5.4 GEOLOGY AND SOILS

This section of the Draft Environmental Impact Report (DEIR) evaluates the potential for implementation of the Proposed Project to impact geological and soil resources in the City of Long Beach.

5.4.1 Environmental Setting

5.4.1.1 REGULATORY BACKGROUND

State and local laws, regulations, plans, or guidelines related to geology and soils that are potentially applicable to the Proposed Project are summarized below:

State

*California Alquist-Priolo Earthquake Fault Zoning Act*

The California Alquist-Priolo Earthquake Fault Zoning Act was signed into state law in 1972, and amended, with its primary purpose being to mitigate the hazard of fault rupture by prohibiting the location of structures for human occupancy across the trace of an active fault. This act (or state law) was a direct result of the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. The act requires the State Geologist (California Geologic Survey) to delineate regulatory zones known as “earthquake fault zones” along faults that are “sufficiently active” and “well defined”, and to issue and distribute appropriate maps to all affected cities, counties, and state agencies for their use in planning and controlling new or renewed construction. Pursuant to this act and as stipulated in Section 3603(a) of the California Code of Regulations, structures for human occupancy are not permitted to be placed across the trace of an active fault. The act also prohibits structures for human occupancy within 50 feet of the trace of an active fault, unless proven otherwise by an appropriate geotechnical investigation and report that the development site is not underlain by active branches of the active fault, as stipulated in Section 3603(a) of the California Code or Regulations. Furthermore, the act requires that cities and counties withhold development permits for sites within an earthquake fault zone until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting, as stipulated in Section 3603(d) of the California Code of Regulations.

*Seismic Hazard Mapping Act*

The Seismic Hazard Mapping Act (SHMA) was adopted by the state in 1990 for the purpose of protecting the public from the effects of nonsurface fault rupture earthquake hazards, including strong ground shaking, liquefaction, seismically induced landslides, or other ground failure caused by earthquakes. The goal of the SHMA is to minimize loss of life and property by identifying and mitigating seismic hazards. The California Geological Survey (CGS) prepares and provides local governments with seismic hazard zones maps that identify areas susceptible to amplified shaking, liquefaction, earthquake-induced landslides, and other ground failures.
California Building and Residential Codes

The state regulations protecting human-occupied structures from geoseismic hazards are provided in the most recent (2013) California Building Code (CBC; California Code of Regulations, Title 24, Part 2) and California Residential Code (CRC; California Code of Regulations, Title 24, Part 2.5). Cities and counties were required to enforce the regulations of the CBC and CRC beginning January 1, 2014. The CBC (adopted by reference in Chapter 18.40 [Building Code] of the City’s Municipal Code) and CRC (adopted by reference in Chapter 18.41 [Residential Code] of the City’s Municipal Code) contain provisions to safeguard against major structural failures or loss of life caused by earthquakes or other geologic hazards. For example, the CBC contains provisions for earthquake safety based on factors including occupancy type, the types of soil and rock onsite, and the strength of ground motion with specified probability of occurring at the site. These codes provide minimum standards to protect property and public safety by regulating the design and construction of excavations, foundations, building frames, retaining walls, and other building elements to mitigate the effects of seismic shaking and adverse soil conditions. The procedures and limitations for the design of structures are based on site characteristics, occupancy type, configuration, structural system height, and the strength of ground motion with specified probability of occurring at the site.

Requirements for Geotechnical Investigations

Requirements for geotechnical investigations are included in Appendix J, Section J104 (Engineered Grading Requirements) of the CBC. As outlined in Section J104, applications for a grading permit are required to be accompanied by plans, specifications, and supporting data consisting of a soils engineering report and engineering geology report. Additional requirements for subdivisions requiring tentative and final maps and for other specified types of structures are contained in California Health and Safety Code Sections 17953 to 17955 and in Section 1802 of the 2013 CBC. Testing of samples from subsurface investigations is required, such as from borings or test pits. Studies must be done as needed to evaluate slope stability, soil strength, position and adequacy of load-bearing soils, the effect of moisture variation on load-bearing capacity, compressibility, liquefaction, differential settlement, and expansiveness.

Local

City of Long Beach

The City of Long Beach adopted the most recent (2013) CBC and (2013) CRC by reference, with certain amendments, into Chapter’s 18.40 (Building Code) and Chapter 18.41 (Residential Code), respectively, of the City’s Municipal Code).

