4.6 Geologic Processes

4.6.1 Existing Setting

Geologic resources include mineral deposits, important landforms, and tectonic features. Disturbances to geological resources may result in geological hazards such as landslides, unstable soils, and/or faulting. These hazards may present substantial obstacles to new development depending on severity. Two site-specific geotechnical evaluations were conducted for the Project site (Campbell Geo, Inc. 2012; Padre Associates, Inc. 2013).

The Project site is located in Carpinteria, California, which is a geologically complex and seismically active region in the County of Santa Barbara. The Project site is located within the Transverse Ranges Geomorphologic Province of California. East-west trending faults, folds, and mountain ranges characterize the Transverse Ranges Province. The Transverse Ranges Province extends from southwestern San Bernardino County westward through northern Los Angeles County and Ventura County, terminating at the Pacific Ocean near Point Arguello in western Santa Barbara County. The Transverse Ranges Province is extensively faulted with known active faults. Rock types in the foothill areas north, west, and east of the Project vicinity are mainly comprised of Quaternary (within the last 1.6 million years) and Tertiary (between 1.6 and 65 million years ago) aged marine and non-marine sandstones, shales, siltstones, claystones, and conglomerates.

The Project site is bounded to the east, north and northwest by the foothills of the Santa Ynez Mountains. The peaks and ridges of the adjacent foothills bounding the site range from approximately 600 to 2,000 feet above mean sea level (msl). In general, topography of the area slopes towards the south to southwest. Drainages in the area of the Project site include Carpinteria Creek to the west and Gobernador Creek to the southeast.

The Project site is located on a mesa at the base of the south flank of the Santa Ynez Mountains. The topography of the main campus is gently sloping to flat with the overall slope to the south and southwest. The current faculty housing and childcare center are located on the southern slope of the mesa where slopes exceeding 20 percent are present. Topography on site ranges from 160 feet msl near the creeks to 390 feet msl at the top of the mesa. Localized Pleistocene Fanglomerate deposits composed of sandstone cobbles and boulders within a silty to clayey sand matrix underlie the Project site, and overlie Oligocene-aged rocks of the Sespe Formation. Artificial fill from 3 to 10 feet deep overlies portions of the campus.

4.6.1.1 Geologic Hazards

Faulting

Some of the larger faults in or near the region that could affect the Project site include the San Andreas, San Cayetano, Oak Ridge, Ventura-Pitas Point, Arroyo-Parida, Red Mountain, and Santa Ynez faults. There are also many smaller localized faults throughout the region. Some of the smaller faults in the Project vicinity include the Rincon Creek, Carpinteria, Holloway, and Shepard Mesa faults. All of these faults in the province are considered potentially active.

There are currently no known active faults occurring through the Project site, however previous studies have indicated a projected trace of the Shepard Mesa fault through Cate School (County of

Santa Barbara 2015). The Shepard Mesa fault, however, is not listed as an active fault in the County's Seismic Safety and Safety Element. Additional features suggestive of recent faulting have not been observed.

Expansive Soils

Expansive soils cause problems because they contain clay minerals that swell when the moisture content increases and shrink when the moisture decreases. Such soils are described as "adobe," and form ground cracks when they are allowed to dry out. The volume changes resulting from variable moisture conditions can cause movement and cracking of structures built on expansive soils. Soils beneath concrete floor slabs tend to increase in moisture content, thus causing heave. Soils under raised floors tend to dry out and shrink, causing settlement of the structure. Expansive soils are fairly common in the County of Santa Barbara.

Liquefaction

Liquefaction is the almost complete loss of strength of saturated sandy soil accompanying ground shaking during an earthquake. The seismic shock waves densify loose, saturated, granular soil causing a reduction in the pore space between the sand grains. This transfers the intergranular load to the pore water and results in a temporary loss of strength. On relatively level ground this may cause the water to rise to the ground surface, usually carrying sand with it and forming sand "boils," which are familiar features where liquefaction occurs as a result of strong ground motion. On sloping ground, liquefaction will usually result in slope failure.

