

4.5 GEOLOGY AND SOILS

This section discusses the Project's potential impacts relating to geologic hazards. This section is partially based on the *Geotechnical Engineering Report* included in Appendix E.

4.5.1 Setting

a. Geological Setting.

Regional. The City of Goleta occupies a portion of the eight-mile long and three-mile wide flat alluvial plain known as the Goleta Valley (City of Goleta, 2006a). The Goleta Valley is a broad, flat alluvial plain bordered on the south by the bluffs of the Pacific coastline, and on the north by foothills and terraces of the foreland of the Santa Ynez Mountain Range. It generally slopes gently into the Goleta Slough, which is located in the south central portion of the valley (City of Goleta, 2004).

Project Site. The site is relatively flat to gently sloping with the exception of the moderately steep slopes that surround the stockpile soils that were previously placed along the perimeter of the archeological area in the center of the project site and the property lines. Topography within the archeological area is characterized by a modest ridge that trends generally northwest to southeast between 25 and 36 feet above sea level (ASL). Low-lying level soils drain generally to the south. Soil stockpiling has resulted in elevating surrounding topography to approximately 43 ASL. As a result, the central portion of the site has the highest elevations on the property and forms a ridge that divides the site drainage, with approximately half of the site draining in a westerly direction and half of the site draining in an easterly direction from the higher, center portion of the site.

Soils in the project area are mapped as Goleta fine sandy loam, 0% to 2% slopes, Milpitas-Positas fine sandy loam, 2% to 9% slopes, and Xerorthents (dry, shallow, erosional soils) cut and fill areas (United States Geological Survey, 1982). A sparse to moderate growth of weeds and brush covers the site. Vegetative cover on the site is variable and dependent upon the activity of the stockpile (Mac Design Associates, 2014). The project site's general subsurface profile consists of fill soils overlying alluvial soils. The fill soils are sands in a slightly moist to moist condition with a loose to medium dense consistency. The underlying alluvium was generally moist to wet layered sand, silt, and clay soils. The sands are loose to very dense, and the clays were very soft to hard. Fine to coarse gravel was also observed within the fill and alluvial soils. Subsurface water was encountered at approximate depths ranging from 22.5 to 38 feet below the existing ground surface.

b. Seismic and Other Geologic Hazards. Similar to much of California, the project site is located within a seismically active region. The Transverse Ranges are characterized by east-west trending structural features in contrast to the dominant northwest-southeast structural trend of California. The nearest confirmed, seismically active fault to the project site is the North Channel Slope Fault located four miles offshore. The closest Alquist-Priolo mapped earthquake fault is over 20 miles to the southeast (Pitas Point/Red Mountain Faults). The More Ranch Fault is located approximately 1 mile south of the Project site, and is characterized as active in the Santa Barbara County Comprehensive Plan Seismic Safety and Safety Element.

Other potential seismic hazards known to occur within the vicinity of the project site include ground rupture, ground acceleration, and liquefaction. The site is approximately 1.6 miles from the Pacific Ocean. The majority of the site is within a Potential Tsunami Runup Area according to the Goleta



General Plan/Coastal Land Use Plan (“General Plan”) Fire, Flood, and Tsunami Hazards Map (2006). The northwestern corner of the project site is outside of the Potential Tsunami Runup Area. Tsunamis are discussed further in Section 4.8, *Hydrology and Water Quality*.

Fault Rupture. Seismically-induced ground rupture occurs as the result of differential movement across a fault. An earthquake occurs when seismic stress builds to the point where rocks rupture. As the rocks rupture, one side of a fault block moves relative to the other side. The resulting shock wave is the earthquake. If the rupture plane reaches the ground surface, ground rupture occurs. Potentially active faults are those that have moved during the last 2.5 million years, but not during the last 10,000 years while active faults show evidence of movement within the last 10,000 years. No fault zones are located on the project site according to the General Plan Geologic Hazards Map (2006).