5.4.1.2 EXISTING CONDITIONS

Regional Setting

The Project Site is in the Los Angeles Basin, a coastal plain at the north end of the Peninsular Ranges Geomorphic Province. The Peninsular Ranges Geomorphic Province is characterized by mountain ranges separated by northwest-trending valleys, and extends from southwestern California south into Mexico. The Los Angeles Basin is bounded by the Santa Monica Mountains and San Gabriel Mountains on the north, the
Santa Ana Mountains on the east, and the Pacific Ocean on the south and west. The Santa Monica Mountains and San Gabriel Mountains are part of the Transverse Ranges Geomorphic Province, an east-west-trending series of steep mountain ranges and valleys extending from Santa Barbara County in the west to central Riverside County in the east.

**Project Site**

**Topography**

The portion of the Project Site south of Willow Street ranges in elevation from 37 feet at Long Beach Boulevard and Anaheim Street to 20 feet on Long Beach Boulevard just south of Willow Street; this part of the site has a northern slope of approximately 0.2 percent grade. The portion of the Project Site north of Willow Street is mostly at higher elevation – reaching 114 feet at Atlantic Avenue and 31st Street, and 88 feet at Long Beach Boulevard and Wardlow Avenue. The portion of the Project Site north of Willow Avenue and east of the Blue Line tracks has a west slope; the grade along Spring Street from Atlantic Avenue to the Blue Line tracks is approximately 2.2 percent. An escarpment extends through Long Beach Boulevard just south of I-405, through Atlantic Avenue at Spring Street, and extends southeast to the west foot of Signal Hill.

**Geologic Units**

Most of the Project Site consists of mixed terrestrial and marine alluvium composed of siltstone, sandstone, and conglomerate, and of late to middle Pleistocene age (the Pleistocene Epoch extends from 11,000 years before present ([ybp] to 1.8 million ybp). The western part of the portion of the Project Site between Spring Street south to Willow Street consists of young alluvial flood plain deposits composed of soft clay, silt and loose to moderately dense sand and silty sand. These deposits are of Holocene and late Pleistocene age; the Holocene Epoch extends from the present to 11,000 ybp (USGS 2003) (see Figure 5.4-1, *Geologic Map*).

**Geologic and Seismic Hazards**

**Seismic Hazards**

**Faults**

Faults showing evidence of surface displacement within the last 11,000 years are classified as active by the California Geological Survey.

The Newport-Inglewood Fault Zone, composed of several individual faults and considered active, passes through the Project Site. An earthquake fault zones is a regulatory zone around active faults; the fault zones vary in width, but average about one-quarter mile wide. Two component faults of the Newport-Inglewood Fault Zone in and near the Project Site are mapped on a 2003 US Geological Survey geologic map: one fault begins near the intersection of Long Beach Boulevard and Willow Street, extending southeast for several miles into the central part of the City of Long Beach; the second, the Cherry Hill Fault, crosses Long Beach Boulevard at 32nd Street, extending northwest to just east of the I-405/I-710 interchange and southeast into the City of Signal Hill (USGS 2003) (see Figure 5.4-1).
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The Newport-Inglewood Fault Zone extends about 47 miles from the City of Culver City southeast, extending offshore; the offshore segment of the fault is known as the Newport-Inglewood – Rose Canyon Fault (SCEDC 2014a).

Other active faults within 30 miles of the Project Site are listed below with distances from the Project Site and are mapped in Figure 5.4-2, Regional Fault Map (CGS 2014).

- Palos Verdes Fault: 5 miles southwest
- Cabrillo Fault: 6.6 miles southwest
- Whittier Fault: 13 miles northeast
- Santa Monica Fault: 19 miles northwest
- Hollywood Fault: 18.5 miles north-northwest
- Raymond Fault: 18.6 miles north
- Verdugo Fault: 20 miles north
- San Fernando Fault: 26 miles north
- Chino Fault: 27 miles east

Historic Earthquakes

The energy released by an earthquake is measured as moment magnitude (Mw). The moment magnitude scale is logarithmic; therefore, each one-point increase in magnitude represents a tenfold increase in amplitude of the waves as measured at a specific location and a 32-fold increase in energy. That is, a magnitude 7 earthquake produces 100 times (10 x 10) the ground motion amplitude of a magnitude 5 earthquake.

