5.8 GEOLOGY AND SOILS

This section describes the geologic setting of the Project site and applicable off-site areas, and evaluates the potential for impacts related to geologic and soil conditions/resources from implementation of the Project.

This EIR tiers from the Previous Environmental Review Documents, as described in Chapter 2.0, *Introduction*. The 2013 SEIR 09-01 did not address geology and soils, but relied on analysis in the 1993 Program EIR for the GDP (EIR 90-01). Section 3.8, *Geology and Soils*, of the Otay Ranch GDP Program EIR, analyzed geology and soils impacts for the entire Otay Ranch site, including the UID Main Campus Property. This analysis concluded that potentially significant but mitigable impacts regarding seismic-related hazards, erosion, unstable soils, and expansive soils would occur with implementation of the Otay Ranch GDP, and is hereby incorporated by reference (along with the associated Geotechnical Investigation included as Appendix G of the GDP Program EIR). Mitigation included requiring site-specific geotechnical analyses and compliance with the Uniform Building Code to mitigate these effects to a level below significance. Section 4.6, *Geology/Geologic Hazards*, of the East Lake III SPA Plan analyzed geology and soils impacts, including the Lake Property. This analysis concluded that potentially significant but mitigable impacts regarding expansive soils would occur with implementation of the EastLake III SPA Plan, and is hereby incorporated by reference (along with the associated Geotechnical Investigation included as Appendix E of the EastLake III Subsequent EIR). Mitigation included site-specific geotechnical and soils analyses to reduce impacts to less than significant. A site-specific Geotechnical Evaluation was prepared for the proposed Project; therefore, mitigation from previous environmental review is not incorporated by reference for geology and soils impacts because it has been satisfied.

Information contained in this section is based on a site-specific Geotechnical Evaluation prepared for the proposed Project by Ninyo & Moore. This report is summarized below along with other applicable data, and the complete technical report is included as Appendix G of this EIR. The technical report updates the applicable information contained in the SEIRs.

5.8.1 <u>Existing Conditions</u>

A. Regulatory Framework

1. Federal

a. Federal Earthquake Hazards Reduction Act

Passed by Congress in 1977, the Federal Earthquake Hazards Reduction Act is intended to reduce the risks to life and property from future earthquakes. The Act established the National Earthquake Hazards Reduction Program (NEHRP). The goals of NEHRP are to educate and improve the knowledge base for predicting seismic hazards, improve land use practices and building codes, and to reduce earthquake hazards through improved design and construction techniques.

2. State

a. California Geological Survey

The California Geological Survey (CGS) provides guidance with regard to addressing seismic hazards. Specifically, CGS Special Publication 117A, *Guidelines for Evaluating and Mitigating Seismic Hazards in California* (2008), provides guidance to evaluate and mitigate earthquake-related hazards for projects within designated zones of required investigation.

b. Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act of 1972 (formerly the Special Studies Zoning Act) regulates the development and construction of buildings intended for human occupancy to avoid surface fault rupture hazards. The Act helps define areas where fault rupture is most likely to occur, and groups faults into categories of active, potentially active, and inactive. Specifically, active faults are defined as those exhibiting historic seismicity and/or displacement of Holocene (less than approximately 11,000 years old) strata, while potentially active faults have no historic seismicity and displace Pleistocene (between approximately 11,000 and 2 million years old) but not Holocene materials. Faults that exhibit evidence of only pre-Quaternary (more than approximately 2 million years old) movement are generally considered inactive.

The Act also requires the State Geologist to establish regulatory zones known as Earthquake Fault Zones around the surface traces of active faults, which are generally intended to "[r]egulate development near active faults so as to mitigate the hazard of surface fault rupture" (CGS 2008). Additional requirements under the Alquist-Priolo Act include distributing Earthquake Fault Zone maps to all affected cities, counties, and state agencies, as well as mandating completion of geologic investigations prior to applicable project approvals, to demonstrate that associated structures would not be placed across active faults, and/or that appropriate set-backs from such faults (generally 50 feet) are included in the project design.

c. California Seismic Hazards Mapping Act

The California Seismic Hazards Mapping Act (CSHMA) provides a statewide seismic hazard mapping and technical advisory program to assist local governments in protecting public health and safety relative to seismic hazards. The CSHMA provides direction and funding for the State Geologist to compile seismic hazard maps and to make those maps available to local governments. The CSHMA, along with related standards in the Seismic Hazards Mapping Regulations (CCR Title 14, Division 2, Chapter 8, Article 10, Section 3270 et seq.), also directs local governments to require the completion and review of appropriate geotechnical studies prior to approving development projects. These requirements are implemented on a local level through means such as General Plan directives and regulatory ordinances.

d. California Building Code (CBC) and International Building Code (IBC) Standards

The CBC guidelines are derived from the IBC (as described below), and encompass criteria specific to California such as geologic and seismic characteristics. Specifically, the CBC includes the following requirements related to geologic issues: general provisions (Chapter 1); structural design, including soil and seismic loading (Chapters 16/16A); structural tests and special

inspections, including seismic resistance (Chapters 17/17A); soils and foundations (Chapters 18/18A); construction safeguards (Chapter 33); and grading, including excavation, fill, drainage, and erosion control criteria (Appendix J).