Groundshaking. The International Building Code (IBC) classifies structures into Seismic Design Categories, which involves more than the location of the structure as is the case with the Uniform Building Code (UBC). Seismic Design Categories includes classifications of A-F and are based on three criteria:

1. *Probable site ground motions, which is based on Federal Emergency Management Agency maps, the maximum spectral acceleration and the design acceleration response;*
2. *Soil site class, which are based on soil classifications A-F (hard rock, rock, very dense soil/soft rock, stiff soil, soft soil and special soil); and*
3. *Building occupancy use, which is broken down by four types – Type IV (agricultural buildings), Type III (essential buildings), Type II (structures that represent a substantial hazard in the event of a collapse), Type I (all other buildings).*

The process to determine the applicable Seismic Design Category must be done by an engineer.

Liquefaction and Seismically Induced Settlement. Liquefaction is a seismic phenomenon in which loose, saturated granular and non-plastic fine grained soils lose their structure/strength when subjected to high-intensity ground shaking. Liquefaction occurs when three general conditions exist:

1. *Shallow groundwater (within the top 50 feet of the ground surface);*
2. *Low density non-plastic soils; and*
3. *High intensity ground motion.*

These conditions are present at the project site and foundation soils may be subject to liquefaction. Loose granular soil can also settle (compact) during liquefaction and as pore pressures dissipate following an earthquake. According to the *Geotechnical Engineering Report* (Earth Systems Pacific, 2014, refer to Appendix E), soil borings and the results of six cone penetrometer test soundings indicate that there is a potential for liquefaction to occur in some layers of the saturated alluvial soils on the project site. If liquefaction were to occur at the site, the repercussions would likely be in the form of dynamic settlement (compression and loss of soil volume). Due to the relative thickness or depth of the overlying non-liquefiable soils and the site's relatively flat topography, loss of soil bearing and lateral spreading are not likely.

Settlement (total and differential) can occur when foundations and surface improvements span materials having variable consolidation characteristics, such as the soils on the project site with variable



in situ moisture and density. Such a situation could stress and possibly damage foundations and surface improvements, often resulting in severe cracks and displacement.

Expansive Soils. Soils with relatively high clay content are expansive due to the capacity of clay minerals to take in water and swell (expand) to greater volumes. According to the Earth Systems Pacific *Geotechnical Engineering Report*, previous expansion index testing of the clay soils produced values that place these soils in the "medium" expansion category. Expansive soils tend to swell with seasonal increases in soil moisture and shrink during the dry season as soil moisture decreases. The volume changes that the soils undergo in this cyclical pattern can stress and damage slabs and foundations if precautionary measures are not incorporated in design and in the construction procedure.

Corrosive Soils. Based on the Earth Systems Pacific *Geotechnical Engineering Report*, site soils are classified as "moderately corrosive to corrosive" to certain construction materials that would be in contact with the soils.

Erosive Soils. Soil erosion is the removal of soil by water and wind. Factors that influence erosion potential include the amount of rainfall and wind, the length and steepness of the slope, and the amount and type of vegetative cover. According to the Earth Systems Pacific *Geotechnical Engineering Report*, site soils are highly erodible.

c. Regulatory Setting. The California Building Code (CBC), the Alquist-Priolo Earthquake Fault Zoning Act, the Seismic Hazards Mapping Act, the Goleta General Plan, and the Goleta Municipal Code (GMC) prescribe measures to safeguard life, health, property and public welfare from geologic hazards. Each of these is described below:

California Building Code. California law provides a minimum standard for building design through the California Building Code (CBC) (C.C.R. Title 24). Chapter 23 of the CBC contains specific requirements for seismic safety. Chapter 29 regulates excavation, foundations, and retaining walls. Chapter 33 of the CBC contains specific requirements pertaining to site demolition, excavation, and construction to protect people and property from hazards associated with excavation cave-ins and falling debris or construction materials. Chapter 70 of the CBC regulates grading activities, including drainage and erosion control. Construction activities are subject to occupational safety standards for excavation, shoring, and trenching as specified in California Division of Occupational Safety and Health (Cal/OSHA) regulations (C.C.R. Title 8).