Long Beach Earthquake

The Long Beach Earthquake of 1933, which occurred on the Newport-Inglewood Fault and had a magnitude estimated at 6.4, caused 120 deaths and over $50 million in property damage. Severe property damage occurred in Compton, Long Beach, and other cities in the area. Most of the spectacular damage was due to land fill, or deep water-soaked alluvium or sand, and to poorly-designed buildings. Minor disturbances of ground water, secondary cracks in the ground, and slight earth slumps occurred, but surface faulting was not observed. Along the shore between Long Beach and Newport Beach, the settling or lateral movement of road fills across marshy land caused much damage to the concrete highway surfaces and to approaches to highway bridges.

In Compton, almost every building in a three-block radius on unconsolidated material and land fill was destroyed. In Long Beach, buildings collapsed, houses were pushed from foundations, walls were knocked down, and tanks and chimneys fell through roofs (NEIC 2014). Many school buildings were destroyed; students were not at school when the 5:54 PM quake occurred. The earthquake led to passage of the Field Act regulating construction of public school buildings in California (SCEDC 2014b).
Qya: Young alluvial flood plain deposits. Holocene and late Pleistocene.

Qoa: Older alluvium, lake, playa, and terrace deposits. Quaternary.

Qyfa and Qyfs: Young alluvial fan and valley deposits, undivided. Holocene and late Pleistocene.

Active Faults:
- Well located
- Approximately located or inferred
- Concealed

Note: The Cherry Hill Fault and the faults labeled A and B are all component faults of the Newport-Inglewood Fault Zone.

Sources: USGS, 2003; Bryant 1985
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- Fault along which historic (last 200 years) displacement has occurred
- Holocene fault displacement (during past 11,700 years) without historic record
- Late Quaternary fault displacement
- Quaternary fault (age undifferentiated; Quaternary Period extends from the present to 1.6 million years before present)
- Pre-Quaternary

NOTE: Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred, and by dotted lines where concealed by younger rocks or by lakes or bays.

Source: CGS, 2013
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Other Historic Earthquakes in the Region

Other historic earthquakes within the last 50 years centered within 50 miles of the Project Site are listed in Table 5.4-1.

<table>
<thead>
<tr>
<th>Table 5.4-1 Selected Historic Earthquakes</th>
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<tbody>
<tr>
<td>Earthquake</td>
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<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Chino Hills</td>
</tr>
<tr>
<td>Northridge</td>
</tr>
<tr>
<td>Whittier Narrows</td>
</tr>
<tr>
<td>Sierra Madre</td>
</tr>
<tr>
<td>Pasadena</td>
</tr>
<tr>
<td>Upland</td>
</tr>
<tr>
<td>San Fernando</td>
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</tbody>
</table>

Source: SCEDC 2014c.

Surface (Fault) Rupture

The Newport-Inglewood Fault, an Alquist-Priolo Earthquake Fault Zone, passes through the Project Site in a northwest-southeast direction, crossing Long Beach Boulevard centered at 32nd Street just south of I-405 (CGS 1986) (see Figure 5.4-3, Alquist-Priolo Earthquake Fault Zone). Evidence of surface displacement within the last 11,000 years has been identified in subsurface trenches across several branches of the Newport-Inglewood Fault (City of Long Beach 1988).

Strong Ground Shaking

The peak horizontal ground acceleration (phga) estimated to have a 10-percent chance of exceedance in 50 years, that is, an average return period of 475 years, is 0.5g where g is the acceleration of gravity. Ground acceleration of 0.50g correlates with intensity VIII on the Modified Mercalli Intensity (MMI) Scale (Wald 1999), a subjective scale of how earthquakes are felt by people and the effects of earthquakes on buildings. The MMI Scale is a 12-point scale where Intensity I earthquakes are generally not felt by people; in Intensity XII earthquakes damage is total, and objects are thrown into the air (USGS 2012).

In an intensity VIII earthquake, damage is slight in specially designed structures; considerable damage occurs in ordinary substantial buildings with partial collapse; and damage is great in poorly-built structures. Chimneys, factory stacks, columns, monuments, and walls fall, and heavy furniture is overturned. Effects of ground shaking in the region during the 1933 Long Beach Earthquake are described above under Historic Earthquakes.

Liquefaction and Related Ground Failure

Liquefaction is a process whereby strong earthquake shaking causes sediment layers that are saturated with groundwater to lose strength and behave as a fluid. This subsurface process can lead to near-surface or surface ground failure that can result in property damage and structural failure. If surface ground failure does occur, it is usually expressed as lateral spreading, flow failures, ground oscillation, and/or general loss of
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bearing strength. Sand boils (injections of fluidized sediment) can commonly accompany these different types of failure.

