3.7 GEOLOGY AND SOILS

This section describes current conditions relative to geology, soils, and paleontological resources at and in the vicinity of the Master Plan Area and analyzes potential environmental impacts related to these topics. Mitigation measures are included where significant impacts were identified.

No comments related to geology and soils were received during public review of the Notice of Preparation (NOP).

3.7.1 Regulatory Setting

FEDERAL

National Earthquake Hazards Reduction Act

In October 1977, the U.S. Congress passed the Earthquake Hazards Reduction Act to reduce the risks to life and property from future earthquakes in the United States. To accomplish this, the act established the National Earthquake Hazards Reduction Program (NEHRP). The mission of NEHRP includes improved understanding, characterization, and prediction of hazards and vulnerabilities; improved building codes and land use practices; risk reduction through post-earthquake investigations and education; development and improvement of design and construction techniques; improved mitigation capacity; and accelerated application of research results. The NEHRP designates the Federal Emergency Management Agency (FEMA) as the lead agency of the program and assigns several planning, coordinating, and reporting responsibilities.

STATE

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act of 1972 (PRC Section 2621-2630) intends to reduce the risk to life and property from surface fault rupture during earthquakes by regulating construction in active fault corridors, and by prohibiting the location of most types of structures intended for human occupancy across the traces of active faults. The act defines criteria for identifying active faults, giving legal support to terms such as active and inactive, and establishes a process for reviewing building proposals in Earthquake Fault Zones. Under the Alquist-Priolo Act, faults are zoned and construction along or across these zones is strictly regulated if they are “sufficiently active” and “well-defined.” A fault is considered sufficiently active if one or more of its segments or strands shows evidence of surface displacement during Holocene time (defined for purposes of the act as within the last 11,000 years). A fault is considered well defined if its trace can be clearly identified by a trained geologist at the ground surface or in the shallow subsurface, using standard professional techniques, criteria, and judgment (Bryant and Hart 2007). Before a project can be permitted in a designated Alquist-Priolo Earthquake Fault Zone, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults. The law addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards.

Seismic Hazards Mapping Act

The intention of the Seismic Hazards Mapping Act of 1990 (PRC Sections 2690–2699.6) is to reduce damage resulting from earthquakes. While the Alquist-Priolo Act addresses surface fault rupture, the Seismic Hazards Mapping Act addresses other earthquake-related hazards, including ground shaking, liquefaction, and seismically induced landslides. The act’s provisions are similar in concept to those of the Alquist-Priolo Act: The state is charged with identifying and mapping areas at risk of strong ground shaking, liquefaction, landslides, and other corollary hazards, and cities and counties are required to regulate development within mapped Seismic Hazard Zones. Under the Seismic Hazards Mapping Act, permit review is the primary mechanism for local regulation of development.

California Building Code

The California Building Code (CBC) (24 CCR) is based on the International Building Code. The CBC has been modified from the International Building Code for California conditions, with more detailed and/or more stringent regulations. Specific minimum seismic safety and structural design requirements are set forth in Chapter 16 of the CBC. The CBC identifies seismic factors that must be considered in structural design. Chapter 18 of the CBC regulates the excavation of foundations and retaining walls, while Chapter 18A regulates construction on unstable soils, such as expansive soils and areas subject to liquefaction. Appendix J of the CBC regulates grading activities, including drainage and erosion control. The CBC contains a provision that provides for a preliminary soil report to be prepared to identify "the presence of critically expansive soils or other soil problems which, if not corrected, would lead to structural defects" (CBC Chapter 18 Section 1803.1.1.1).

Surface Mining and Reclamation Act of 1975

The Surface Mining and Reclamation Act of 1975 (PRC Sections 2710–2796) provides for the classification of non-fuel mineral resources in the state to show where economically significant mineral resources occur or are likely to occur. Classification is carried out under the Mineral Land Classification Project under the direction of the State Geologist. Once lands have been classified, they may be designated by the State Mining and Geology Board as mineral-bearing areas of statewide or regional significance if they are in areas where urban expansion or other irreversible land uses may occur that could restrict or preclude future mineral extraction. Designation is intended to prevent future land use conflicts and occurs only after consultation with lead agencies and other stakeholders.

The California Department of Conservation, Division of Mines and Geology has developed guidelines for the classification and designation of mineral lands. These guidelines contain information on what are known as Mineral Resource Zones (MRZs), which together comprise a system of classifying lands based on their economic importance (DOC 1989). The MRZ system consists of four categories into which lands may be classified based on the degree of available knowledge about the resource, and the level of economic significance of the resource:

- MRZ-1: Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence
- MRZ-2: Areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood exists for their presence
- MRZ-3: Areas containing mineral deposits for which the significance cannot be determined from available data
- MRZ-4: Areas where available information is inadequate for assignment of any other MRZ category

California Onsite Wastewater Treatment Standards

Assembly Bill 885 amended California Water Code Section 13290, which required the State Water Resources Control Board (SWRCB) to develop statewide standards for permitting and operation of Onsite Wastewater Treatment Systems, septic systems. The SWRCB adopted the Water Quality Control Policy for Siting, Design, Operation and Maintenance of Onsite Wastewater Systems which became effective on May 13, 2013. This policy established a statewide risk-based tiered approach for the regulation and management of Onsite Wastewater Treatment Systems.

California State University Seismic Policy

California State University (CSU) Seismic Requirements were established to implement the Seismic Policy set by the Board of Trustees. The CSU Seismic Policy applies to all structures within the bounds of a CSU campus master plan. Planning for all projects shall address the options considered to improve seismic performance beyond minimally required code conformance. The basis for determination of the selected option shall be documented. The CSU Seismic Requirements address many special conditions, including geotechnical investigations, modular buildings, pre-engineered structures, temporary use of buildings, voluntary retrofits, use of engineered wood products, and designated seismic systems. Design professionals are expected to directly notify the CSU construction manager and seismic peer reviewer of potential construction changes or modification to the approved design documents that could substantively impact expected structural performance and, where appropriate, directly contact the Seismic Peer Reviewer for consideration of and concurrence with the changes as specific conditions warrant.

California Public Resources Code, Section 5097.5

PRC Section 5097.5 defines as a misdemeanor the unauthorized disturbance or removal of archaeological, historic, or paleontological resources located on public lands.

LOCAL

Cal Poly is an entity of the CSU, which is a constitutionally created state agency, and is therefore not subject to local government planning and land use plans, policies, or regulations. Cal Poly may consider, for informational purposes, aspects of local plans and policies for the communities surrounding the campus when it is appropriate. The proposed project would be subject to state and federal agency planning documents described herein but would not be bound by local or regional planning regulations or documents such as the City's General Plan or municipal code.

San Luis Obispo County General Plan

The San Luis Obispo County (County) General Plan is the foundation upon which all land use decisions for unincorporated county lands are based. Its main purposes are to illustrate the public policy for future land use for both public and private lands, and to provide the County Board of Supervisors, Planning Commission, Subdivision Review Board and Zoning Administrator (Hearing Officer) with specific direction for future decisions affecting land use development. The County General Plan Safety Element establishes policies and programs to protect the community from risks associated with geologic hazards, earthquakes, and other natural disasters (County of San Luis Obispo 1999). The County General Plan Conservation and Open Space Element incorporates policies for the conservation of significant paleontological resources (County of San Luis Obispo 2010).