There is no historic evidence of liquefaction in the County of Santa Barbara; most of the valley bottoms underlain by alluvium are considered at moderate risk with respect to liquefaction potential by the Santa Barbara County Comprehensive Plan Seismic Element. This rating is largely based on the probable depth to groundwater with consideration given to probable soil characteristics (i.e., classification, grain size, density) and probable earthquake intensity and duration (County of Santa Barbara 2009).

Subsidence

Subsidence refers to deep-seated settlement due to the withdrawal of fluids (water, oil, natural gas). It is most commonly caused by the lowering of the water table and tends to cover broad areas. According to the Santa Barbara County Comprehensive Plan, no evidence of significant subsidence or problems related to subsidence has been reported in the coastal regions of Santa Barbara County (County of Santa Barbara 2009).

Soil Creep

Soil creep is the slow downslope movement of surficial soils. It involves clayey soils and is due, at least in large part, to the volume changes from cyclic wetting and drying. Although soil creep can be a serious problem, it usually occurs on, or within a few feet of, slopes so that most structures are protected by the required building setbacks. During periods of heavy and prolonged rains, the soils may become saturated and slump—a small shallow form of landslide involving only the upper few feet of surficial material. One of the major problems in hillside construction is slope stability. Much the County of Santa Barbara is mountainous or hilly with variable complex geologic conditions; thus, slope stability can be a problem in areas of potential development.

Landslides and Slope Stability

The stability of slopes is a complex function of the height and steepness of slopes, the inherent strength of the basic material underlying the slopes, and the presence and orientation of geologic planes of weakness such as bedding, joints, and faults. The surface and subsurface moisture conditions, weathering, and temporal effects are important factors also in determining slope stability. Much the County of Santa Barbara is mountainous or hilly with variable and complex geologic conditions; thus, slope stability can be a problem in areas of potential development.

Tsunami and Seiches

Tsunamis are sea waves that are caused by submarine or coastline earthquakes. These are relatively low and harmless in the open ocean, but can reach substantial heights when they approach shallow water depths near shore. Tsunamis can travel hundreds or thousands of miles and maintain enough energy to be destructive. Seiches are waves that are generated in an inland body of water by earthquakes. The Project site is located approximately 1.6 miles inland from the Pacific Ocean and at least 160 feet above msl.

Seiches can affect bodies of water as small as swimming pools, but would generally cause major damage only to developed areas surrounding, or downstream from, large lakes. In addition to small waves initiated by ground shaking that might affect the local shoreline, larger waves can be generated by large landslides triggered by an earthquake. These waves could overtop a dam and cause serious damage to property lying downstream. There are several lakes in the County, the largest being Lake Cachuma. Carpinteria Reservoir is located approximately 0.28 mile west of the Project site.

4.6.1.2 Regulatory Setting

State of California's geology resource policies that apply to the proposed Project include:

- The *Alquist-Priolo Earthquake Fault Zoning Act of 1972* regulates development and construction of buildings intended for human occupancy to avoid the hazard of surface fault rupture. Any project that involves the construction of buildings or structures for human occupancy, such as an operation and maintenance building, is subject to review under the Alquist-Priolo Earthquake Fault Zoning Act, and any structures for human occupancy must be located at least 50 feet from any active fault.

- The *Seismic Hazards Mapping Act of 1990* is intended to reduce the threat to public health and safety and to minimize the loss of life and property by identifying and mitigating seismic hazards. Cities, counties, and state agencies are directed to use seismic hazard zone maps developed by CGS in their land-use planning and permitting processes. Site-specific geotechnical investigations must be performed prior to permitting urban development projects within seismic hazard zones.

- The *California Building Code (CBC)* provides minimum standards for building design. In accordance with the CBC, a grading permit is required if more than 50 cubic yards (cy) of soil are moved during implementation of a project. Chapter 16 of the CBC contains definitions of seismic sources and the procedure used to calculate seismic forces on structures.

- The *California Coastal Act of 1979* serves to protect and preserve coastal resources, which includes those geologic resources threatened by any development to be located within the Coastal Zone. Section 30253 of the California Coastal Act requires that new developments within the Coastal Zone shall:

1. Minimize risk to life and property in areas of high geologic, flood, and fire hazard.
2. Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.