In order to determine a region’s susceptibility to liquefaction, three major factors must be analyzed. These include:

- The intensity and duration of ground shaking.
- The age and textural characteristic of the alluvial sediments. Generally, the younger, less well compacted sediments tend to have a higher susceptibility to liquefaction. Textural characteristics also play a dominant role in determining liquefaction susceptibility. Sand and silty sands deposited in river channels and floodplains tend to be more susceptible to liquefaction and floodplains tend to be more susceptible to liquefaction than coarser or finer grained alluvial materials.
- The depth to the groundwater. Groundwater saturation of sediments is required in order for earthquake induced liquefaction to occur. In general, groundwater depths shallower than 10 feet to the surface can cause the highest liquefaction susceptibility.

Research and historical data indicate that loose, granular materials at depths of less than 50 feet with silt and clay contents of less than 30 percent saturated by relatively shallow groundwater table are most susceptible to liquefaction. Much of the western part of the Project Site between Willow Street and Spring Street is in a Zone of Required Investigation for Liquefaction, as designated by the California Geological Survey (CGS 1999) (see Figure 5.4-4, Liquefaction Hazards Map). Soils in that part of the Project Site are young alluvial flood plain deposits composed of soft clay, silt and loose to moderately dense sand and silty sand. The depth to groundwater under the Project Site is approximately 77 feet below ground surface at the southern end at Long Beach Boulevard and Anaheim Street to approximately 194 feet below ground surface at Atlantic Avenue and 31st Street (WRD 2013).¹

Hazardous Buildings (Unreinforced Masonry)

The principal threat in an earthquake is not limited to ground shaking, fault rupture or liquefaction, but the damage that the earthquake causes to buildings that house people or an essential function. Continuing advances in engineering design and building code standards over the past decade have greatly reduced the potential for collapse in an earthquake of most of our new buildings. However, many buildings were built in past decades, before some of the earthquake design standards were incorporated into the building code. Several specific building types are a particular concern in this regard.

¹ The groundwater contours reported at these two locations were 40 feet below ground surface (bgs) at Long Beach Boulevard and Anaheim Street, and 80 feet bgs near Atlantic Avenue and 31st Street. The above-stated depths to groundwater were determined by adding elevations above mean sea level at the respective locations to groundwater contours below sea level.
Figure 5.4-3 - Alquist-Priolo Earthquake Fault Zone

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Source: CGS, 1986
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Figure 5.4-4 - Liquefaction Hazards Map

5. Environmental Analysis

Source: CGS, 1999
5. Environmental Analysis

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- **Unreinforced Masonry Buildings:** In the late 1800s and early 1900s, unreinforced masonry was the most common type of construction for larger downtown commercial structures and for multi-story apartment and hotel buildings. These were recognized as a collapse hazard following the San Francisco earthquake of 1906, the Santa Barbara earthquake of 1925, and again the aftermath of the Long Beach earthquake of 1933. These buildings are still recognized as the most hazardous buildings in an earthquake.

Per Senate Bill 547, local jurisdictions are required to enact structural hazard reduction programs by (a) inventorying pre-1943 unreinforced masonry buildings, and (b) developing mitigation programs to correct the structural hazards.

- **Pre-cast Concrete Tilt-up Buildings:** This building type was introduced following World War II and gained popularity in light industrial buildings during the late 1950s and 1960s. Extensive damage to concrete tilt-up buildings in the 1971 San Fernando earthquake revealed the need for better anchoring of walls to the roof, floor, and foundation elements of the building and for stronger roof diaphragms.

In the typical damage to these buildings, the concrete wall panels would fall outward and the adjacent roof would collapse, creating a direct hazard.

- **Soft-Story Buildings:** Soft-story buildings are those in which at least one story, commonly the ground floor, has significantly less rigidity and/or strength than the rest of the structure. This can form a weak link in the structure, unless special design features are incorporated to give the building adequate structural integrity. Typical examples of soft-story construction are buildings with glass curtain walls on the first floor only, or buildings placed on stilts or columns, leaving the first story open for landscaping, street-friendly building entry, parking, or other purposes. In the early 1950s to early 1970s, soft story buildings were a popular construction style for low- and mid-rise concrete frame structures.

- **Nonductile Concrete Frame Buildings:** Nonductile concrete frame buildings have stiff reinforced concrete frames that do not bend when shaken or twisted, which increases the likelihood of structural failure during an earthquake. This type of construction was common in the very early days on reinforced concrete buildings, and they continued to be built until the codes were changed to require improved building performance in earthquakes in 1973. There were large numbers of these buildings built for commercial and light industrial use in California's older, densely populated cities. Although many of these buildings have four to eight stories, there are many in the lower height range. This category also includes one-story parking garages with heavy concrete roof systems supported by non-ductile concrete columns.