San Luis Obispo County Code, Title 19 – Septic

Title 19 of the San Luis Obispo County Code includes regulations related to septic tanks and leach area systems. As outlined in San Luis Obispo County Code Section 19.07(3)(a), septic tank and leach area systems shall be used only where the proposed site can maintain subsurface disposal, and satisfy various standards outlined in this section. For instance, septic tanks can only be use when the proposed site for soil absorption disposal area shall be free from soils or formations containing continuous channels, cracks or fractures, unless a setback distance of at least 250 feet to any domestic water supply well or surface water is assured. Further, septic tanks or leaching systems installed on slopes of 20 percent or more shall be designed and installation certified by a registered engineer, designed to minimize grading disruption associated with access for installation and maintenance. Per Section 19.07(3)(a) of the San Luis Obispo County Code, no soil absorption sewage disposal area shall be located where the natural slope is 30 percent or greater.

City of San Luis Obispo General Plan

The City of San Luis Obispo (City) General Plan was adopted in December 9, 2014, to guide the use and protection of various resources to meet community purposes. The City's General Plan Safety Element incorporates policies regarding various safety topics, including earthquakes and other geologic hazards, such as surface rupture, ground shaking, and settlement and liquefaction (City of San Luis Obispo 2014a). One policy regarding paleontological resources is also incorporated in the Conservation and Open Space Element (City of San Luis Obispo 2014b).

3.7.2 Environmental Setting

REGIONAL GEOLOGY

The Master Plan Area is located just southwest of Garcia Mountain and the La Panza Mountain Range in the Coast Ranges Geomorphic Province of California. The Coast Ranges Geomorphic Province consists of land between the Pacific Ocean and the Sacramento–San Joaquin Valley and trends northwesterly along the California coast for approximately 600 miles between Santa Maria and the southern border of Oregon (California Geological Survey 2015). The La Panza Mountain Range is approximately 30 miles long and runs from northwest to southeast between the Santa Lucia Range to the west and the Temblor Range to the east, with peaks at approximately 4,054 feet above mean sea level.

LOCAL GEOLOGY

The western portion of San Luis Obispo County, including the city of San Luis Obispo, is primarily underlain by Jurassic period (approximately 180-million-year-old) rocks of the Franciscan complex, comprised of a mixture of igneous, metamorphic, and sedimentary rocks (DOC 2010). Cretaceous and Tertiary sedimentary rocks in the Monterey and Pismo formations overlie the Franciscan complex in many parts of the San Luis Obispo area. The most distinctive morphological feature in the area is a chain of 14 Tertiary volcanic remnants that extend northwesterly from the city of San Luis Obispo to the city of Morro Bay, terminating in the prominent visual landmark of Morro Rock. Other notable features of the chain of volcanic remnants include Hollister Peak, Bishop Peak, and Cerro San Luis Obispo, which are located approximately 1.5, 2.0, and 7.5 miles southwest of the campus, respectively.

TOPOGRAPHY AND DRAINAGE

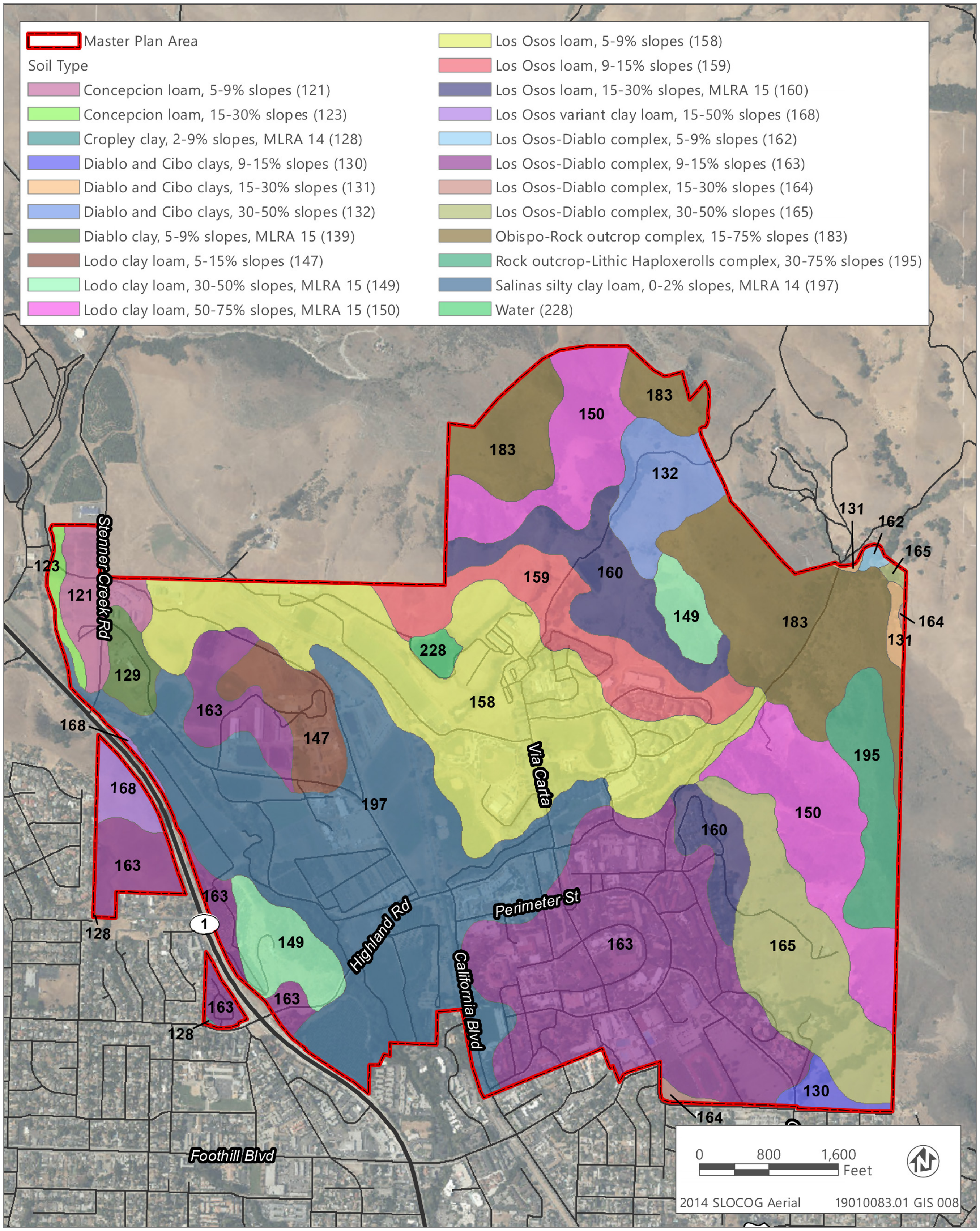
Topography varies throughout the Master Plan Area. While various rolling hills are present throughout the Master Plan Area, the campus is generally flat. However, steep hills are located in the north and east of the Master Plan Area, within the West, East, and North Campus subareas. Although the majority of the stormwater within the main campus drains into Brizzolara Creek, stormwater runoff from portions of the West Campus subarea drain into Stenner Creek. Both creeks ultimately drain into the Pacific Ocean.

GROUNDWATER

The majority of the Master Plan Area lies within the Stenner Creek Subbasin within the San Luis Obispo Creek Basin, which serves as an important groundwater recharge area for the San Luis Obispo Creek Basin (California Polytechnic State University 2015). Local groundwater is provided via seven agricultural wells on site, owned and operated by the University. A portion of the West Campus subarea is located within the San Luis Obispo Valley Basin, designated as a high priority basin by the California Department of Water Resources (County of San Luis Obispo 2019). For more information groundwater in the plan area, refer to Section 3.9, "Hydrology and Water Quality," of this EIR.

SOILS

The campus is underlain by various soil types, ranging from 0 to 75 percent slope, low to high shrink-swell potential, and slight to very high erosion hazard. The suitability of these soil types for development varies, as does the potential for geologic hazards. A discussion of soil characteristics associated with the campus is provided in Table 3.7-1, and soils are also shown in Figure 3.7-1.



