impacts to paleontological resources to less than significant, the proposed Project would not contribute to cumulative impacts in an additive sense. Therefore, cumulative paleontological impacts would not be cumulatively considerable.

8. MITIGATION MEASURES

The following mitigation measure is proposed to reduce potential impacts to risk, loss, or injury to people and structures based on seismic-related ground shaking, including liquefaction and lateral spreading to a less than significant level:

MM GEO-1: Worker's Environmental Awareness Program (WEAP)

Prior to the start of the proposed Project activities, all field personnel will receive a worker's environmental awareness training on paleontological resources. The training will provide a description of the laws and ordinances protecting fossil resources, the types of fossil resources that may be encountered in the Project area, the role of the paleontological monitor, outline steps to follow in the event that a fossil discovery is made, and provide contact information for the Project Paleontologist. The Project Paleontologist will develop the training, which can be delivered concurrent with other training including cultural, biological, safety, etc. A copy of all training material, as well as the qualifications and contact for the Project Paleontologist shall be provided to the City prior to the start of the proposed Project activities.

MM GEO-2: Paleontological Mitigation Monitoring

Prior to the commencement of ground-disturbing activities, a professional paleontologist will be retained to prepare and implement a PRMMP for the proposed Project. The PRMMP will describe the monitoring required during excavations that extend into older Quaternary (Pleistocene) age sediments, and the location of areas deemed to have a high paleontological resource potential. Monitoring will entail the visual inspection of excavated or graded areas and trench sidewalls. If the Project Paleontologist determines full-time monitoring is no longer warranted, based on the geologic conditions at depth, he or she may recommend that monitoring be reduced or cease entirely. A copy of the PRMMP shall be provided to the City prior to the start of the proposed Project activities.

MM GEO-3: Fossil Discoveries

In the event that a paleontological resource is discovered, the monitor will have the authority to temporarily divert the construction equipment around the find until it is assessed for scientific significance and, if appropriate, collected. If the resource is determined to be of scientific significance, the Project Paleontologist shall complete the following:

- Salvage of Fossils

  If fossils are discovered, all work in the immediate vicinity should be halted to allow the paleontological monitor, and/or Project Paleontologist to evaluate the discovery and determine if the fossil may be considered significant. If the fossils are determined to be potentially significant, the Project Paleontologist (or paleontological monitor) should recover them following standard field procedures for collecting paleontological as outlined in the PRMMP prepared for the project. Typically, fossils can be safely salvaged quickly by a single paleontologist and not disrupt construction activity. In some cases, larger fossils (such as complete skeletons or large mammal fossils) require more extensive excavation and longer salvage periods. In this case the paleontologist should have the authority to temporarily direct, divert or halt construction activity to ensure that the fossil(s) can be removed in a safe and timely manner.

- Fossil Preparation and Curation

  The PRMMP will identify the museum that has agreed to accept fossils that may be discovered during project-related excavations. Upon completion of fieldwork, all significant fossils collected will be prepared in a properly equipped laboratory to a point ready for curation. Preparation may include the removal of excess matrix from fossil materials and stabilizing or repairing specimens. During preparation and inventory, the fossils specimens will be identified to the lowest taxonomic level practical prior to curation at an accredited museum. The fossil specimens must be delivered to the accredited museum or repository no later than 90 days after all fieldwork is completed. The cost of curation will be assessed by the repository and will be the responsibility of the client.

MM GEO-4: Final Paleontological Mitigation Report

Upon completion of ground disturbing activity (and curation of fossils if necessary) the Project Paleontologist should prepare, and submit to the City, a final mitigation and monitoring report outlining the results of the mitigation and monitoring program. The report should include discussion of the location, duration and methods of the monitoring, stratigraphic sections, any recovered fossils, and the scientific significance of those fossils, and where fossils were curated.

9. LEVEL OF SIGNIFICANCE AFTER MITIGATION

Implementation of **MM GEO-1** through **MM-GEO 4** would ensure that paleontological resources would be identified before they are damaged or destroyed and are properly evaluated and treated to reduce potentially significant impacts to less than significant. **MM GEO-1** would implement a WEAP developed by the designated Project Paleontologist prior to Project construction. The WEAP would provide a description of the laws and ordinances protecting fossil resources, the types of fossil resources that may be encountered in the Project area, the role of the paleontological monitor, outline steps to follow if a fossil discovery is made and provide contact information for the Project Paleontologist. **MM GEO-2** would require a retained professional paleontologist to prepare a PRMMP to outline monitoring required during excavation that extend into Pleistocene sediments and the location of areas on the Project Site that have high paleontological resource potential. **MM GEO-3** outlines the processes related to proper fossil salvaging, preparation, and curation in the event a scientifically significant paleontological resource is discovered. Finally, **MM GEO-4** would require a final Paleontological Mitigation Report which would be prepared upon completion of ground-disturbing activity during Project construction. This report would outline the results of the PRMMP, including discussion of the location, duration and methods of the monitoring, stratigraphic sections, any recovered fossils, and the scientific significance of those fossils and where fossils were curated. Following the process outlined by the mitigation measures would ensure the protection of any unforeseen fossil resources discovered during construction and the proper handling and documentation of such resources. Therefore, implementation of **MM GEO-1** through **MM GEO-4** would ensure potential impacts related to paleontological resources would be less than significant.