The IBC, which encompasses the former Uniform Building Code (UBC), is produced by the International Code Council, Inc. (ICC) to provide standard specifications for engineering and construction activities, including measures to address geologic and soil concerns. Specifically, these measures encompass issues such as seismic loading (e.g., classifying seismic zones and faults), ground motion, and engineered fill specifications (e.g., fill composition, compaction levels, and moisture content). The referenced guidelines, while not comprising formal regulatory requirements per se, are widely accepted by regulatory authorities and are routinely included in related standards such as local development codes. The IBC guidelines are regularly updated to reflect current industry standards and practices including criteria such as the American Society of Civil Engineers (ASCE) and ASTM International (formerly known as the American Society for Testing and Materials [ASTM]).

3. Local

a. Chula Vista General Plan

The Chula Vista General Plan Environmental Element requires that individual development projects under City jurisdiction address potential geologic hazards through conformance with applicable regulatory requirements (e.g., the CBC and IBC). Specifically, Objective E 14 of the Environmental Element is intended to "…Minimize the risk of injury, loss of life, and property damage associated with geologic hazards...", with associated policies (E 14.1 through E 14.3) requiring the completion of appropriate engineering and geotechnical investigations for proposed development to reduce potential impacts associated with geologic hazards and public safety.

B. Geologic Setting

The project site is located within the coastal foothill section of the Peninsular Ranges Geomorphic Province (Province), a region characterized by northwest-trending structural blocks and intervening fault zones. The Province extends from the Los Angeles Basin to the tip of Baja California, and generally consists of rugged mountains underlain by Jurassic (between approximately 145 and 200 million years old) metamorphic rocks intruded by Cretaceous (between approximately 65 and 145 million years old) plutonic rocks of the southern California batholith (a large igneous intrusive body). In the coastal foothill section, the metamorphic and plutonic basement rocks are typically overlain by Cretaceous- to Pleistocene-age sedimentary strata (as outlined below).

Topographically, the Province is composed of generally parallel ranges of steep hills and mountains separated by alluvial valleys. The project site is located on Otay Mesa, a broad, uplifted highland, with local topography varying from rolling hills and canyons to relatively level mesa tops. Drainage within the site and vicinity is characterized by generally south-flowing tributaries of the Otay River (including Salt Creek), which is located south of the site and flows generally west to San Diego Bay. On-site elevations range from approximately 340 to 620 feet AMSL on the Main Campus Property, and from approximately 500 to 560 feet AMSL on the Lake Property.

Surficial and geologic exposures within or underlying the Project site and vicinity are described below in order of increasing age, with the principal units shown on Figure 5.8-1, *Geologic Map*.

1. Historic Undocumented Fill (Not Mapped)

Undocumented fill is present in the northern portion of the site in association with development including Hunte Parkway and High Tech K-12 School. Shallow fill may also be present locally in areas with buried utilities and unpaved roads/trails. Fill materials typically consist of sandy deposits with variable amounts of gravel and cobble-size materials and the project Geotechnical Evaluation notes that "the nature and depth of these fill materials is not known." As a result, in order to provide a conservative analysis, it is assumed that on-site fill deposits do not conform to applicable engineering standards for characteristics such as composition, compaction and moisture content (i.e., they do not constitute engineered fill).

2. Holocene Native Topsoils (Not Mapped)

Native topsoils are expected to be present in undeveloped portions of the site at depths ranging from approximately 1 to 4 feet (with thicker deposits generally occurring along the base of existing slopes and grading into alluvial materials in local drainages). Mapped topsoils consist of Olivenhain cobbly loams on the Lake Property, while the Main Campus Property includes primarily Diablo clays and relatively minor areas of Olivenhain cobbly loams and Linne clay loams in the southern areas (Bowman R.H., 1973). All of the noted soil types are derived from local sedimentary rocks and/or associated alluvial deposits, and include substantial clay content and/or clay subsoils.