Source: Data downloaded from the NRCS in 2019

Figure 3.7-1 Soils in the Master Plan Area

Table 3.7-1 Summary of Soil Characteristics

Soil Group	Description	Shrink-Swell Potential	Erosion Hazard
Concepcion loam	Very deep soil, moderate drainage, permeability very slow, runoff medium to moderate hazard	High	Moderate
Concepcion loam	Deep to moderate soil, well drained, permeability very slow	High	Moderate to high
Cropley clay	Drains moderately well, potential for soil compaction	High	Slight
Diablo clay	Deep soil, drains well	High	Slight to moderate
Diablo and Cibo clay	Deep soil, drains well, slow permeability	High	Moderate
Lodo clay loam	Somewhat excessively drained, moderate permeability	Moderate to high	Moderate
Lodo clay loam	Excessively drained, moderate permeability	Low	High
Lodo clay loam	Shallow soil, excessively drained, very steep, moderate permeability	Moderate to high	High
Los Osos loam	Moderate to deep soil, drains well	High	Moderate
Los Osos loam	Moderate to deep soil, drains well	High	High
Los Osos-Diablo complex	Moderately deep soil, drains well, permeability slow, runoff medium	High	Moderate
Los Osos-Diablo complex	Moderately deep soil, drains well, permeability slow	High	High
Los Osos variant clay loam	Moderately deep, drains well, high runoff	High	Moderate
Salinas silty clay loam	Very deep soil, drains well, permeability slow	Moderate	Slight

Source: USDA 2019

SUBSIDENCE

Land subsidence is the gradual settling or sinking of an area with very little horizontal motion. Subsidence can be induced by both natural and human phenomena. Natural phenomena include shifting of tectonic plates and dissolution of limestone resulting in sinkholes. Subsidence related to human activity includes pumping water, oil, and gas from underground reservoirs; collapse of underground mines; drainage of wetlands; and soil compaction.

Land subsidence in California is a problem that has been acknowledged and is tied to groundwater pumping. Since 2009, the California Statewide Groundwater Elevation Monitoring Program has tracked seasonal and long-term groundwater elevation trends in groundwater basins statewide (California Department of Water Resources 2019). The San Luis Obispo County Flood Control and Water Conservation District, through the San Luis Obispo County Public Works Water Resources Division, manages the countywide groundwater monitoring program that measures groundwater levels in over 300 wells within San Luis Obispo County. These groundwater level monitoring wells also monitor potential subsidence (County of San Luis Obispo Public Works Department 2018).

EXPANSIVE SOILS

Expansive soils (also known as shrink-swell soils) are soils that contain expansive clay minerals that can absorb significant amounts of water. The presence of these clay minerals makes the soil prone to large changes in volume in response to changes in water content. When an expansive soil becomes wet, water is absorbed and it increases in volume, and as the soil dries it contracts and decreases in volume. This repeated change in volume over time can produce enough force and stress on buildings, underground utilities, and other structures to damage foundations, pipes, and walls. The quantity and type of expansive clay minerals affects the potential for the soil to expand or contract. Where native soils still exist, soil types may be expected to be similar to those of the nearby areas. As shown in Table 3.7-1, soil types range in shrink-swell potential from low to high.

One measure of the shrink-swell potential of soils is linear extensibility. Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. The volume change is reported as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent, moderate if 3 to 6 percent, high if 6 to 9 percent, and very high if more than 9 percent. The Natural Resources Conservation Service (NRCS) has prescribed linear extensibility ratings to most soil series in California. As shown in Figure 3.7-2, the majority of soils in the plan area exhibit a range in linear extensibility from moderate to high, while a small area within the northwestern portion of the Master Plan Area exhibits very high linear extensibility (USDA 2019).

SEISMICITY

Most earthquakes originate along fault lines. A fault is a fracture in the Earth's crust along which rocks on one side are displaced relative to those on the other side due to shear and compressive crustal stresses. Most faults are the result of repeated displacement that may have taken place suddenly and/or by slow creep (Bryant and Hart 2007). The State of California has a classification system that designates faults as either active, potentially active, or inactive, depending on how recently displacement has occurred along them. Faults that show evidence of movement within the last 11,000 years (the Holocene geologic period) are considered active, and faults that have moved between 11,000 and 1.6 million years ago (comprising the later Pleistocene geologic period) are considered potentially active.

A review of available published geologic and seismic hazards maps indicates that there are various known active faults identified within the proximity of the campus. The nearest active faults that have the greatest potential to affect the campus during a seismic event include the Los Osos, Hosgri, Rinconada, and the San Andreas Faults, which are located approximately 5 miles west, 19 miles west, 20 miles east, and 40 miles east of the campus, respectively. Potentially active faults near the project site also include Cambria Fault, West Huasna Fault, and Edna Fault (see Figure 3.7-3). The campus is not located within an Alquist-Priolo Fault Zone, as defined in the Alquist-Priolo Earthquake Fault Zoning Act, which is designed to prohibit the construction of structures for human occupancy across active faults. Table 3.7-2 lists some of the active and potentially active faults in relatively close proximity to the Master Plan Area.

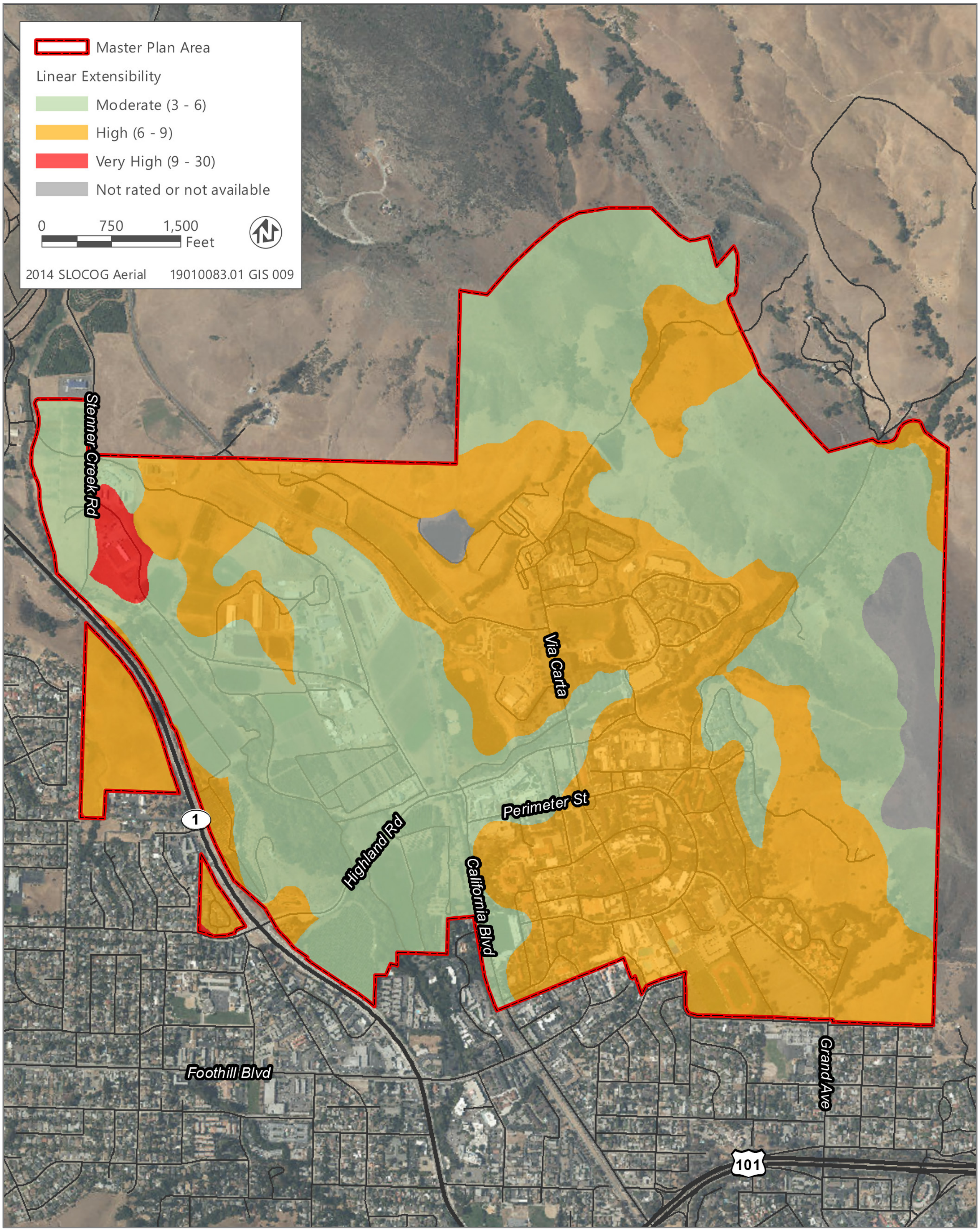
Table 3.7-2 Active Faults Within 100 Miles of the Master Plan Area