County of Santa Barbara policies and requirements for geological processes that apply to the proposed Project include:

- The *County of Santa Barbara Comprehensive Plan Seismic Safety and Safety Element* provides pertinent data regarding geologic, soil, seismic, fire, and flood hazards. Geologic, soil, and seismic factors affect the suitability of land for various uses and, hence, should be considered, along with other factors, in land use planning in order to eliminate or minimize their adverse effects. Geologic and Seismic Goal 1 applies to the proposed Project:
    - *Geologic and Seismic Goal 1* aims to protect the community to the extent feasible from risks associated with the effects of seismically induced incidents by requiring*: (Protection Policy 1)* the County minimizes the potential effects of geologic, soil, and seismic hazards through the development review process; *(Protection Policy 2*) it shall refer to the CBC, the Land Use Development Code (LUDC), County Ordinances, the Coastal Land Use Plan (CLUP), and the Comprehensive Plan when considering the siting and construction of structures in seismically hazardous areas; *(Protection Policy 3)* the County shall ensure compliance with state seismic and building standards in the evaluation, design, and siting of critical facilities; *(Protection Policy 4)* the Office of Emergency Services (OES) shall continue coordinating emergency planning for the Santa Barbara Operational Area pursuant to the California Emergency Services Act of 1970; and lastly *(Protection Policy 5)* the County shall require a preliminary soil report prepared by a qualified civil engineer be submitted at the time a tentative map is submitted.
- *County of Santa Barbara Comprehensive Plan Environmental Resource Management Element* summarizes the various environmental factors analyzed in the Seismic Safety and Safety, Conservation, and Open Space Elements. This element states that urbanization should be prohibited on slopes 30 percent and greater and should be prohibited, except in a relatively few special instances on slopes between 20 and 30 percent.
- *County of Santa Barbara Comprehensive Plan Coastal Land Use Plan* lays out the general patterns of development throughout the coastal areas of the County. Its purpose is to protect coastal resources while accommodating land use development within the coastal zone. Policies outlined in the CLUP that are applicable to the Project are listed below:
    - **Policy 3-8:** Applications for grading and building permits, and applications for subdivision shall be reviewed for adjacency to, threats from, and impacts on geologic hazards arising from seismic events, tsunami runup, landslides, beach erosion, or other geologic hazards such as expansive soils and subsidence areas. In areas of known geologic hazards, a geologic report shall be required. Mitigation measures shall be required where necessary.
    - **Policy 3-13:** Plans for development shall minimize cut and fill operations. Plans requiring excessive cutting and filling may be denied if it is determined that the development could be carried out with less alteration of the natural terrain.

- **Policy 3-14:** All developments shall be designed to fit the site topography, soils, geology, hydrology, and any other existing conditions and be oriented so that grading and other site preparation is kept to an absolute minimum. Natural features, landforms, and native vegetation, such as trees, shall be preserved to the maximum extent feasible. Areas of the site which are not suited to development because of known soil, geologic, flood, erosion or other hazards shall remain in open space.
- **Policy 3-15:** For necessary grading operations on hillsides, the smallest practical area of land shall be exposed at any one time during development, and the length of exposure shall be kept to the shortest practicable amount of time. The clearing of land should be avoided during the winter rainy season and all measures for removing sediments and stabilizing slopes should be in place before the beginning of the rainy season.
- **Policy 3-16***: Sediment basins (including debris basins, desilting basins, or silt traps) shall be installed on the project site in conjunction with the initial grading operations and maintained throughout the development process to remove sediment from runoff waters. All sediment shall be retained on site unless removed to an appropriate dumping location*
- **Policy 3-17:** Temporary vegetation, seeding, mulching, or other suitable stabilization method shall be used to protect soils subject to erosion that have been disturbed during grading or development. All cut and fill slopes shall be stabilized as rapidly as possible with planting of native grasses and shrubs, appropriate non-native plants, or with accepted landscaping practices.

- *County of Santa Barbara Grading Code* (Ord. No. 4766, 11-9-2010 of County Code of Ordinance) addresses compliance with the National Pollutant Discharge Elimination System (NPDES) Phase II storm water regulations and sets forth local storm water requirements for the disturbance of less than 1 acre, to avoid pollution of water courses and drainage ways with sediments or other pollutants generated on or caused by surface runoff on or across a construction site.
- *County of Santa Barbara Building Code Chapter 10* (Ord. No. 4822, 1-17-2012) addresses geological, topographical, and climatic conditions in the County including extreme weather conditions, firefighting resources, flammable vegetation, High Hazard Areas, extreme wind conditions, and seismic shaking and the minimum standards to safeguard and protect life, buildings, and structures within the County.