**Other Geologic Hazards**

**Subsidence**

Subsidence is a regional lowering of the ground surface. The major cause of ground subsidence is withdrawal of groundwater; withdrawal of oil and gas can also cause subsidence. Subsidence due to oil and gas...
withdrawal has occurred in the Long Beach Harbor area and along the coast extending eastward to the City of Seal Beach, amounting up to 30 feet in the center of the Long Beach Harbor. Water injection has been used to stabilize the area since 1958; soil has also been imported to help keep port land uses usable. Property damage in and near Long Beach due to ground subsidence has amounted to billions of dollars in 2014. Subsidence under most of the Project Site is estimated to be less than four feet (Long Beach 2014).

**Expansive Soils**

Expansive soils shrink or swell as the moisture content decreases or increases; the shrinking or swelling can shift, crack, or break structures built on such soils. Expansive clayey soils were identified in the geotechnical investigation conducted for the proposed Todd Cancer Institute, part of Long Beach Memorial Medical Center (located in the northern portion of the Project Site), at 2810 Long Beach Boulevard near the southeast corner of Long Beach Boulevard and Columbia Street (MACTEC 2004).

**Collapsible Soils**

Collapsible soils are low-density, silty to very fine-grained, predominantly granular soils, containing minute pores and voids. When saturated, these soils undergo a rearrangement of their grains and a loss of cementation, causing substantial, rapid settlement under even relatively low loads. A rise in the groundwater table or an increase in surface water infiltration, combined with the weight of a building or structure, can cause rapid settlement and consequent cracking of foundations and walls. The upper few feet to several feet of existing soils on a project site – whether native soils or soils on a developed site – are often unsuitable to support a building. Geotechnical investigation reports provide recommendations for site preparation, excavation, and grading, including replacement of existing soils with engineered fill soils capable of supporting a building.

5.4.2 **Thresholds of Significance**

According to Appendix G of the CEQA Guidelines, a project would normally have a significant effect on the environment if the project would:

**G-1** Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

i) 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.)

ii) Strong seismic ground shaking.

iii) Seismic-related ground failure, including liquefaction.

iv) Landslides.

**G-2** Result in substantial soil erosion or the loss of topsoil.
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G-3 Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.

G-4 Be located on expansive soil, as defined in Table 18-1B of the Uniform building Code (1994), creating substantial risks to life or property.

G-5 Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.

The Initial Study, included as Appendix A, substantiates that impacts associated with the following thresholds would be less than significant:

- Threshold G-1(iv)
- Threshold G-2
- Threshold G-5

These impacts will not be addressed in the following analysis.

5.4.3 Environmental Impacts

The following impact analysis addresses thresholds of significance for which the Initial Study disclosed potentially significant impacts. The applicable thresholds are identified in brackets after the impact statement.

Impact 5.4-1: Future development within certain areas of the Project Site could subject persons and structures to hazards from surface rupture of a known Alquist-Priolo Earthquake Fault Zone. [Threshold G-1]

Impact Analysis: Two component faults of the active Newport-Inglewood Fault Zone pass through the Project Site (see Figure 5.4-1, Geologic Map): the Cherry Hill Fault crosses Long Beach Boulevard at 32nd Street northwest-southeast; an Alquist-Priolo Earthquake Fault Zone is centered on this fault (see Figure 5.4-3, Alquist-Priolo Earthquake Fault Zone). A second fault, extending southeast from near the intersection of Long Beach Boulevard and Willow Street, is unnamed apart from being a component fault in the Newport-Inglewood Fault Zone (see Figure 5.4-1); no Alquist-Priolo Earthquake Fault Zone is designated along this fault.

The potential impacts resulting from the Proposed Project within each of the areas of the Project Site are addressed below.

Midtown Specific Plan Area

As shown in Figure 5.4-3, two areas of the Project Site fall within the area designated as an Alquist-Priolo Earthquake Fault Zone associated with the Newport-Inglewood Fault. The first area occurs in the northern portion of the Midtown Specific Plan area. This area extends from Eldridge Street on the south to Crest
5. Environmental Analysis

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Drive on the north, and is one-half block wide on each side of Long Beach Boulevard. Existing land uses within this area include commercial uses including auto service businesses, health care businesses, and other retail and service uses; one multifamily residential complex; and several single-family residences. Most of the existing uses, except for the multifamily residential use, are one story. Future development that would be accommodated within this portion of the Project Site under the Midtown Specific Plan would be in accordance with the permitted uses under the Midtown Specific Plan, which would permit residential and nonresidential uses.