Fault Name	Distance from Fault to Project Site (Miles)	Age of Movement	Characteristic Earthquake (moment magnitude)
Los Osos Fault	5 miles west	Within the least 11,000 years	6.75
Hosgri Fault	19 miles west	Every 200 to 800 years	7.2 to 7.7
Rinconada Fault	20 miles east	Approximately 0.5 to 1 million years ago	Not available
San Andreas Fault	40 miles east	1857	7.9

Sources: Jennings and Bryant 2010; Pacific Gas and Electric Company 2011; U.S. Geological Survey 2019

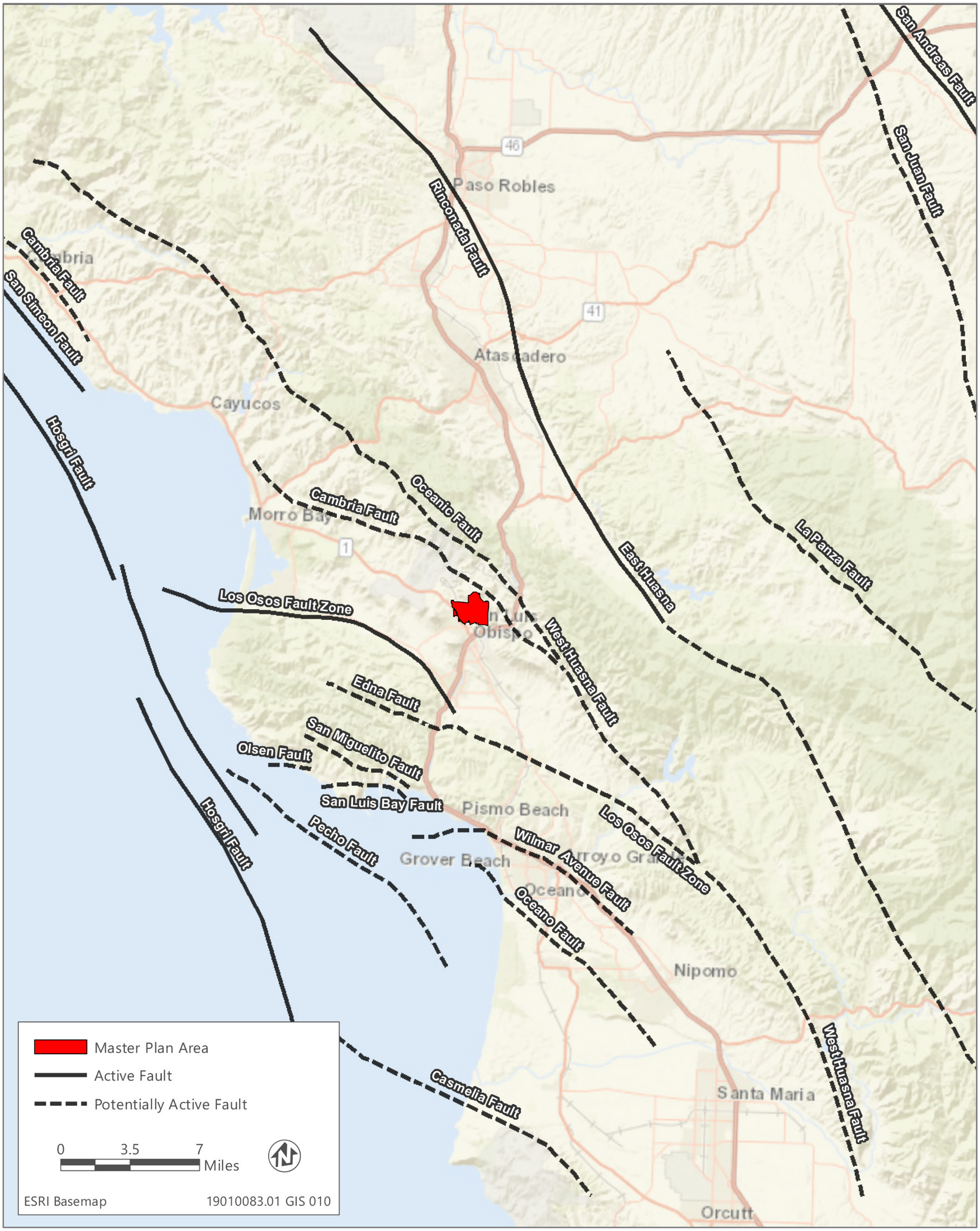
The San Andreas Fault is considered to be the most likely source of a future major earthquake in California. There are segments along the fault where no large earthquakes have occurred for long intervals of time. Studies conducted by the U.S. Geological Survey show that large earthquakes have occurred at about 150-year intervals on the southern San Andreas Fault. As the last large earthquake on the southern San Andreas occurred in 1857, that section of the fault is considered a likely location for an earthquake in the next few decades (U.S. Geological Survey 2016).

Seismic hazards resulting from earthquakes include surface fault rupture, ground shaking, and liquefaction. Each of these potential hazards is discussed below.



Source: Data downloaded from the NRCS in 2019

Figure 3.7-2 Linear Extensibility (Shrink-Swell Potential) of Soils in the Master Plan Area



Source: Data downloaded from the NRCS in 2019

Figure 3.7-3 Faults in the Vicinity of the Master Plan Area

Surface Fault Rupture

Surface rupture is the surface expression of movement along a fault. Structures built over an active fault can be torn apart if the ground ruptures. The potential for surface rupture is based on the concepts of recency and recurrence. Surface rupture along faults is generally limited to a linear zone a few meters wide. The Alquist-Priolo Act (see the Regulatory Setting discussion above) was created to prohibit the location of structures designed for human occupancy across, or within 50 feet of, an active fault, thereby reducing the loss of life and property from an earthquake. The project site is not located within an Alquist-Priolo active fault zone (Bryant and Hart 2007). However, as shown in Table 3.7-2, above, there are various active faults in proximity of the project site.