4.6.2 Impact Analysis

This section reviews the analysis and mitigation measures from the Scoping Document and MND. The construction and operation of the Project may result in potential geological hazard impacts associated as summarized in Table 4.6-1 below.

Table 4.6-1. Summary of Geologic Resources Impacts

Geologic Processes Impacts	Mitigation Measures	Residual Significance
Impact GEO-1. The Project would not expose people to landslides, earthquakes, liquefaction, soil creep, mudslides, ground failure, or other geologic hazards during construction or operation.	MM GEO-1	Less than significant with mitigation (Class II)
Impact GEO-2. Development of facilities adjacent to steep slopes could result in impacts to erosion and sedimentation.	MM WAT-3b MM WAT-3c MM GEO-1 MM GEO-2	Less than significant with mitigation (Class II)

4.6.2.1 Thresholds of Significance

In accordance the County of Santa Barbara Environmental Thresholds and Guidelines Manual, impacts related to geological resources may be significant if the Project involves any of the following characteristics:

a. The Project site or any part of the Project is located on land having substantial geologic constraints, as determined by Planning and Development. 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.

d. The Project is located on slopes exceeding 20 percent grade.

4.6.2.2 Project Impacts

Impact GEO-1. The Project would not expose people to landslides, earthquakes, liquefaction, soil creep, mudslides, ground failure, or other hazards during construction or operation.

The Project site is not underlain by any known active or potentially active faults; however, the Project could be exposed to ground shaking as a result of earthquakes. Earthquakes have the potential to cause severe damage to buildings and infrastructure. However, such seismic hazards are common throughout California and while measures can be taken to reduce potential structural damage, nothing can be done to absolutely ensure that structures do not fail during significant seismic events.

Other unstable earth conditions—including expansive soils, liquefaction, ground failure, subsidence, soil creep, and landslides—have the potential to occur in various regions throughout the County. The geotechnical evaluation identified the Project site as having a medium expansion potential, and provides construction recommendations that would reduce this impact to a less than significant level. Liquefaction and ground failure potential in the area has been determined to be low (Padre Associates 2013). Compliance with Santa Barbara County Comprehensive Plan goals and policies, as well as Title

24 of the CBC and Section 30253 of the California Coastal Act, would require an assessment of hazards related to unstable earth conditions prior to final design and approval, as well as the incorporation of design measures to address hazards if development were considered feasible. The approved geotechnical investigation provides recommendations for appropriate foundation design and incorporation of these recommendations along with proper engineering measures, in accordance with existing state and county regulations. Compliance with these requirements would be ensured through the normal building permit review and inspection process, minimizing geologic hazards and risks. In addition, MM GEO-1, *Geotechnical Study*, would further ensure that recommendations contained within the geotechnical study are implemented. This would reduce the exposure of persons to geologic hazards. Therefore, impacts associated with landslides, earthquakes, liquefaction, soil creep, mudslides, ground failure, or other hazards would be *less than significant with mitigation* (Class II).

Impact GEO-2. Development of facilities adjacent to steep slopes could result in impacts to erosion and sedimentation.

While the main campus area is generally level or gently sloping, development of the Project involves grading that has the potential to modify site topography. The Project proposes multiple dormitories immediately adjacent to a steep descending slope at the western end of the campus mesa. In addition, the proposed five new faculty single-family dwellings concentrated within the faculty housing cluster would be located on a vegetated slope with slopes exceeding 20 percent in areas, and would require cut and fill techniques. Development of the Project would result in a total of 85,460 cy of cut and 71,950 cy of fill, for a total estimated grading quantity of 157,410 cy, including over excavation and re-compaction. These efforts are expected to reduce the need for imported material from 7,880 cy to 2,000 cy and for export of material from 21,540 cy to 5,000 cy. Grading would remove vegetative cover and disturb the ground surface, exposing bare slopes and thereby increasing the potential for erosion and sedimentation impacts. However, the potential for the Project to cause substantial erosion and sediment transport would be adequately mitigated by MM WAT-3b, *Sediment and Contamination Containment*, and MM WAT-3c, *Erosion and Sediment Control Revegetation*.