The second area that falls within the area designated as an Alquist-Priolo Earthquake Fault Zone occurs in the northeastern portion of the Midtown Specific Plan Area; this area is a part of the Long Beach Memorial medical center (see Figure 3-3). This area is vacant for the most part, with two parking lots that serve the medical center as well as four operating oil production wells and their associated metal pump jacks, above-ground equipment, and fencing. Future development that would be accommodated within this portion of the Project Site under the Midtown Specific Plan would be in accordance with the Medical District designation of the Midtown Specific Plan, which would permit medical-related uses.

The Alquist-Priolo Earthquake Fault Zoning Act prohibits the location of structures for human occupancy across the trace of an active fault; this prohibition is codified in various state codes and regulations. For example, Section 2621.5 of the California Public Resources Code and Section 3600 of the California Code of Regulations prohibit the location of developments and structures for human occupancy across the trace of active faults. Specifically, Section 2621.5(a) of the California Public Resources Code states: “…prohibit the location of developments and structures for human occupancy across the trace of active faults.” Section 3606(a) of the California Code of Regulations states: “No structure for human occupancy…shall be permitted to be placed across the trace of an active fault.” Additionally, Section 3603(a) of the California Code or Regulations prohibits structures for human occupancy within 50 feet of the trace of an active fault, unless proven otherwise by an appropriate geotechnical investigation and report that the development site is not underlain by active branches of the active fault. Furthermore, Section 3603(d) of the California Code of Regulations requires that cities and counties withhold development permits for sites within an earthquake fault zone until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting.

In accordance with Section 2621.5 of the California Public Resources Code and Section 3600 of the California Code of Regulations, any project-related structures for human occupancy would be prohibited along the fault trace. Additionally, in accordance with Sections 3603(a) and 3603(d) of the California Code or Regulations, application for a development permit for any project that lies within Newport-Inglewood Fault Zone (whether within 50 feet of the fault trace or within the overall fault zone) is required to be accompanied by a geotechnical investigation and report prepared by a geologist registered in the State of California; the geotechnical investigation and report is required to demonstrate that proposed buildings would not be constructed across an active fault and to determine whether a branch of the active fault passes through or next to the affected development site. For example, if an active fault is found through the geotechnical investigation and report, a structure for human occupancy cannot be placed over the trace of the fault and must be set back from the fault (generally 50 feet). The geologic investigation and report would be required to be submitted to the City for review and approval prior to any development occurring on a development site.
Therefore, before any development can occur on sites that are within the Newport Inglewood Fault Zone, all such development is required to obtain all necessary approvals, clearances, and permits from the City.

With adherence to the state regulations, impacts resulting from an Alquist-Priolo Earthquake Fault Zone are not anticipated to occur.

**Area Outside the Midtown Specific Plan**

Under the Proposed Project, the area that is outside the Midtown Specific Plan, which covers two residential blocks around Officer Black Park (approximately 4 acres) west of Pasadena Avenue between 21st Street and 20th Street (see Figure 3-5, *Current and Proposed Zoning Designations*), would be extracted from PD 29 and retain its underlying conventional zoning designations, which include Single-Family Residential, standard lot (R-1-N); Three-Family Residential (R-3-S); and Park (P). With the exception of the zoning designation revisions that would be undertaken, no physical change (e.g., additional development intensity, redevelopment) is expected to occur within this area and all existing uses (which include residential uses, a church, and Officer Black Park) are expected to remain. Therefore, impacts resulting from Alquist-Priolo Earthquake Fault Zone are not anticipated to occur.

**Impact 5.4-2: Future development within the Project Site could expose increased numbers of persons and structures to strong ground shaking from active faults in the region. [Threshold G-1.ii]**

**Impact Analysis:** The potential impacts resulting from the Proposed Project within each of the areas of the Project Site are addressed below.