Ground Shaking

The intensity of seismic shaking, or strong ground motion, during an earthquake is dependent on the distance and direction from the epicenter of the earthquake, the magnitude of the earthquake, and the geologic conditions of the surrounding area. Ground shaking could potentially result in the damage or collapse of buildings and other structures. The probable seismic ground shaking expected at the project site is anticipated to produce peak ground accelerations (PGA) between 10 and 20 percent of the acceleration of gravity (g): 0.11 g and 0.27 g, respectively (DOC 2019). PGA is expressed as "g," representing the acceleration due to Earth's gravity (g-force). Earthquake intensities generally associated with this amount of ground shaking are typically between VI and VII on the Modified Mercalli Intensity Scale (MMI) (Table 3.7-3). A historic record search indicates that approximately 46 earthquakes with magnitudes of 5.0 or greater have occurred within 65 miles of the campus between 1800 and 2016. The highest reported PGA on campus is 0.269 g. The earthquake that resulted in this peak PGA on campus occurred in 1906 approximately 2.8 miles northwest of the campus and had a reported 5.9 magnitude. This was also the closest reported earthquake to the campus to date. The largest magnitude earthquake reported was a 7.9 magnitude earthquake on the southern portion of the San Andreas Fault, approximately 40 miles northeast of the campus. This earthquake, known as the 1857 Fort Tejon Earthquake, produced an estimated PGA of 0.11 g on the campus (Earth Systems 2017a).

Table 3.7-3 The Modified Mercalli Scale of Earthquake Intensities

If most of these effects are observed	Then the intensity is
Earthquake shaking not felt but people may observe marginal effects of large distance earthquakes without identifying these effects as earthquake-caused. Among them: trees, liquids, bodies of water sway slowly, or doors swing slowly.	I
Effect on people: Shaking felt by those at rest, especially if they are indoors, and by those on upper floors.	II
Effect on people: Felt by most people indoors. Some can estimate duration of shaking but many may not recognize shaking of building as caused by an earthquake; the shaking is like that caused by the passing of light trucks.	III
Other effects: Hanging objects swing. Structural effects: Windows or doors rattle. Wooden walls and frames creak.	IV
Effect on people: Felt by everyone indoors and by most people outdoors. Many now estimate not only the duration of shaking but also its direction and have no doubt as to its cause. Sleepers wakened. Other effects: Hanging objects swing. Standing autos rock. Crockery clashes, dishes rattle or glasses clink. Structural effects: Doors close, open or swing. Windows rattle.	V
Effect on people: Felt by everyone indoors and by most people outdoors. Many now estimate not only the duration of shaking but also its direction and have no doubt as to its cause. Sleepers wakened. Other effects: Hanging objects swing. Shutters or pictures move. Pendulum clocks stop, start, or change rate. Standing autos rock. Crockery clashes, dishes rattle or glasses clink. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Structural effects: Weak plaster and Masonry D* crack. Windows break. Doors close, open, or swing.	VI
Effect on people: Felt by everyone. Many are frightened and run outdoors. People walk unsteadily. Other effects: Small church or school bells ring. Pictures thrown off walls, knickknacks and books off shelves. Dishes or glasses broken. Furniture moved or overturned. Trees, bushes shaken visibly, or heard to rustle. Structural effects: Masonry D* damaged; some cracks in Masonry C*. Weak chimneys break at roof line. Plaster, loose bricks, stones, tiles, cornices, unbraced parapets, and architectural ornaments fall. Concrete irrigation ditches damaged.	VII

If most of these effects are observed	Then the intensity is
Effect on people: Difficult to stand. Shaking noticed by auto drivers. Other effects: Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Furniture broken. Hanging objects quiver. Structural effects: Masonry D* heavily damaged; Masonry C* damaged, partially collapses in some cases; some damage to Masonry B*; none to Masonry A*. Stucco and some masonry walls fall. Chimneys, factory stacks, monuments, towers, elevated tanks twist or fall. Frame houses move on foundation if not bolted down; loose panel walls thrown out. Decayed piling broken off.	VIII
Effect on people: General fright. People thrown to ground. Other effects: Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes. Steering of autos affected. Branches broken from trees. Structural effects: Masonry D* destroyed; Masonry C* heavily damaged, sometimes with complete collapse; Masonry B* is seriously damaged. General damage to foundations. Frame structures, if not bolted, shifted off foundations. Frames cracked. Reservoirs seriously damaged. Underground pipes broken.	IX
Effect on people: General panic. Other effects: Conspicuous cracks in ground. In areas of soft ground, sand is ejected through holes and piles up into a small crate, and, in muddy areas, water fountains are formed. Structural effects: Mast masonry and frame structures destroyed along with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, and embankments. Railroads bent slightly.	X
Effect on people: General panic. Other effects: Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Structural effects: General destruction of buildings. Underground pipelines completely out of service. Railroads bent greatly.	XI
Effect on people: General panic. Other effects: Same as for Intensity X. Structural effects: Damage nearly total, the ultimate catastrophe. Other effects: Large rock masses displaced. Lines of sight and level distorted. Objects thrown into air.	XII

* Masonry A: Good workmanship and mortar, reinforced, designed to resist lateral forces.

* Masonry B: Good workmanship and mortar, reinforced.

* Masonry C: Good workmanship and mortar, unreinforced.

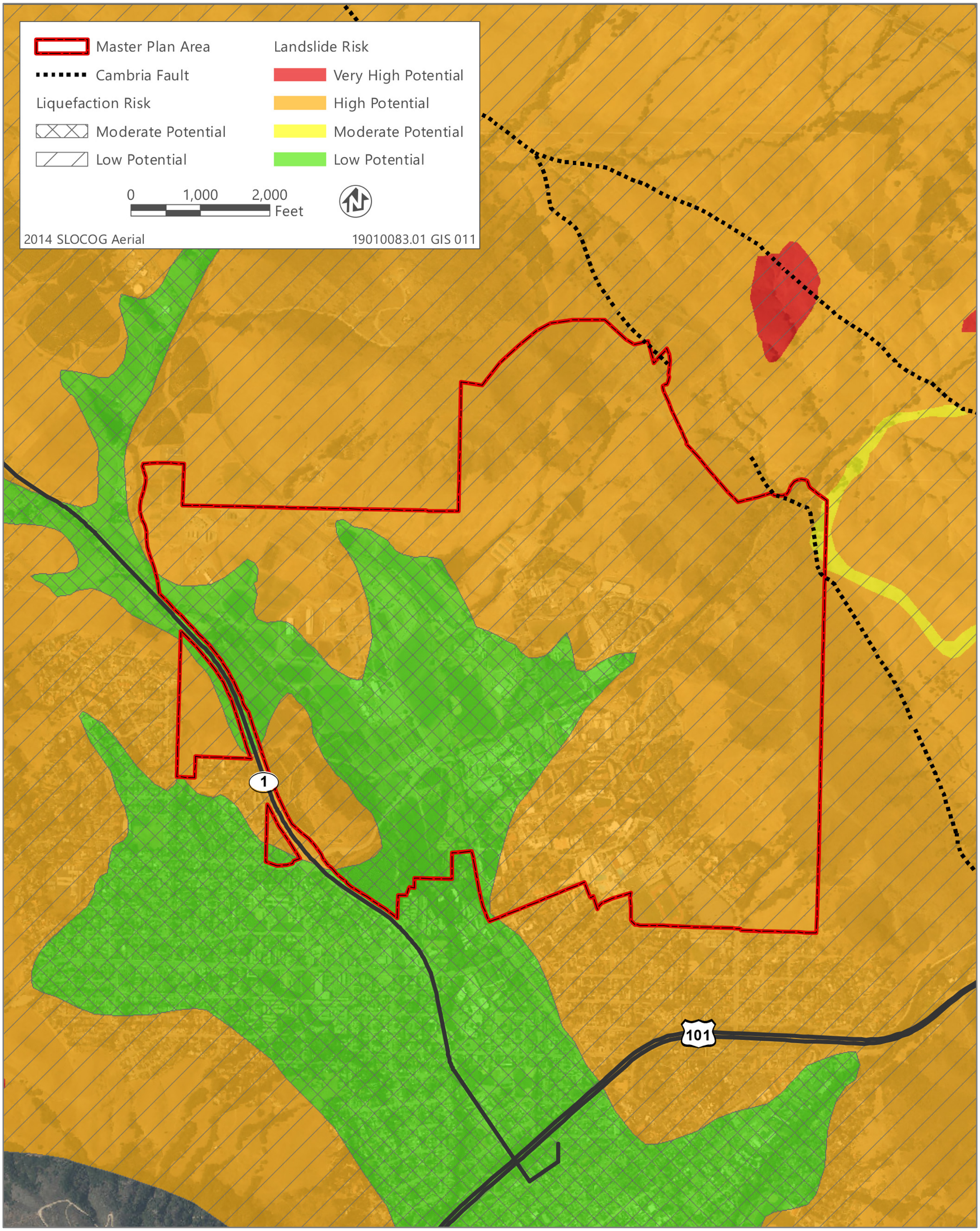
* Masonry D: Poor workmanship and mortar and weak materials, like adobe.