The Geotechnical Study prepared by Padre Associates (2013) and the Geologic Hazards Evaluation prepared by Campbell Geo (2012) provide recommendations for appropriate foundation design in order to ensure that the buildings are not exposed to geologic hazards such as slope instability. Implementation of these recommendations through MM-GEO-1, *Geotechnical Study,* would adequately mitigate potential impact from development on or adjacent to steep slopes, and achieve consistency with the guidelines set forth in ERME and with CLUP Policy 3-14. Compliance with the CBC through normal building permit review and inspection process would ensure structural stability of development on sloping topography. Approval of the Project would require an Erosion and Sediment Control Plan to reduce grading impacts and ensure compliance with regulatory standards. Compliance with county standard erosion control and drainage requirements during and after construction and MM GEO-2, *Erosion and Sediment Control Plan*, would reduce the Project's potential to cause substantial erosion and sediment transport. All other soils-related hazards would be reduced to a less than significant level through the normal building permit review and inspection process. Therefore, impacts to erosion and sedimentation would be *less than significant with mitigation* (Class II).

4.6.2.3 Mitigation Measures

The following mitigation measures would reduce the Project's geologic resource impacts to a less than significant level:

MM WAT-3b, *Sediment and Contamination Containment* would apply (see Section 4.13, *Water Resources/Flooding*)

MM WAT-3c, *Erosion and Sediment Control Revegetation* would apply (see Section 4.13, *Water Resources/Flooding*)

MM GEO-1 ***Geotechnical Study.*** *The Applicant shall follow the recommendations outlined in the Geotechnical Study prepared by Padre Associates (January 2013) and the Geologic Hazards Evaluation prepared by Campbell Geo (April 2012) related to the dormitory buildings to ensure appropriate foundational design and other structural design criteria.*

Plan Requirements and Timing. Elements of the reports shall be reflected on grading and building plans as required. Plans shall reflect required structural design criteria prior to Zoning Clearance issuance for each applicable phase of development.

Monitoring. The Applicant shall demonstrate that submitted plans conform to required study components. Grading and building inspectors shall ensure compliance in the field.

MM GEO-2 ***Erosion and Sediment Control Plan.*** *Where required by the latest edition of the California Green Code and/or Chapter 14 of the County of Santa Barbara Code, a Storm Water Pollution Prevention Plan (SWPPP), Storm Water Management Plan (SWMP) and/or an Erosion and Sediment Control Plan (ESCP) shall be implemented as part of the Project. Grading and erosion and sediment control plans shall be designed to minimize erosion during construction and shall be implemented for the duration of the grading period and until re-graded areas have been stabilized by structures, long-term erosion control measures or permanent landscaping. The Applicant shall submit the SWPPP, SWMP or ESCP using Best Management Practices (BMP) designed to stabilize the site, protect natural watercourses/creeks, prevent erosion, convey storm water runoff to existing drainage systems keeping contaminants and sediments onsite. The SWPPP or ESCP shall be a part of the Grading Plan submittal and will be reviewed for its technical merits by Planning and Development.*

Plan Requirements and Timing. The grading and SWPPP, SWMP and/or ESCP shall be submitted for review and approved by Planning and Development prior to approval of zoning clearances. The plan shall be designed to address erosion, sediment and pollution control during all phases of development of the site until all disturbed areas are permanently stabilized.

The SWPPP requirements shall be implemented prior to the commencement of grading and throughout the year. The ESCP/SWMP requirements shall be implemented between November 1st and April 15th of each year, except pollution control measures shall be implemented year round.

Monitoring. Planning and Development staff shall perform site inspections throughout the construction phase.

4.6.2.4 Residual Impacts

With the incorporation of mitigation measures MM WAT-3b, *Sediment and Contamination Containment*, and MM WAT-3c, *Erosion and Sediment Control* Revegetation, and MM GEO-1, *Geotechnical Study*, and GEO-2, *Erosion and Sediment Control Plan,* residual impacts to geologic resources would be *less than significant with mitigation* (Class II).

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