Alquist-Priolo Earthquake Fault Zoning Act. The Alquist-Priolo Earthquake Fault Zoning Act was signed into law in 1972 (Public Resources Code § 2621, et seq.; 14 C.C.R. §§ 3600, et seq.). The purpose of this Act is to prohibit the location of most structures for human occupancy across the traces of active faults and to thereby mitigate the hazard of fault rupture. Under the Act, the State Geologist identifies "Earthquake Fault Zones" along known active faults in California (14 C.C.R. §3601). Cities and counties affected by the zones must regulate certain development projects within the zones. They must withhold development permits for sites within the zones until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting (14 C.C.R. §3603).

Seismic Hazards Mapping Act. The California Geologic Survey, formerly the California Department of Conservation, Division of Mines and Geology (CDMG), provides guidance with regard to seismic hazards. Under CDMG's Seismic Hazards Mapping Act (1990), seismic hazard zones are to be identified and mapped to assist local governments in land use planning (Public Resources Code §§ 2690, et seq.). The intent of



these maps is to protect the public from the effects of strong ground shaking, liquefaction, landslides, ground failure, or other hazards caused by earthquakes. In addition, CDMG's Special Publications 117, "Guidelines for Evaluating and Mitigating Seismic Hazards in California," provides guidance for the evaluation and mitigation of earthquake-related hazards for projects within designated zones of required investigations.

City of Goleta Regulations. The Safety Element of the Goleta General Plan contains policies intended to reduce the potential for geologic hazards to adversely affect people and property, including the following:

- SE 1.3** ***Site-Specific Hazards Studies.** Applications for new development shall consider exposure of the new development to coastal and other hazards. Where appropriate, an application for new development shall include a geologic/soils/geotechnical study and any other studies that identify geologic hazards affecting the proposed project site and any necessary mitigation measures. The study report shall contain a statement certifying that the project site is suitable for the proposed development and that the development will be safe from geologic hazards. The report shall be prepared and signed by a licensed certified engineering geologist or geotechnical engineer and shall be subject to review and acceptance by the City.*

- SE 1.6** ***Enforcement of Building Codes. [GP]** The City shall ensure through effective enforcement measures that all new construction in the city is built according to the adopted building and fire codes.*

- SE 4.3** ***Geotechnical and Geologic Studies Required. [GP/CP]** Where appropriate, the City shall require applications for planning entitlements for new or expanded development to address potential geologic and seismic hazards through the preparation of geotechnical and geologic reports for City review and acceptance.*

- SE 4.5** ***Adoption of Updated California Building Code Requirements. [GP]** The City shall review, amend, and adopt new California Building Code requirements, when necessary, to promote the use of updated construction standards. The City shall consider and may adopt new optional state revisions for Seismic Hazards.*

The GMC adopts the most recent CBC and contains additional requirements for construction in the City (Chapter 15, Buildings and Construction) (15 GMC, § 15.01, et seq.).

4.5.2 Impact Analysis

a. Methodology and Significance Thresholds. Assessment of impacts is based on review of site information and conditions and City information regarding geologic issues. In accordance with the CEQA Guidelines, a project would result in a significant impact if it would:



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, or landslides;
2. Result on substantial soil erosion or the loss of topsoil;
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;
4. Be located on expansive soil, creating substantial risks to life or property; or
5. 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.

Per the City's *Environmental Thresholds and Guidelines Manual* (2002), impacts are classified as potentially significant with regard to geology if:

- A. The project site or any part of the project is located on land having substantial geologic constraints, as determined by Planning and Environmental Review or Public Works departments. Areas constrained by geology include parcels located near active or potentially active faults and property underlain by rock types associated with compressible/collapsible soils or susceptible to landslides or severe erosion. "Special Problems" areas designated by the Board of Supervisors have been established based on geologic constraints, flood hazards and other physical limitations to development;
- B. The project results in potentially hazardous geologic conditions such as the construction of cut slopes exceeding a grade of 1.5 horizontal to 1 vertical;
- C. The project proposes construction of a cut slope over 15 feet in height as measured from the lowest finished grade; and
- D. The project is located on slopes exceeding 20% grade.