Overall, the Master Plan Area is located in a seismically active region that includes several active earthquake faults and therefore could experience low levels of ground shaking on an infrequent basis (California Seismic Safety Commission 2003). Based in data from the California Department of Conservation (DOC 2008), the Master Plan Area would have 2-percent chance in 50 years to experience a ground motion of 0.507 g.

Liquefaction and Lateral Spreading

Liquefaction is a phenomenon in which loose, saturated, granular soil deposits lose a significant portion of their shear strength because of excess pore water pressure buildup. An earthquake typically causes the increase in pore water pressure and subsequent liquefaction. These soils are behaving like a liquid during seismic shaking and re-solidify when shaking stops. The potential for liquefaction is highest in areas with high groundwater and loose, fine, sandy soils at depths of less than 50 feet.

Liquefaction may also lead to lateral spreading. Lateral spreading (also known as expansion) is the horizontal movement or spreading of soil toward an "open face," such as a streambank, the open side of fill embankments, or the sides of levees. It often occurs in response to liquefaction of soils in an adjacent area. The potential for failure from lateral spreading is highest in areas where there is a high groundwater table, where there are relatively soft and recent alluvial deposits, and where creek banks are relatively high. As discussed above, groundwater is known to be present throughout the Master Plan Area. As shown in Figure 3.7-4, the project site is characterized by areas of low to moderate liquefaction risk.



Source: Data downloaded from San Luis Obispo County in 2019

Figure 3.7-4 Seismic Hazard Areas in the Vicinity of the Master Plan Area

MASS WASTING AND LANDSLIDES

Mass wasting refers to the collective group of processes that characterize down slope movement of rock and unconsolidated sediment overlying bedrock. These processes include landslides, slumps, rockfalls, flows, and creeps. Many factors contribute to the potential for mass wasting, including geologic conditions as well as the drainage, slope, and vegetation of the site. As shown in Figure 3.7-4, the landslide hazard risk within the Master Plan Area ranges from low to high potential. Further, as discussed above, steep hills are located in the north and east of the Master Plan Area, within the West, East, and North Campus subareas. Various landslide incidents have been known to occur within this portion of the main campus. A landslide occurred in February 2017, upslope of the Fremont Dorm, located at the intersection Klamath and Deer Road (approximately 1,500 feet north and east of the recently developed Student Housing South). The event resulted in immediate closure of the building. Grading work has since been completed to remove the upper landslide mass contributing to the driving force of the landslide. Investigations are currently in progress to develop recommendations to best reduce potential risks associated with this landslide (Earth Systems 2017b).

PALEONTOLOGICAL RESOURCES

The Master Plan Area is underlain by Franciscan Complex (KJf) deposits of the Coast Ranges and Young Surficial Deposits (Qya). The Franciscan Complex includes Cretaceous and Jurassic sandstone with smaller amounts of shale, chert, limestone, and conglomerate (DOC 2010). This deposit primarily consists of variably deformed and metamorphosed sandstone, graywacke, mudstone, and chert. For this reason, the potential to find fossils within the Franciscan Complex is rare, as this formation is heavily deformed and metamorphosed in many locations (a process that destroys fossils). Qya consists of alluvial gravel and sand and is typically too young to produce significant paleontological findings (DOC 2010).

3.7.3 Environmental Impacts and Mitigation Measures

METHODOLOGY

To evaluate project impacts, resource conditions that could pose a risk to the 2035 Master Plan were identified through review of documents pertaining to these topics within the Master Plan Area. Sources consulted include the County and City of San Luis Obispo General Plans, the 2035 Master Plan, U.S. Geological Survey and California Geological Survey technical maps and guides; the NRCS Soil Survey (available through the Soil Survey Geographic Database); previous environmental impact reports; background reports prepared for nearby plans and projects; and published geologic literature. The information obtained from these sources was reviewed and summarized to establish the existing conditions (described above) and identify potential environmental hazards. In determining level of significance, the analysis assumes that the project would comply with relevant laws, regulations, and guidelines.

Potential effects associated with implementation of the 2035 Master Plan are characterized as permanent. Temporary effects from construction of specific components of the 2035 Master Plan would be evaluated on a project-level basis.

THRESHOLDS OF SIGNIFICANCE

A geology, soils, or paleontological resources impact would normally be significant if implementation of the 2035 Master Plan would:

- directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death through the rupture of a known earthquake fault; strong seismic ground shaking; seismic-related ground failure, including liquefaction, or landslides;
- result in substantial soil erosion or the loss of topsoil;

- locate project facilities 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-site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;
- locate project facilities on expansive soil, creating substantial direct or indirect risks to property;
- have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater; or
- directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

ISSUES NOT DISCUSSED FURTHER

Fault Rupture

Although the project site is located in a seismically active region that includes several active earthquake faults of local and regional significance, the project site is not located within a designated Alquist-Priolo Earthquake Fault Zone and there are no known fault traces that extend through, or in the immediate vicinity of, the project site (see Figure 3.7-3). Therefore, fault rupture is not anticipated to occur. Compliance with the CSU Seismic Requirements and CBC requirements would minimize any potential impacts related to fault rupture. Thus, buildout of the 2035 Master Plan would not expose people or structures to potential substantial adverse effects related to the rupture of a known earthquake fault; and this issue is not discussed further.

Soils Capable of Supporting Septic Tanks

Future development associated with the 2035 Master Plan does not include the construction or use of septic facilities on campus; therefore, no impact would occur.

ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Impact 3.7-1: Directly or Indirectly Cause Potential Substantial Adverse Effects, including the Risk of Loss, Injury, or Death Involving Seismic Ground Shaking

Although the Master Plan Area is located in a seismically active region that includes several active earthquake faults of local and regional significance, none of these faults extend directly through campus. All structures proposed to be constructed or redeveloped would be required to comply with the CSU Seismic Requirements and the latest CBC, to ensure that all new and modified buildings would be capable of withstanding anticipated levels of ground shaking. For this reason, the potential impact related to ground shaking would be **less than significant**.

As discussed in Section 3.7.2, the Master Plan Area is located in a seismically active region that includes several active earthquake faults of local and regional significance. However, none of these faults extend directly through campus (see Figure 3.7-3). Strong ground shaking from an earthquake can result in damage associated with landslides, ground lurching, structural damage, and liquefaction. The severity of ground shaking within the Academic Core subarea during a seismic event would be influenced by the distance from the seismic source. Based on geotechnical studies prepared in 2014 for the Student Housing South Environmental Impact Report, expert assumptions indicate that the most significant seismic event predicted to affect structures within the campus would be a 6.8 magnitude event along the Los Osos Fault (SWCA 2014). However, all structures proposed to be constructed or redeveloped would be required to comply with the CSU Seismic Requirements and the latest CBC, to ensure that all new and modified buildings would be capable of withstanding anticipated levels of ground shaking. The CSU Seismic Requirements mandate the preparation of a site-specific geotechnical investigation using campus-specific 'seismic ground motion parameters' for all future development on campus. These parameters supersede CBC requirements in new construction. Thus, compliance with CSU Seismic Requirements and CBC would reduce the potential impact related to seismic ground shaking through the identification of site-specific seismic hazards and implementation of responsive structural design in accordance with peer-reviewed earthquake loads and seismic performance requirements. Therefore, the potential impact related to ground shaking would be **less than significant**.