3. Holocene Colluvial Deposits (Not Mapped)

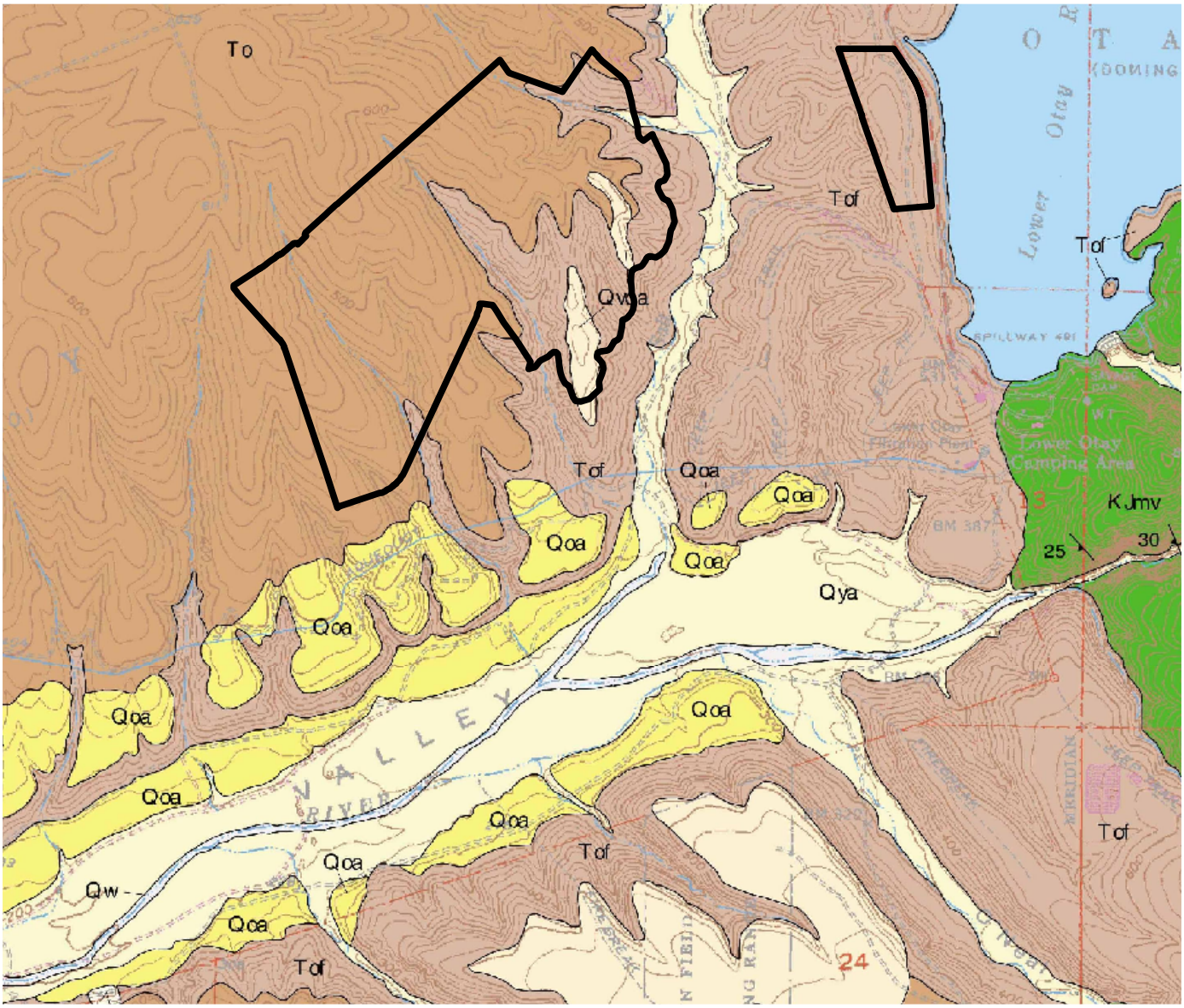
Colluvial deposits are transported by gravity, and are anticipated to be present along the bottoms of on-site canyon slopes and drainages. These materials are generally on the order of 4 to 6 feet thick, and consist of poorly sorted (variable grain sizes) sandy clay and clayey sand with scattered gravel and cobbles (and are generally more angular and less well-rounded than alluvial deposits).

4. Holocene Alluvial Deposits (Qya)

Holocene alluvial deposits are mapped in on- and off-site portions of Salt Creek, as well as the Otay River Valley in off-site areas to the south. Alluvial deposits typically consist of unconsolidated sandy materials with variable amounts of gravel, cobbles, and occasional boulders.

5. Quaternary Alluvial Terrace Deposits (Qvoa)

Alluvial terrace deposits consist of poorly consolidated and poorly sorted floodplain materials, and typically include variable amounts of silt, sand, gravel, and clay. These deposits are mapped in larger drainages in the eastern and southern portions of the site, and may also be present in other on-site drainage courses.



SITE BOUNDARY
Qw LATE HOLOCENE ACTIVE CHANNEL AND WASH DEPOSITS
Qya HOLOCENE ALLUVIAL DEPOSITS
Qoa ALLUVIAL DEPOSITS
Qvoa ALLUVIAL TERRACE DEPOSITS
Tsd SAN DIEGO FORMATION
To OTAY FORMATION
Tof OTAY FORMATION-FANGLOMERATE
KJmv METAVOLCANIC ROCKS
7 STRIKE AND DIP OF INCLINED SEDIMENTARY BEDS
30 STRIKE AND DIP OF FOLIATION IN METAVOLCANIC ROCKS

N
APPROXIMATE SCALE
0 2,000 4,000 FEET

Source: Ninyo and Moore 2016a

I:\PROJECTS\CCV\CCV-08_ChulaVistaUniversity\Map\EIR\Fig5.8-1_GeologicMap.indd CCV-08 04/27/16 -CL

Geologic Map

UNIVERSITY INNOVATION DISTRICT EIR

HELIX Environmental Planning

Figure 5.8-1

6. Tertiary Otay Formation (To)

The Otay Formation is mapped in substantial portions of the Main Campus Property (particularly the western and northern areas), and is anticipated to underlie much of this site. This formation typically consists of poorly indurated (cemented) and massive (lacking distinct structure such as bedding) sandstone, siltstone, and claystone, with interbedded bentonite (clay) lenses. Harder and more resistant gritstone subunits also occur within the Otay Formation.

7. Tertiary Otay Formation-Fanglomerate Facies (Tof)

This unit is mapped in the Lake Property and the eastern portions of the Main Campus Property, and locally interfingers with the overlying Otay Formation as described above. The Otay-Fanglomerate Facies consists of poorly cemented cobble and boulder conglomerate, along with coarse-grained sandstone.