Based on the *Geotechnical Engineering Report* and the geologic hazards mapping in the General Plan, geologic hazards posed by onsite septic systems, fault rupture, landslides, lateral spreading, and slopes exceeding 20% grade would be less than significant [*Thresholds A and D*]. In addition, the Project involves no construction of cut slopes exceeding a grade of 1.5:1 or construction of a cut slope over 15 feet in height [*Thresholds B and C*]. Consequently, impacts related to these thresholds would be less than significant and are discussed in Section 4.15, *Effects Found Not to be Significant*.

b. Project Impacts and Mitigation Measures.

Impact GEO-1 Project site soils are prone to liquefaction, which could cause settlement in a seismic event and expose on-site structures to property damage. Impacts would be Class II, significant but mitigable [*Thresholds 1 and 3*].

As discussed in Section 4.5.1, *Setting*, soil borings and the results of six cone penetrometer test soundings indicate that there is a potential for liquefaction to occur in some layers of the saturated



alluvial soils on the project site. Liquefaction could result in settlement that could cause property damage.

The combined magnitude of both liquefaction and seismically induced settlement would be less than four inches. The magnitude of differential settlement was estimated to be less than two inches. As described in the *Geotechnical Engineering Report* (Earth Systems Pacific, 2014), settlement resulting from liquefaction and seismic activity may damage foundations and surface improvements if grading of the project site is not completed to the recommendations in the *Geotechnical Engineering Report*. Therefore, this impact is potentially significant, and mitigation is required to ensure that grading is completed to the recommendations of the *Geotechnical Engineering Report*.

Mitigation Measure. Mitigation Measure GEO-1 would reduce impacts related to seismically induced liquefaction to a less than significant level. To reduce the potential for settlement within the archaeological area, special grading techniques will need to be implemented to minimize the impact of site development in this area. Accordingly, recommendations from the *Geotechnical Engineering Report* for the archaeological area and buffer zone are included in Mitigation Measure GEO-1.

GEO-1 Geotechnical Design Considerations. The recommendations in the *Geotechnical Engineering Report* (Earth Systems Pacific, 2014) related to soil engineering within and outside of the Archaeological Area must be incorporated into the Project's grading and building plans, as summarized here:

Areas Outside the Archaeological Area:

- *All existing fill soils should be completely removed and replaced as compacted fill Any existing utilities that will not be serving the site must be removed or properly abandoned*
- *Voids created by the removal of materials or utilities, and extending below the recommended overexcavation depth, must be immediately called to the attention of the geotechnical engineer. No fill may be placed unless the geotechnical engineer has observed the underlying soil*
- *Following site preparation, soils in the building area should be removed to a level plane at a minimum depth of 3 to 8 feet below the bottom of the deepest footing or 3 to 8 feet below existing grade, whichever is deeper, as recommended by the geotechnical engineer in the field*
- *Soils in the surface improvement area should be removed to a level plane at a minimum depth of 1-foot below the proposed subgrade elevation or 2 feet below the existing ground surface, whichever is deeper*
- *Soils in the fill areas beyond the building and surface improvement areas should be removed to a depth of 2 feet below the existing ground surface*
- *Stabilization of surface soils by vegetation or other means during and following construction must be implemented, particularly those disturbed during construction*

Areas Inside the Archaeological Area, including the 50-foot Archaeological Buffer Zone:



- *Existing ground surface in the grading area inside of the archaeological area should be prepared for construction by removing the stockpile soils and all other existing fill soils down to the native soil surface*
- *All vegetation, debris, and other deleterious material should be removed from the native soil surface by hand (can include brushing, raking, or the use of a power blower) to the degree practicable at the ground surface such that no soil disturbance occurs*
- *Remnants of the vegetation should then be sprayed with topical herbicide per manufacturer's specifications approximately 60 days prior to implementing grading operations*
- *Root ball masses must be left in place to die*
- *Any existing utilities that will not be serving the site must be removed or properly abandoned. The appropriate method of utility abandonment will depend upon the type and depth of the utility*
- *Surface vegetation removal and herbicide application must be accomplished 60 days prior to the geogrid placement; it is acceptable to place import sand on the native soil surface where uneven areas or undulations exist to create as level a surface as practicable to place the geogrid on as it improves both the constructability and performance of the geogrid system*
- *The native soil surface must be covered with a tri-axial geogrid such as Tensar TX 7, or an approved equivalent. The geogrid must be anchored and/or overlapped as recommended by the manufacturer prior to placing any fill soil*
- *The first 6 inches of fill placed on top of the geogrid must be an imported sand material reviewed and approved by the City of Goleta to provide a visual indication to avoid impeding into the native soils*
- *Fill soils must be placed and spread from the outside to the inside of the archeological area with track earthmoving equipment such that the equipment must only be working on top of the fill soils. The fill soils must be placed such that the earthmoving equipment does not come into contact with the archeological area native soils or the geogrid*

Grading (General):

- *On-site material and approved import materials may be used as general fill and up to 18 inches below the bottom of the slab-on-grade elevation within the building area where conventional foundations will be used*
- *A minimum of 18 inches of nonexpansive material when measured from the bottom of the conventional foundation slabs-on-grade should be placed in the building area*
- *Proposed imported soils should be evaluated by a geotechnical engineer before being used, and on an intermittent basis during placement on the site*
- *All materials used as fill should be cleaned of any debris and rocks larger than 6 inches in diameter, and no rocks larger than 3 inches in diameter should be used within the upper 3 feet of finish grade*
- *Fill slopes should be keyed and benched into competent soil*



- *Slopes under normal conditions should be constructed at 2:1(horizontal to vertical) or flatter inclinations. Slopes subject to inundation should be constructed at 3:1 or flatter inclinations*
- *Stabilization of surface soils by vegetation or other means during and following construction must be implemented, particularly those disturbed during construction*

If the portions of the site cannot be graded to those recommendations, rigid mat foundations should be used in lieu of conventional foundation systems.

Foundations:

- *Foundations must not be constructed within 10 feet of LID drainage improvements. If this is not the case, the geotechnical engineer must review the type of LID drainage improvement planned within 10 feet of a foundation to ascertain if revised and/or supplemental foundation recommendations are needed*
- *Conventional and Rigid Mat Foundations systems must be engineered in accordance with the recommendations contained in the Geotechnical Engineering Report (Earth Systems Pacific, 2014)*

Plan Requirements and Timing. Grading and building plans must be submitted for review and approval by the Planning and Environmental Review Director or designee before the City issues grading and building permits.

Monitoring. The Project soils engineer must observe all excavations before placement of compacted soil, gravel backfill, or rebar and concrete and report observations to the City. The City will conduct field inspections as needed.

Significance After Mitigation. Implementation of Mitigation Measure GEO-1 would reduce potential impacts due to liquefaction resulting in settling of soils on the site to a less than significant level by requiring removal of onsite soils, moisture conditioning, and compaction of surfaces before placing appropriate fill soils or a rigid mat foundation system. As noted above, Mitigation Measure GEO-1 includes special grading techniques to minimize the impact of site development in the archaeological area.

Impact GEO-2 **Expansive soils are present on the project site, which could damage slabs and foundations. Impacts would be Class II, significant but mitigable [Threshold 4].**

As discussed in Section 4.5.1, *Setting*, according to the Earth Systems Pacific *Geotechnical Engineering Report*, previous expansion index testing of the clay soils on the project site produced values that place these soils in the “medium” expansion category. Expansive soils tend to swell with seasonal increases in soil moisture and shrink during the dry season as soil moisture decreases. The volume changes that the soils undergo in this cyclical pattern can stress and damage slabs and foundations if precautionary measures are not incorporated in design and in the construction procedure. Impacts would be potentially significant.