Mitigation Measures

No mitigation is required.

Impact 3.7-2: Directly or Indirectly Cause Potential Substantial Adverse Effects, including the Risk of Loss, Injury, or Death Involving Seismic-Related Ground Failure, including Liquefaction

Due to the varied conditions and capabilities of subsurface soils and depth to the groundwater table, the potential for liquefaction and liquefaction-induced lateral spreading also varies throughout the Master Plan Area. However, all future development proposed by the 2035 Master Plan would be required to comply with the CSU Seismic Requirements and the latest CBC requirements. For this reason, compliance with CBC and CSU Seismic Requirements would ensure that the impact related to ground failure and liquefaction would be **less than significant**.

The Master Plan Area is underlain by soils that range from very low to moderate potential for liquefaction (see Figure 3.7-4). Due to the varied conditions and capabilities of subsurface soils and depth to the groundwater table, the potential for liquefaction and liquefaction-induced lateral spreading also varies throughout the project site. Depending on site-specific subsurface conditions at each location proposed for development within the Master Plan Area, new development could expose people and/or structures to the effects of liquefaction resulting from ground shaking during a seismic event.

However, as discussed above, all future development proposed by the 2035 Master Plan would be required to comply with the CSU Seismic Requirements and the latest CBC requirements. Site-specific geotechnical studies and soil engineering reports would also be required before consideration of approval of future projects, per the CSU Seismic Requirements. These site-specific geotechnical studies and soil engineering reports would evaluate potential risk associated with seismic ground failure and liquefaction for individual future projects and incorporate project-specific design requirements and conditions of approval for all future projects. For this reason, compliance with CBC and CSU Seismic Requirements would ensure that the impact related to ground failure and liquefaction would be **less than significant**.

Mitigation Measures

No mitigation is required.

Impact 3.7-3: Directly or Indirectly Cause Potential Substantial Adverse Effects, including the Risk of Loss, Injury, or Death Involving Landslides

The Master Plan Area incorporates a few existing steep slopes within the eastern boundary of the East Campus subarea and along the northern portion of the North Campus subarea. All structures proposed to be constructed or redeveloped under the 2035 Master Plan would be required to comply with the CSU Seismic Requirements and the latest CBC, to ensure structural design of all new and modified buildings would not result in adverse effects resulting from landslides. However, because of the presence of steep slopes along the eastern and northern portion of the Master Plan Area, and the recent landslide that occurred within the East Campus subarea, future development in these areas is considered to have the potential to expose people and structures to risks from landslides. This impact would be **significant**.

As discussed in Section 3.7.2 and shown on Figure 3.7-4 the landslide hazard risk within the Master Plan Area ranges from low to high potential. Various portions of the Master Plan Area, including the northern portion of the North and West Campus subareas and the eastern boundary of the East Campus subarea consist of steep slopes that could result in a high potential for landslides. Additionally, as discussed in Section 3.7.2, a landslide event occurred in February 2017 upslope of the Fremont Dorm within the East Campus subarea that required immediate closure of the building. Grading work has since been completed to remove the upper landslide mass contributing to the driving force of the landslide. Investigations are currently in progress to develop recommendations to best reduce potential risks associated with this landslide (Earth Systems 2017b).

All structures proposed to be constructed or redeveloped under the 2035 Master Plan would be required to comply with the CSU Seismic Requirements and the latest CBC, to ensure structural design of all new and modified buildings would not result in adverse effects resulting from landslides. For instance, buildings would be required to designed and constructed to support safely the factored loads in load combinations without exceeding the appropriate strength limit states for materials of construction. Foundation walls and retaining walls may also be required to resist lateral soil loads. For the majority of the Master Plan Area, compliance with the CBC and CSU's Seismic Requirements would adequately identify and minimize the potential impact related to landslides from future development. Nonetheless, because of the presence of steep slopes along the eastern and northern portion of the Master Plan Area, and the recent landslide that occurred within the East Campus subarea, future development in these areas is considered to have the potential to expose people and structures to risk from landslides. This impact would be **significant**.

Mitigation Measures

Mitigation Measure 3.7-3: Perform Site-Specific Geotechnical Investigations

For any areas within the campus where development is proposed in an area designated as having a high potential for landslide hazards, have substantial erosion potential, or be located on a geologic unit that is unstable or within an area known to have expansive soils, a site-specific geotechnical investigation shall be performed. Based on the findings of the geotechnical investigation for each future development or redevelopment projects under the 2035 Master Plan, any appropriate stabilization and site design recommendations, or low impact development features determined necessary to support proposed development shall be incorporated in the project design and implemented as part of project construction. Examples of stabilization and erosion control recommendations may include, but are not limited to:

- installation of earthen buttress(es);
- excavation of landslide mass/material;
- slope stabilization through excavation into benches and/or keyways and other methods;
- deep soil mixing;
- installation of retaining walls;
- use of tie-back anchors, micropiles, or shear pins; or
- a combination of any of these methods.

Before final plan approval, Cal Poly shall incorporate into the project design and implement all recommendations identified in the site-specific geotechnical investigation, including all recommendations included in the final geotechnical report prepared for the project. All recommendations shall be shown on final plans and/or included as project specifications.

Significance after Mitigation

Mitigation 3.7-3 would require a site-specific geotechnical investigation for all 2035 Master Plan projects proposed in areas determined to have a high potential for landsliding and other geologic hazards. The geotechnical investigation would require implementation of stabilization recommendations that would reduce the impact from potential erosion. This mitigation would reduce potential direct or indirect impacts associated with the risk of loss, injury, or death involving landslides impacts associated with erosion or loss of topsoil to a **less-than-significant** level.

Impact 3.7-4: Result in Substantial Erosion or Loss of Topsoil during Construction

Construction of development and redevelopment projects under the 2035 Master Plan would involve clearing and grading of soils, which could result in erosion and loss of topsoil, particularly if soils are exposed to wind or stormwater during construction. However, through compliance with all required regulations, such as SWRCB General Permit for Discharges of Stormwater Associated with Construction Activity (Construction General Permit Order 2009-0009-DWQ), and a Storm Water Pollution Prevention Plan (SWPPP) for projects that would result in more than 1 acre of ground disturbance, the impact related to substantial erosion or loss of topsoil during construction would be **less than significant**.

Long-term, permanent increases in impervious surfaces as a result of land use development could result in increased potential for erosion. For discussion of this impact please refer to Chapter 3.9, "Hydrology and Water Quality." This impact addresses short-term construction-related erosion potential.

As discussed in Section 3.7.2, above, the Master Plan Area is underlain with soils that range from slight to very high erosion hazard (see Table 3.7-1 and Figure 3.7-1). Construction activities associated with the development of proposed facilities and modification of existing facilities would likely require ground-disturbing activities, such as grading and excavation, which could result in erosion and loss of topsoil, particularly if soils are exposed to wind or stormwater during construction. However, all new development within the Master Plan Area would be required to comply with the SWRCB's General Permit for Discharges of Stormwater Associated with Construction Activity (Construction General Permit Order 2009-0009-DWQ). Additionally, all future development that would result in more than 1 acre of ground disturbance would be required to prepare a SWPPP. The SWPPP would include site-specific best management practices (BMPs) that would be implemented to prevent erosion and stormwater runoff and would include applicable monitoring programs to be implemented as necessary (see Chapter 3.9, Hydrology and Water Quality for additional discussion related to stormwater runoff). Because existing regulatory and permitting requirements for building construction and stormwater control provide adequate protection against soil erosion during and as a result of construction, the impact associated with erosion from implementing the 2035 Master Plan would be **less than significant**.