C. Groundwater

As outlined in Section 5.11, *Hydrology and Water Quality*, the project site is not within the areal extent of any regional mapped groundwater basins, with no known water wells present and typical local groundwater depths of 25 feet or less. While shallow groundwater was not observed during site investigation, perched aquifers may occur locally, particularly in association with alluvial deposits along larger drainage courses (e.g., Salt Creek).

D. Geologic Hazards

The following discussion describes the existing setting in relation to potential geologic hazards identified in the project Geotechnical Evaluation or from other sources, including faulting and seismicity; ground rupture; liquefaction and related effects; landslides; compressible/collapsible soils; expansive or corrosive soils, subsidence, erosion, and tsunamis and seiches.

1. Faulting and Seismicity

The project site is located within a broad, seismically active region characterized by a series of northwest-trending faults associated with the San Andreas Fault System. No active or potentially active faults or CGS Alquist-Priolo Earthquake Fault Zones are mapped or known to occur within the project site and vicinity (Appendix G). As shown in Table 5.8-1, *Summary of Regional Fault Locations and Seismicity Data*, the closest known active fault is the Rose Canyon Fault, approximately 12 miles to the west, with the closest CGS Earthquake Fault Zone also associated with the described segment of the Rose Canyon Fault.

Table 5.8-1 SUMMARY OF REGIONAL FAULT LOCATIONS AND SEISMICITY DATA

Fault Zone	Distance from Site (miles)	Direction from Site	Maximum Moment Magnitude
Rose Canyon	12	W	7.2
Coronado Bank	20	W	7.6
Elsinore (Julian Segment)	40	NE	7.1
Elsinore (Coyote Mtn. Segment	42	NE	6.8
Earthquake Valley	43	NE	6.5
Newport-Inglewood (offshore)	46	NW	7.3
Elsinore (Temecula Segment)	53	N	6.8
San Jacinto-Coyote Creek	60	NE	6.8
San Jacinto-Borrego	60	NE	6.3

Source: Appendix G

Several additional major active faults are also located within approximately 60 miles of the site, as shown in Table 5.8-1. An additional mapped fault in the project site vicinity is the La Nacion Fault, which is located approximately two miles to the west. This fault is designated as Quaternary in age, and is generally considered potentially active (Jennings, C.W. 2010).

The 2013 CBC recommends that structure design be based on the horizontal peak ground acceleration (PGA, or ground shaking) value with a one percent probability of being exceeded in a 50-year period (with the associated seismic event defined as the Maximum Considered Earthquake, or MCE). A probabilistic[1] PGAMCE was calculated for the project site at 0.38g (where g equals the acceleration due to gravity), based on the U.S. Geological Survey (USGS) ground motion methodology. The mapped and design PGA for the project site is estimated as 0.26g in the project Geotechnical Evaluation, based on the ASCE 7-10 Standard (Appendix G). These estimated acceleration values, along with other applicable seismic considerations such as motion frequency/duration and CBC design criteria, are used to evaluate related site-specific hazards such as liquefaction.

2. Ground Rupture

Seismic fault (or ground) rupture is the physical surface or near surface displacement (typically along a fault structure) resulting from earthquake-induced movement. As previously described, no known active or potentially active faults, or associated Alquist-Priolo/County Fault Zones, are mapped or known to occur within the project site and immediate vicinity. The closest active fault and related Earthquake Fault Zone designation are associated with the Rose Canyon Fault, approximately 12 miles west (Appendix G). Accordingly, the potential for associated seismic ground rupture is considered low, although the Geotechnical Evaluation notes that "…lurching or cracking of the ground surface as a result of nearby seismic events is possible."

[1] A probabilistic model generates a percentage probability of exceeding a ground acceleration value within a designated time period, as opposed to a deterministic model which uses distance/magnitude data to produce ground acceleration values for individual faults.

3. Liquefaction and Related Effects

Liquefaction is the phenomenon whereby soils subjected to seismic (or other) ground shaking effects exhibit a loss of shear strength and demonstrate fluid-like flow behavior due to excess pore pressure. Loose, granular, and saturated soils with relative densities of less than approximately 70 percent are most susceptible to these effects, with liquefaction potential greatest at depths of less than approximately 50 feet. Surface and near surface manifestations from these events can include loss of support for structures/foundations, pavement, and pipelines; excessive dynamic (seismically induced) settlement; and other effects such as lateral spreading (i.e., horizontal displacement on sloped surfaces as a result of underlying liquefaction). No identified Liquefaction Hazard Areas are identified on site on Figure 9-7, *Geologic Hazards Map*, of the Chula Vista General Plan Environmental Element, and the project Geotechnical Evaluation concludes that "…the potential for liquefaction over most of the project area is not a design consideration…" This analysis also notes, however, that "…alluvial soils within the Salt Creek Valley…may be subject to liquefaction or settlement during a nearby seismic event."

4. Landslides

The occurrence of landslides and other types of slope failures is influenced by a number of factors, including slope grade, geologic and soil characteristics, moisture levels and vegetation cover. Landslides can be triggered by a variety of potentially destabilizing conditions or events, such as gravity, fires, precipitation, grading and seismic activity. No Landslide Areas are mapped within or adjacent to the project site on Figure 9-7 in the Chula Vista General Plan Environmental Element, and the project Geotechnical Evaluation concludes that "…no landslides or related features underlie or are adjacent to the project and the potential for landslides is considered low." The analysis also notes, however, that much of the project site is designated as "generally susceptible to landsliding" by the CGS, and that the underlying Otay Formation "…is prone to landsliding and slope instability." Specifically, this formation locally includes bentonite clay lenses as previously described, which often comprises weakness planes susceptible to slope failures.