**Midtown Specific Plan Area**

Future development that would be accommodated by the Midtown Specific Plan would expose increased numbers of persons and structures to strong ground shaking. The Project Site is in a seismically active region; strong ground shaking is very likely to occur in the Project Site during the design lifetime of buildings and structures that would be accommodated by the Midtown Specific Plan. There are a number of active and potentially active faults within or in the vicinity of the Project Site, as discussed in detail above under the *Seismic Hazards* section. An earthquake along any of these faults would represent a hazard in the city, potentially causing many deaths and injuries, along with extensive property damage. Earthquakes in the region within the last 50 years, including the 1933 Long Beach Earthquake, are also described above under the *Seismic Hazards* section.

Buildout in accordance with the Midtown Specific Plan would add approximately 1,700 dwelling units, 4,200 residents, 369,000 square feet of employment-generating land uses, and 2,800 workers to the Project Site (see Table 3-1, *Land Use Projections for Midtown Specific Plan Area*); thereby, exposing increased numbers of persons and structures to strong ground shaking. However, seismic shaking is a risk throughout southern California, and the Project Site is not at greater risk of seismic activity or impacts than other areas of California.
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Additionally, state and local jurisdictions regulate development in California through a variety of tools that reduce hazards from earthquakes and other geologic hazards. For example, the state regulations protecting human-occupied structures from geoseismic hazards are provided in the most recent (2013) CBC (California Code of Regulations, Title 24, Part 2) and CRC (California Code of Regulations, Title 24, Part 2.5). The CBC (adopted by reference in Chapter 18.40 [Building Code] of the City’s Municipal Code) and CRC (adopted by reference in Chapter 18.41 [Residential Code] of the City’s Municipal Code) contain provisions to safeguard against major structural failures or loss of life caused by earthquakes or other geologic hazards. For example, the CBC contains provisions for earthquake safety based on factors including occupancy type, the types of soil and rock onsite, and the strength of ground motion with specified probability of occurring at the site. The design and construction of the future development projects that would be accommodated by the Midtown Specific Plan would be required to adhere to the provisions of the CBC and CRC, which are imposed on project developments by the City’s Development Services Department during the development review and building plan check process. Compliance with the requirements of the CBC and CRC for structural safety during a seismic event would reduce hazards from strong seismic ground shaking.

Furthermore, future development projects that would be accommodated by the Midtown Specific Plan would be required to have a site-specific geotechnical investigation report prepared by the project applicant’s/developer’s geotechnical consultant, in accordance with Appendix J Section J104 (Engineered Grading Requirements) of the CBC; such investigation would determine seismic design parameters for the site and the proposed building type per CBC requirements. Compliance with the design parameters and recommendations of the geotechnical investigation report would be required as a condition of a grading permit and/or building permit, and would be ensured by the City’s Development Services Department during the development review and building plan check process.

Therefore, impacts resulting from strong ground shaking are not anticipated to be significant.

Area Outside the Midtown Specific Plan

As noted above, with the exception of the zoning designation revisions that would be undertaken in this area of the Project Site under the Proposed Project, no physical change (e.g., additional development intensity, redevelopment) is expected to occur within this area and all existing uses are expected to remain. Therefore, impacts resulting from strong ground shaking are not anticipated to occur.

<table>
<thead>
<tr>
<th>Impact 5.4-3: Future development within certain areas of the Project Site could subject persons and structures to hazards from liquefaction. [Threshold G-1.iii]</th>
</tr>
</thead>
</table>

**Impact Analysis:** The potential impacts resulting from the Proposed Project within each of the areas of the Project Site are addressed below.

Midtown Specific Plan Area

Some areas of the Project Site lie within a Zone of Required Investigation for Liquefaction, as designated by the California Geological Survey (CGS 1999) (see Figure 5.4-4, Liquefaction Hazards Map). The Midtown Specific Plan designations for these areas include Transit Node District, Medical District, Open Space.
District, and Corridor District, which would permit a wide range of residential and nonresidential development. Existing land uses within these areas include commercial and residential uses; a school; a park; a hospital (Pacific Hospital), and part of Long Beach Memorial Medical Center and associated medical office uses.

Future development projects that would be accommodated by the Midtown Specific Plan within the areas that lie within a Zone of Required Investigation for Liquefaction would be required to have a site-specific geotechnical investigation report prepared by the project applicant’s/developer’s geotechnical consultant in, in accordance with Appendix J Section J104 (Engineered Grading Requirements) of the CBC; such investigation would assess liquefaction potential onsite and provide any needed recommendations to minimize hazards from liquefaction. Compliance with the recommendations of the geotechnical investigation report would be required as a condition of a grading permit and/or building permit, and would be ensured by the City’s Development Services Department during the development review and building plan check process.

Therefore, impacts resulting from hazards due to liquefaction are not anticipated to be significant.