Mitigation Measures

No mitigation is required.

Impact 3.7-5: Be Located on a Geologic Unit 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

Construction activities under the 2035 Master Plan, such as grading and excavation, could increase the risk that soils would become unstable, which could eventually result in on- or off-site landslides, lateral spreading, subsidence, liquefaction, or collapse. Development and redevelopment projects that are proposed in areas where unstable soils are present could result in building damage. Because future projects could potentially be located on a geologic unit that is unstable, or that would become unstable as a result of the project, this impact would be **significant**.

As discussed under Impact 3.7-3, above, construction activities associated with the development of proposed facilities and modification of existing facilities would require ground-disturbing activities, such as grading and excavation. These construction activities could be located on geologic units or soils that are unstable or that may become unstable as a result of the development. For this reason, construction activities could increase the risk that soils would become unstable, which could eventually result in on- or off-site landslides, lateral spreading, subsidence, liquefaction, or collapse. Further, development and redevelopment projects that are proposed in areas where unstable soils are present could result in building damage. For instance, unstable soils can become prone to liquefaction and lateral spreading during large earthquake events. Developments are vulnerable to heavy damage by lateral spreading, including being pulled apart, buckled, or severe structural damage. Further, subsidence can occur through groundwater withdrawals from the shallow/intermediate aquifers, which can lead to unstable soils within the

Master Plan Area. As discussed under Impact 3.7-3, above, because various portions of the Master Plan Area, including the northern portion of the North and West Campus subareas and the eastern boundary of the East Campus subarea, consist of steep slopes, proposed development under the 2035 Master Plan could be located on unstable slopes that could result in landslides. All structures proposed to be constructed or redeveloped under the 2035 Master Plan would be required to comply with the CSU Seismic Requirements and the latest CBC, to ensure structural design of all new and modified buildings would not result in adverse effects such on- or off-site landslides, lateral spreading, subsidence, liquefaction, or collapse. Nonetheless, because the precise building footprints and design of future projects under the 2035 Master Plan is not known at this time, future projects could potentially be located on a geologic unit that is unstable, or that would become unstable as a result of the project. For this reason, this impact would be **significant**.

Mitigation Measures

Mitigation Measure 3.7-5: Perform Site-Specific Geotechnical Investigations

Implement Mitigation Measure 3.7-3, described above.

<u>Significance after Mitigation</u>

Mitigation Measure 3.7-6 would require a site-specific geotechnical investigation for all 2035 Master Plan projects proposed in areas determined to have a high potential for landsliding and other geologic hazards. The geotechnical investigation would require implementation of stabilization recommendations, such as fill selection, moisture control, and compaction during construction, that would reduce the potential impact on life and property resulting from unstable soils. This mitigation measure would reduce the potential impact associated with unstable soils to a **less-than-significant** level.

Impact 3.7-6: Be Located on Expansive Soil, Creating Substantial Direct or Indirect Risks to Property

The Master Plan Area includes several soils with high shrink-swell and linear extensibility potential. Ground-disturbing construction activities associated with this development on soils that have a high shrink-swell potential and/or linear extensibility could result in adverse effects such as damage to foundations from ground movement. Development and redevelopment projects within the 2035 Master Plan on soils that have a high shrink-swell potential and/or linear extensibility could result in shrinking and swelling of soils, which can cause damage to foundations. Thus, this impact would be **significant**.

As discussed in Section 3.7.2 and shown in Table 3.7-1, soil types range in shrink-swell potential from low to high. Further, the majority of soils in the plan area exhibit a range in linear extensibility from moderate to high, while a small area within the northwestern portion of the Master Plan Area exhibits very high linear extensibility (USDA 2019) (see Figure 3.7-2). Implementation of the 2035 Master Plan would include the construction of new facilities as well as replacement of existing facilities within the Master Plan Area, which could potentially occur within areas that consist of expansive soils. Development on soils that have a high shrink-swell potential and/or linear extensibility could result in adverse effects to structures. For instance, shrinking and swelling of soils can result in differential ground movement, which can cause damage to foundations. Because future development associated with the 2035 Master Plan would not result in changes to existing soils, this phenomenon would not be exacerbated though implementation of the 2035 Master Plan. However, projects that are proposed in areas where expansive soils are present could result in building damage, which could result in risks to life and property. All projects proposed under the 2035 Master Plan, would be subject to all applicable requirements outlined in the CBC, as well as the CSU Seismic Requirements. Nonetheless, because portions of the Master Plan Area are located within areas with linear extensibility of high to very high and high shrink-swell potential, this impact would be **significant**.

Mitigation Measures

Mitigation Measure 3.7-6: Perform Site-Specific Geotechnical Investigations

Implement Mitigation Measure 3.7-3, described above.

<u>Significance after Mitigation</u>

Mitigation Measure 3.7-6 would require a site-specific geotechnical investigation for all 2035 Master Plan projects proposed in areas determined to have a high potential for landsliding and other geologic hazards. The geotechnical investigation would require implementation of stabilization recommendations, such as fill selection, moisture control, and compaction during construction, that would reduce the potential impact on life and property resulting from expansive soils. This mitigation measure would reduce this potential impact associated with expansive soils to a **less-than-significant** level.

Impact 3.7-7: Directly or Indirectly Destroy a Unique Paleontological Resource or Site or Unique Geological Feature

Although the Master Plan Area is underlain by Franciscan Complex (KJf) and Young Surficial Deposits (Q_{ya}) deposits, which are not known to host paleontological resources, discoveries of yet unknown paleontological resources during ground-disturbing activities under development of the 2035 Master Plan could still occur. Thus, this impact would be **significant**.

As discussed in Section 3.7-2, above, the Master Plan Area is underlain by Franciscan Complex (KJf) deposits of the Coast Ranges and Young Surficial Deposits (Q_{ya}). The Franciscan Complex includes Cretaceous and Jurassic sandstone with smaller amounts of shale, chert, limestone, and conglomerate, which primarily consists of variably deformed and metamorphosed sandstone, graywacke, mudstone, and chert (DOC 2010). Because the Franciscan Complex formation is heavily deformed and metamorphosed in many locations, a process that destroys fossils, it is rare to find fossils within this deposit. Q_{ya} deposits consist of alluvial gravel and sand. This type of soil is typically too young to consist of significant paleontological resources.

Although unlikely, paleontological resources such as trace fossils, mollusks, and marine reptiles have been historically documented within the Franciscan Complex. For this reason, although there are no known paleontological resources, unique geologic formations, or sites are located within the Master Plan Area, a significant impact on paleontological resources could result if an inadvertent discovery is made during ground-disturbing activities associated with construction of development and redevelopment projects under the 2035 Master Plan. Therefore, the impact on paleontological resources would be **significant**.

Mitigation Measures

Mitigation Measure 3.7-7: Treatment of Paleontological Resources

If any paleontological resources are encountered during ground-disturbing activities, the construction contractor shall ensure that activities in the immediate area of the find are halted and Cal Poly informed. Cal Poly shall retain a qualified paleontologist to evaluate the discovery and recommend appropriate treatment options pursuant to guidelines developed by the Society of Vertebrate Paleontology, including development and implementation of a paleontological resource impact mitigation program for treatment of the resource, if applicable.

<u>Significance after Mitigation</u>

Mitigation Measure 3.7-8 would require retaining a qualified paleontologist to evaluate the discovery and the implementation of appropriate treatment, if a paleontological resource is found during ground-disturbing activities. This mitigation measure would reduce the potential impact associated with paleontological resources to a **less-than-significant** level.

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