5. Compressible/Collapsible Soils

Surficial deposits within the site include non-engineered fill, topsoils, and alluvial/colluvial materials as previously described. All of these deposits are potentially subject to settlement under conditions such as structural loading or increased moisture content from site irrigation or drainage. In addition, portions of these materials may also be susceptible to soil collapse, or near-surface subsidence, which is generally associated with: (1) hydroconsolidation, the tendency of unsaturated soils to rapidly lose fine material upon saturation; and (2) water table depression (lowering) due to groundwater withdrawal. Collapse associated with hydroconsolidation is most common in arid and semi-arid areas, with the associated effects generally localized but potentially substantial. Collapse related to groundwater withdrawal generally occurs over a wide region and a longer timeframe (i.e., decades), with less noticeable short-term effects. The potential occurrence of compressible and/or collapsible soils could result in hazards such as differential settlement (different degrees of settlement over relatively short distances) and related effects to surface or subsurface facilities such as pavement, foundations, and utilities.

6. Expansive Soils

Expansive (or shrink-swell) behavior in soils is attributable to the water-holding capacity of clay minerals, and can adversely affect the integrity of facilities such as foundations, pavement, and underground utilities. All of the mapped on-site soils exhibit generally high expansion potential due to clay content, and the Project Geotechnical Evaluation notes that "…the siltstone and claystone portions of the Otay Formation may be expansive."

7. Corrosive Soils

As outlined in the project Geotechnical Evaluation, soils that exceed the following Caltrans criteria are defined as corrosive: (1) more than 500 ppm chlorides; (2) more than 0.2 percent sulfates; and (3) pH levels of less than 5.5. While testing for corrosive soils was not conducted onsite, the project Geotechnical Evaluation notes that a number of local soil types have been classified as corrosive to ferrous metals, and concludes that "the potential for similar corrosive soils to occur at the project site is high." Long-term exposure of metal facilities such as reinforcing steel and subsurface pipelines to corrosive soils could potentially result in deterioration and eventual failure.

8. Subsidence

Potential impacts related to subsidence are typically associated with conditions such as groundwater (or other fluid) withdrawal and/or loading related to the placement of larger surface structures. Associated potential hazards include effects to surface and subsurface facilities such as pavement, structures/foundations, and utilities. The Otay Formation is not susceptible to subsidence. There are no activities in the project area that pump large amounts of groundwater; however, the surficial units on the site (alluvium, undocumented fill, and topsoil) are susceptible to minor amounts of subsidence.

9. Erosion

The project site includes a number of surficial materials susceptible to erosion and off-site sediment transport (sedimentation) hazards, such as alluvium/colluvium, topsoil, and fill. Extensive or prolonged erosion can result in effects such as damaging or destabilizing slopes, loss of topsoil, and deposition of eroded material in roadways or drainage structures. In addition, the off-site transport of sediment can potentially result in effects to downstream receiving water quality, such as increased turbidity and the provision of a transport mechanism for other contaminants that tend to adhere to sediment particles (e.g., hydrocarbons, with additional discussion of potential water quality effects related to erosion and sedimentation provided in Section 5.11).

10. Tsunamis and Seiches

Tsunamis (commonly referred to as tidal waves) are sea waves generated by sources such as underwater earthquakes or volcanic eruptions, and can generate impacts related to inundation in coastal zones. Based on the inland location and elevation of the project site, the project Geotechnical Evaluation concludes that potential inundation effects related to tsunamis are not a design consideration.

Seiches are defined as wave-like oscillatory movements in enclosed or semi-enclosed bodies of water such as lakes or reservoirs, and are most typically associated with seismic activity. Seiches can result in flooding damage and related effects (e.g., erosion) in surrounding areas from spilling or sloshing water, as well as increasing pressure on containment structures. While the Lake Property is in close proximity to Lower Otay Reservoir, the project Geotechnical Evaluation concludes that the potential for seiche-related effects on-site is considered low due to elevational differences.

5.8.2 Thresholds of Significance

Based on Appendix G of the CEQA Guidelines and related City criteria, impacts related to geology and soils would be significant if the project would:

- **Threshold 1:** Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving: rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault; strong seismic ground shaking; seismic-related ground failure, including liquefaction; and/or landslides.

- **Threshold 2:** Result in substantial soil erosion or the loss of topsoil.

- **Threshold 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.

- **Threshold 4:** Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code, creating substantial risks to life or property (with the UBC replaced by the IBC, and the definition of expansive soil now based on Section 1802.3.2 of the IBC and Section 1803A.5.3 of the CBC).

- **Threshold 5:** Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for disposal of wastewater.