Mitigation Measure. The recommendations in the *Geotechnical Engineering Report* (Earth Systems Pacific, 2014) related to removal of existing fill, site grading, and foundation design, which are required by Mitigation Measure GEO-1, would reduce impacts related to expansive soils to a less than significant level.

Significance After Mitigation. Implementation of Mitigation Measure GEO-1 would reduce potential impacts due to expansive soils to a less than significant level by requiring non-expansive materials or a rigid mat foundation system to be placed below all building areas.

Impact GEO-3 Soils on the project site are highly erodible. On-site development may increase soil erosion on the project site during and after construction. Impacts would be Class II, significant but mitigable [Threshold 2].

The Project would involve construction of 360 dwelling units and associated landscaping and hardscape. Based on information provided in the Project grading plan, the amount of stockpiled dirt on the Project site totals 293,100 cubic yards. Of this 293,100 cubic yards, a total of 115,000 cubic yards of soil would be exported off-site before construction of the Project. Excavation and grading could result in erosion of soils and sedimentation. During grading and soil storage, there is the potential for soil migration offsite via wind entrainment and/or water erosion.

Impacts would be minimized during all phases of Project construction through compliance with a City-issued Grading Permit (this permit is described in Section 4.8, *Hydrology and Water Quality*). To comply with this permit, the applicant would be required to prepare and implement a Stormwater Pollution Prevention Plan (SWPPP), which must include erosion and sediment control BMPs that would meet or exceed measures required by the City-issued Grading Permit, as well as BMPs that control other potential construction-related pollutants. Erosion control BMPs are designed to prevent erosion, whereas sediment controls are designed to trap sediment once it has been mobilized. Examples of BMPs that may be implemented during construction include the use of geotextiles and mats, temporary drains and swales, silt fences and sediments traps. Erosion control practices may include the use of drainage controls such as down drains, detention ponds, filter berms, or infiltration pits; removal of any sediment tracked offsite within the same day that it is tracked; containment of polluted runoff onsite; use of plastic covering to minimize erosion from exposed areas; and restrictions on the washing of construction equipment.

A SWPPP would be developed for the Project as required by, and in compliance with, the City-issued Grading Permit and City regulations, including grading regulations. The Construction General Permit requires the SWPPP to include a menu of BMPs to be selected and implemented based on the phase of construction and the weather conditions to effectively control erosion and sediment using the Best Available Technology Economically Achievable and Best Conventional Pollutant Control Technology (BAT/BCT). As development implementation of an SWPPP is a standard requirement that would apply to the Project.

Nonetheless, soils on the project site are highly erodible. Implementation and maintenance of proper drainage and the stabilization of surface soils, particularly those disturbed during construction, by vegetation or other means during and following construction are necessary to reduce the potential of erosion damage. Impacts would be potentially significant.



Mitigation Measure. The recommendations in the *Geotechnical Engineering Report* (Earth Systems Pacific, 2014) related to grading, drainage and landscape maintenance, which are required by Mitigation Measure GEO-1, would reduce impacts related to soil erosion to a less than significant level.

Significance After Mitigation. Implementation of Mitigation Measure GEO-1 would reduce potential impacts related to soil erosion to a less than significant level by requiring soils exposed by grading to be stabilized with vegetation or other materials during and following construction.

c. Cumulative Impacts. Cumulative projects proposed in and around Goleta (refer to Section 3.0, *Related Projects*) would expose additional people and property to seismic and geologic hazards that are present in the region. The magnitude of geologic hazards for individual projects would depend upon the location, type, and size of development and the specific hazards associated with individual sites. Any specific geologic hazards associated with each individual site would be limited to that site without affecting other areas. In addition, existing regulations, including compliance with CBC requirements, would reduce seismic and geologic hazards to acceptable levels. Seismic and geologic hazards would be addressed on a case-by-case basis and would not result in cumulatively considerable impacts. Cumulative geologic hazard impacts would be less than significant and the Project's contribution would not be cumulatively considerable.