Area Outside the Midtown Specific Plan

As noted above, with the exception of the zoning designation revisions that would be undertaken in this area of the Project Site under the Proposed Project, no physical change (e.g., additional development intensity, redevelopment) is expected to occur within this area and all existing uses are expected to remain. Therefore, impacts resulting from hazards due to liquefaction are not anticipated to occur.

Impact 5.4-4: Future development within the Project Site could subject persons or structures to hazards arising from collapsible soils, expansive soils, or ground subsidence. [Thresholds G-3 and G-4]

Impact Analysis: The potential impacts resulting from the Proposed Project within each of the areas of the Project Site are addressed below.

Midtown Specific Plan Area

Collapsible Soils, Ground Subsidence, and Expansive Soils

Existing soils within a few feet of the ground surface are often unsuitable for supporting a proposed building, even on developed sites. Future development within the Midtown Specific Plan area could be exposed to collapsible soils. Additionally, ground subsidence within the Midtown Specific Plan area is estimated to be up to four feet (Long Beach 2014). Furthermore, expansive soils were identified in the geotechnical investigation conducted for the proposed Todd Cancer Institute, part of Long Beach Memorial Medical Center (located in the northern portion of the Midtown Specific Plan area), at 2810 Long Beach Boulevard near the southeast corner of Long Beach Boulevard and Columbia Street (MACTEC 2004). Expansive soils could also be present in other areas of the Project Site.
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Buildout under the Midtown Specific Plan would increase development intensity within the Project Site by approximately 1,700 dwelling units and 369,000 square feet of employment-generating land uses (see Table 3-1, Land Use Projections for Midtown Specific Plan Area). Development under the Midtown Specific Plan could subject persons and structures to hazards arising from collapsible soils, ground subsidence, or expansive soils. However, future development projects that would be accommodated by the Midtown Specific Plan would be required to have a site-specific geotechnical investigation report prepared by the project applicant’s/developer’s geotechnical consultant, in accordance with Appendix J Section J104 (Engineered Grading Requirements) of the CBC; such investigation would assess hazardous soil conditions onsite and would provide recommendations as needed to minimize these potential soils hazards. Compliance with the recommendations of the geotechnical reports is required as a condition of a grading permit and/or building permit, and would be ensured by the City’s Development Services Department during the development review and building plan check process.

Therefore, impacts resulting from ground subsidence are not anticipated to be significant.

Area Outside the Midtown Specific Plan

As noted above, with the exception of the zoning designation revisions that would be undertaken in this area of the Project Site under the Proposed Project, no physical change (e.g., additional development intensity, redevelopment) is expected to occur within this area and all existing uses are expected to remain. Therefore, impacts resulting from ground subsidence are not anticipated to occur.

5.4.4 Cumulative Impacts

Geology and soils impacts are site-specific and generally do not combine to result in cumulative impacts. As future development that would be accommodated by the Proposed Project, each cumulative development project that would be accommodated by the Long Beach General Plan would be required to have a site-specific geotechnical investigation prepared by the project applicant/developer and to comply with recommendations in the geotechnical investigation report, as well as comply with the provisions of the CBC and CRC. Therefore, no significant cumulative impact would occur.

5.4.5 Existing Regulations

State

- California Public Resources Code Sections 2621 et seq.: Alquist-Priolo Earthquake Fault Zoning Act
- California Public Resources Code Section 2695: Seismic Hazard Mapping Act
- California Code of Regulations, Title 24, Part 2.5: 2013 California Residential Code
- California Health and Safety Code Sections 17953-17955: Requirements for Geotechnical Investigations
Local

- City of Long Beach Municipal Code, Chapter’s 18.40 (Building Code) and 18.41 (Residential Code)

5.4.6 Level of Significance Before Mitigation

Upon implementation of regulatory requirements, the following impacts would be less than significant: 5.4-1, 5.4-2, 5.4-3, and 5.4-4.

5.4.7 Mitigation Measures

No potentially significant impacts have been identified and no mitigation measures are required.

5.4.8 Level of Significance After Mitigation

No mitigation measures have been identified and impacts are less than significant.

5.4.9 References

http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#.


http://gmw.consrv.ca.gov/shmp/download/quad/LONG_BEACH/maps/LONGBCH.PDF.


http://www.data.scec.org/significant/newport.html.

———. 2014b, July 11. Long Beach 1933 Earthquake.
http://www.data.scec.org/significant/longbeach1933.html.


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