5.8.3 Impact Analysis

The project Geotechnical Evaluation (Ninyo & Moore 2016a) identifies a number of potential geologic issues associated with proposed development at the Project site, as well as recommendations to address these concerns. Specifically, these recommendations assume that a detailed, site-specific geotechnical evaluation will be conducted prior to finalization of Project plans. This evaluation would include appropriate subsurface exploration, laboratory testing and field inspection/verification to further evaluate geologic conditions and provide additional information on the engineering characteristics of earth materials and associated conditions present within the site. From these data, the recommendations provided in the 2016 Geotechnical Evaluation regarding the design and construction of the Project facilities would be verified or modified as appropriate to ensure conformance with applicable industry and regulatory standards

(e.g., CBC, IBC and City criteria). In addition to identifying requirements for a detailed geotechnical analysis, the 2016 Geotechnical Evaluation identifies a number of recommendations related to individual geotechnical hazards within the site, with these considerations included in the following impact assessments as applicable.

A. Threshold 1: Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault; strong seismic ground shaking; seismic-related ground failure, including liquefaction; and/or landslides.

The following analysis considers potential impacts related to seismic activity that may occur in the Project area, including ground rupture, ground shaking, liquefaction, and landslides. As described in Section 5.8.2 above, the Project site does not encompass any known active or potentially active faults, and is not located within a designated Alquist-Priolo Fault Zone. Based on these conditions, potential impacts related to ground rupture from implementation of the Project would be less than significant; however, there are active faults in the vicinity of the Project (see Table 5.8-1), including the Rose Canyon Fault, and strong ground shaking could occur during a seismic event. The estimated ground acceleration values at the project site are 0.38g, which could potentially result in damage and related hazards to facilities such as structures, foundations, pavement and utilities. Implementation of appropriate design and construction measures to accommodate projected seismic loading, pursuant to applicable industry/regulatory standards (e.g., the IBC/CBC) would reduce potential impacts; however, impacts remain potentially significant (Impact 5.8-1a).

The majority of the Project site is underlain by dense formational materials with no shallow groundwater present, and is not considered susceptible to liquefaction and related hazards. While alluvial materials in the vicinity of Salt Creek (and potentially other on-site areas) may be subject to liquefaction and related effects during a nearby seismic event, project implementation would incorporate appropriate design and construction measures to address potential liquefaction and related hazards, pursuant to applicable industry/regulatory standards (e.g., the IBC/CBC), recommendations from the Project Geotechnical Evaluation, and pertinent updates from subsequent detailed geotechnical investigation as described above. Specifically, these measures may include standard efforts such as removal of unsuitable soils and replacement with engineered fill, soil densification (i.e., introducing cement to consolidate loose soils), use of appropriate foundation design to provide support (e.g., stone columns), use of subdrains in appropriate areas to avoid or reduce saturation, and appropriate foundation/utility design (e.g., post-tensioned foundations or flexible couplings for utility connections). As previously noted, site-specific conditions and remedial efforts associated with liquefaction and related hazards would be verified through City plan review and on-the-ground geotechnical observations and testing during project excavation, grading and construction activities (including detailed geotechnical investigation).

Although landslides have not been mapped on-site and were not observed during geotechnical evaluation, much of the Project site is classified as generally susceptible to landslides and other slope instabilities. As previously described, however, Project implementation would incorporate appropriate design and construction measures to address potential landslide and slope instability hazards based on industry/regulatory standards (e.g., the IBC/CBC), recommendations from the Project Geotechnical Evaluation, and pertinent updates from subsequent detailed geotechnical

investigation. Specifically, these measures may include standard efforts such as removal of slide masses and replacement with engineered fill, placement of buttress fills, or a combination of these efforts. As previously noted, site-specific conditions and remedial efforts associated with landslide and slope instability hazards would be verified through City plan review and on-the-ground geotechnical observations and testing during project excavation, grading and construction activities (including detailed geotechnical investigation). Nonetheless, grading activities associated with cut slopes have the potential to result in instabilities within the area and a potentially significant impact could occur (Impact 5.8-1b).

B. Threshold 2: Result in substantial soil erosion or the loss of topsoil.

The Project site includes rolling hills that slope southward and tributary drainages travel from the Project site towards the Otay River. Implementation of the Project would increase the potential for erosion and sedimentation both within and downslope of the site during construction and operation. Specifically, proposed activities may involve: (1) removal of surface stabilizing features (e.g., vegetation); (2) excavation of compacted materials; and (3) redeposition of excavated and/or imported material as backfill in proposed development areas. While graded/excavated areas and fill materials would be stabilized through efforts such as compaction and installation of structures/hardscape and landscaping, erosion potential would be higher in the short-term than for existing conditions. Developed areas would be especially susceptible to erosion between the beginning of grading/construction and the installation of pavement or establishment of permanent cover in landscaped areas. The off-site transport of sediment also could potentially result in effects to downstream receiving water quality, such as increased turbidity and the provision of a transport mechanism for other contaminants that tend to adhere to sediment particles (e.g., hydrocarbons). Additional discussion of potential water quality effects associated with Project-related erosion and sedimentation is provided in Section 5.11.

Erosion and sedimentation are not considered to be significant long-term concerns for the Project, as developed areas would be stabilized through installation of structures/hardscape and landscaping as part of Project design. The Project also would incorporate as part of Project design long-term water quality controls pursuant to City and NPDES guidelines, including (among other efforts) measures that would avoid or reduce off-site sediment transport. This would include efforts such as the use of bioretention basins, energy dissipators, irrigation controls and drainage facility maintenance (i.e., to remove accumulated sediment).

Short-term erosion and sedimentation impacts would be addressed through conformance with applicable elements of the NPDES and related City storm water standards. Specifically, this would entail implementing an appropriate Storm Water Pollution Prevention Plan (SWPPP) and related efforts, including erosion and sediment control best management practices (BMPs; refer to Section 5.11 for additional discussion of NPDES and City criteria) as part of Project design. Typical erosion and sediment control BMPs that may be required in the Project SWPPP include the following: (1) seasonal grading restrictions during the rainy season; (2) preparation and implementation of a Construction Site Monitoring Program (CSMP) and, if applicable, a Rain Event Action Plan (REAP) to provide enhanced erosion and sediment control measures prior to predicted storm events; (3) use of erosion control/stabilizing measures such as geotextiles, mats, fiber rolls, or soil binders; (4) use of sediment controls to protect the site perimeter and prevent off-site sediment transport, including measures such as silt fencing, fiber rolls, gravel bags,

temporary sediment basins, street sweeping, stabilized construction access points and sediment stockpiles, and use of properly fitted covers for sediment transport vehicles; (5) compliance with local dust control measures; (6) conducting appropriate BMP performance monitoring and as-needed maintenance; and (7) implementation of additional BMPs as necessary to ensure adequate erosion/sediment control and regulatory conformance.

In summary, impacts associated with soil erosion and topsoil loss associated with Project construction and operation would be potentially significant (Impact 5.8-2).

C. Threshold 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.

Potential impacts from landslides, liquefaction, and related effects (including lateral spreading) are addressed above under Threshold 1. As noted therein, these potential impacts would be avoided through conformance with applicable regulatory/industry standards and geotechnical recommendations included as mitigation measures.

The Otay Formation and surficial units (alluvium, undocumented fill, and topsoil) underlaying the Project site could become unstable as a result of the Project. As a result, there is the potential for landsliding, lateral spreading, and/or collapse and impacts are considered to be potentially significant (Impact 5.8-3a).

Potential impacts related to subsidence and collapse from Project implementation would be less than significant, based on the following considerations: (1) subsidence is typically associated with conditions such as groundwater (or other fluid) withdrawal, with such activities not proposed as part of the Project and shallow groundwater generally not observed or expected to occur on site; (2) while subsidence effects can also be associated with loading related to placement of larger surface structures, the Project site is underlain by formational materials which are generally not subject to subsidence; and (3) potentially less stable materials present within the Project area (fill, topsoil, alluvium/colluvium, and portions of the Otay Formation/Fanglomerate facies) would be addressed through the required inclusion of geotechnical recommendations and conformance with applicable regulatory requirements (as described above and in the project Geotechnical Evaluation). Specifically, such measures would include provisions related to the removal/ replacement of unsuitable materials; appropriate composition and placement methodology (e.g., compaction) for materials used as backfill; and appropriate seismic, manufactured slope, retaining wall, drainage, structure, foundation, and pavement design, pursuant to standards from regulatory/industry sources including the City and CBC/IBC. Conformance with the described geotechnical recommendations and regulatory/industry standards would effectively avoid or reduce potential subsidence and collapse impacts below a level of significance.

An additional potential concern related to soil instability involves the presence of corrosive soils, as outlined in Section 5.8.1 above. Due to the potential presence of corrosive soils, the Project could result in potentially significant impacts (Impact 5.8-3b).

D. Threshold 4: Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code, creating substantial risks to life or property (with the UBC replaced by the IBC, and the definition of expansive soil now based on Section 1802.3.2 of the IBC and Section 1803A.5.3 of the CBC).

A number of surficial and underlying deposits within the project site exhibit generally high expansion potential, including topsoils and sediments associated with the Otay Formation. Soils documented within the Project site have a high expansion potential and development of structures on these soils could create substantial risks to life or property. As a result, impacts associated with potential soil expansion would be potentially significant (Impact 5.8-4).

E. Threshold 5: Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for disposal of wastewater.

All development under the proposed project would be served by the City of Chula Vista municipal sewer system. As a result, no septic tanks or alternative wastewater disposal systems are proposed, and no associated soil-related impacts would result from implementation of the Project.

5.8.4 Level of Significance Prior to Mitigation

A. Exposure to Seismic Related Hazards

Impact 5.8-1a: The Project is subject to potential seismic-related ground shaking that could result in a significant impact.

Impact 5.8-1b: Project grading activities could result in slope instabilities or landslides within the Project site and impacts prior to mitigation would be potentially significant.

B. Soil Erosion or Topsoil Loss

Impact 5.8-2: Impacts associated with soil erosion and topsoil loss associated with Project construction and operation would be potentially significant.

C. Slope Stability

Impact 5.8-3a: The Otay Formation and surficial units (alluvium, undocumented fill, and topsoil) underlaying the Project site could become unstable as a result of the Project. As a result, there is the potential for landsliding, lateral spreading, and/or collapse and impacts would be potentially significant.

Impact 5.8-3b: Soils documented within the Project site have a potential to be corrosive, which could create substantial risks to life or property. As a result, impacts associated with potential soil corrosion would be potentially significant.

D. Expansive Soils

Impact 5.8-4: Soils documented within the Project site have a high expansion potential and development of structures on these soils could create substantial risks to life or property. As a result, impacts associated with potential soil expansion would be potentially significant.

E. Septic Tank/Wastewater Disposal Systems

No significant impacts related to septic systems or alternative wastewater disposal systems have been identified for the Project and impacts would be less than significant.

5.8.5 Mitigation Measures

A. Exposure to Seismic Related Hazards

Project grading activities could result in seismic-related ground shaking (Impact 5.8-1a) and/or slope instabilities or landslides within the Project site (Impact 5.8-1b). Implementation of Mitigation Measures 5.8-1a through 5.8-1c would address these impacts:

5.8-1a **Site-specific Geotechnical Evaluation.** Prior to the issuance of any grading permit for the UID, the applicant shall have a detailed, site-specific geotechnical evaluation conducted prior to finalization of Project plans. This evaluation will include appropriate subsurface exploration, laboratory testing and field inspection/verification to further evaluate geologic conditions and provide additional information on the engineering characteristics of earth materials and associated conditions present within the site. The site-specific geotechnical evaluation will be submitted to the City for review and approval prior to Project construction. All measures and recommendations included in the site-specific geotechnical evaluation will be incorporated into the final design plans for the Project.

5.8-1b **Geotechnical Risk Reduction Measures.** Prior to the issuance of any grading permit for the UID, the applicant shall verify that the applicable recommendations in the Geotechnical Evaluation prepared by Ninyo & Moore, dated May 27, 2016, have been incorporated into the final project design and construction documents to the satisfaction of the City of Chula Vista Engineer. These recommendations address issues including soft ground, expansive soils, ground shaking, liquefaction, and shallow groundwater. Geotechnical review of grading plans shall include a review of all proposed storm drain facilities to ensure the storm water runoff would not interfere with the proposed geotechnical recommendations.

5.8-1c **Slope Factor of Safety.** Prior to the issuance of any grading permit for the UID, the City Engineer shall review and approve all slopes stability strategies to ensure all graded slopes have a minimum factor of safety of 1.5. Strategies to increase stability may include, but are not limited to, a stability buttress or sheer pins.

B. Soil Erosion or Topsoil Loss

Project construction and operation would result in significant impacts associated with soil erosion and topsoil loss (Impact 5.8-2). Implementation of Mitigation Measures 5.11-1a through 5.11-1f in Section 5.11 would address impacts related to soil erosion and topsoil loss.

C. Slope Stability

There is the potential for significant Project impacts associated with landsliding, lateral spreading, and/or collapse (Impact 5.8-3a) and/or corrosive soils (Impact 5.8-3b). Mitigation Measures 5.8-1a through 5.8-1c would address impacts related to slope stability.

D. Expansive Soils

Project impacts associated with potential soil expansion would be potentially significant (Impact 5.8-4). Mitigation Measures 5.8-1a and 5.8-1b would address impacts related to expansive soils.

E. Septic Tank/Wastewater Disposal Systems

No mitigation measures are required.

5.8.6 Level of Significance After Mitigation

A. Exposure to Seismic Related Hazards

Potential impacts related to seismic-related ground shaking (Impact 5.8-1a) and/or slope instabilities or landslides resulting from Project grading activities (Impact 5.8-1b) would be reduced to less than significant levels with implementation of Mitigation Measures 5.8-1a through 5.8-1c because the mitigation would require additional site-specific geotechnical evaluations and incorporation of risk reduction measures, including ground shaking and slope stability strategies, to meet the minimum factors of safety as required by regulations (i.e., the IBC and CBC). Implementation of the noted design measures and related efforts to ensure conformance with applicable industry/regulatory standards would be verified through City plan review and on-the-ground geotechnical observations and testing during project excavation, grading and construction activities. Based on these efforts, site-specific modifications to the described recommendations would be implemented as necessary to ensure conformance with all applicable regulatory requirements and industry standards. Implementation of and conformance with such recommendations and standards would effectively avoid or reduce potential seismic ground shaking hazards to less than significant levels.

B. Soil Erosion or Topsoil Loss

Significant impacts associated with soil erosion and topsoil loss from Project construction and operation (Impact 5.8-2) would be reduced to less than significant levels with implementation of Mitigation Measures 5.11-1a through 5.11-1f because the mitigation would require appropriate erosion and sediment control BMPs as part of development of future SWPPPs and compliance

with related City and NPDES requirements, which would include performance measures to reduce soil erosion to less than significant levels.

C. Slope Stability

Potential for significant Project impacts associated with landsliding, lateral spreading, and/or collapse (Impact 5.8-3a) and potentially corrosive soils (Impact 5.8-3b) would be reduced to less than significant levels with implementation of Mitigation Measures 5.8-1a through 5.8-1c because the mitigation would require additional site-specific geotechnical evaluations and incorporation of risk reduction measures, including slope stability and corrosive soils strategies, to meet at least the minimum factor of safety.

D. Expansive Soils

Project impacts associated with potential soil expansion (Impact 5.8-4) would be reduced to less than significant levels with implementation of Mitigation Measures 5.8-1a and -1b because the mitigation would require conformance with industry recommendations and standards related to expansive soils. Site-specific modifications to the described recommendations would be implemented as necessary to ensure conformance with applicable regulatory requirements and industry standards. Implementation of and conformance with such recommendations and standards, included as mitigation measures, would effectively avoid or reduce potential project-related impacts from expansive soils to less than significant levels.

E. Septic Tank/Wastewater Disposal Systems

Impacts associated with septic tanks and wastewater disposal systems would be less than significant without mitigation.