SECTION 3.4
GEOTECHNICAL/SOILS

3.4 GEOTECHNICAL/SOILS

3.4.1 INTRODUCTION

This section is based on a geotechnical input report prepared for the Proposed Project by Southland Geotechnical Consultants (May 2009). The geotechnical report evaluated the geologic hazards, soil engineering properties, and pedologic characteristics of the Project site, and identified potential geotechnical constraints to the Proposed Project. As further discussed below, based on the geotechnical studies, the geotechnical conditions in the Project area would not significantly impact the Proposed Project if appropriate geotechnical design recommendations, developed from site-specific geotechnical investigations, are included in the Project's design and construction. The geotechnical report is presented in its entirety in **Appendix 3.4** of this EIR.

3.4.2 METHODOLOGY

The methodology utilized to prepare the geotechnical report included the following:

- Review of geologic maps, literature and aerial photographs pertaining to the Project site and general vicinity;
- Review of existing geotechnical reports for portions of the Project site and nearby properties;
- Field reconnaissance of the existing surficial soils and geologic conditions in the Project area; and,
- Geotechnical analysis of the data obtained.

The geotechnical report is based on Southland Geotechnical Consultants' review of information presented in existing geologic/geotechnical literature, including geotechnical reports previously prepared for other projects at SDSU, and their experience with SDSU projects and properties with similar geotechnical conditions.

3.4.3 EXISTING CONDITIONS

3.4.3.1 General Geologic Setting

The Project site, the SDSU campus, and the City of San Diego all are located in the coastal section of the Peninsular Ranges geomorphic province. The northwesterly-trending mountain ranges of this province generally are underlain by basement rocks consisting of Jurassic metamorphic rocks intruded by Cretaceous igneous rocks of the southern California batholith. During the past 54 million years, the western, coastal flank of this mountainous area has experienced several episodes of marine inundation and subsequent regression. This ebb and flow resulted in deposition of a thick sequence of marine and nonmarine sediments (e.g., claystones, siltstones, sandstones and conglomerates) on the basement rocks. Lower base levels, a result of post-Pleistocene, sea-level lowering, allowed stream erosion to create the relatively steep, deeply-incised canyons present in the area.

3.4.3.2 Geologic/Soil Units

The geologic and soil units underlying the Project site and nearby vicinity have been mapped and investigated by various geologists and geotechnical consultants. Detailed descriptions of the geologic/soils units encountered by these geologists and consultants are provided in various geologic/geotechnical documents for the campus area. Relevant geotechnical information from these previous evaluations is included within this analysis.

A general overview of the area's geologic composition is contained in **Figure 3.4-1, Geologic Map**, taken from Kennedy and Peterson's "Geology of the La Mesa Quadrangle, San Diego County, California." Additionally, summary descriptions of the geologic/soil units underlying the Project area, presented in order of increasing age, are set forth below.

3.4.3.2.1 Existing Fill Soils

Development of the SDSU campus and surrounding areas has included the placement of fill in various locations, and the infilling of previously existing canyons. For example, to the northeast of the Project site, College Avenue descends from the mesa along the approximate location of one of these previously filled canyons. Fill soils also were placed on portions of the Project site during previous grading. The fill soils in the Project area primarily appear to be comprised of

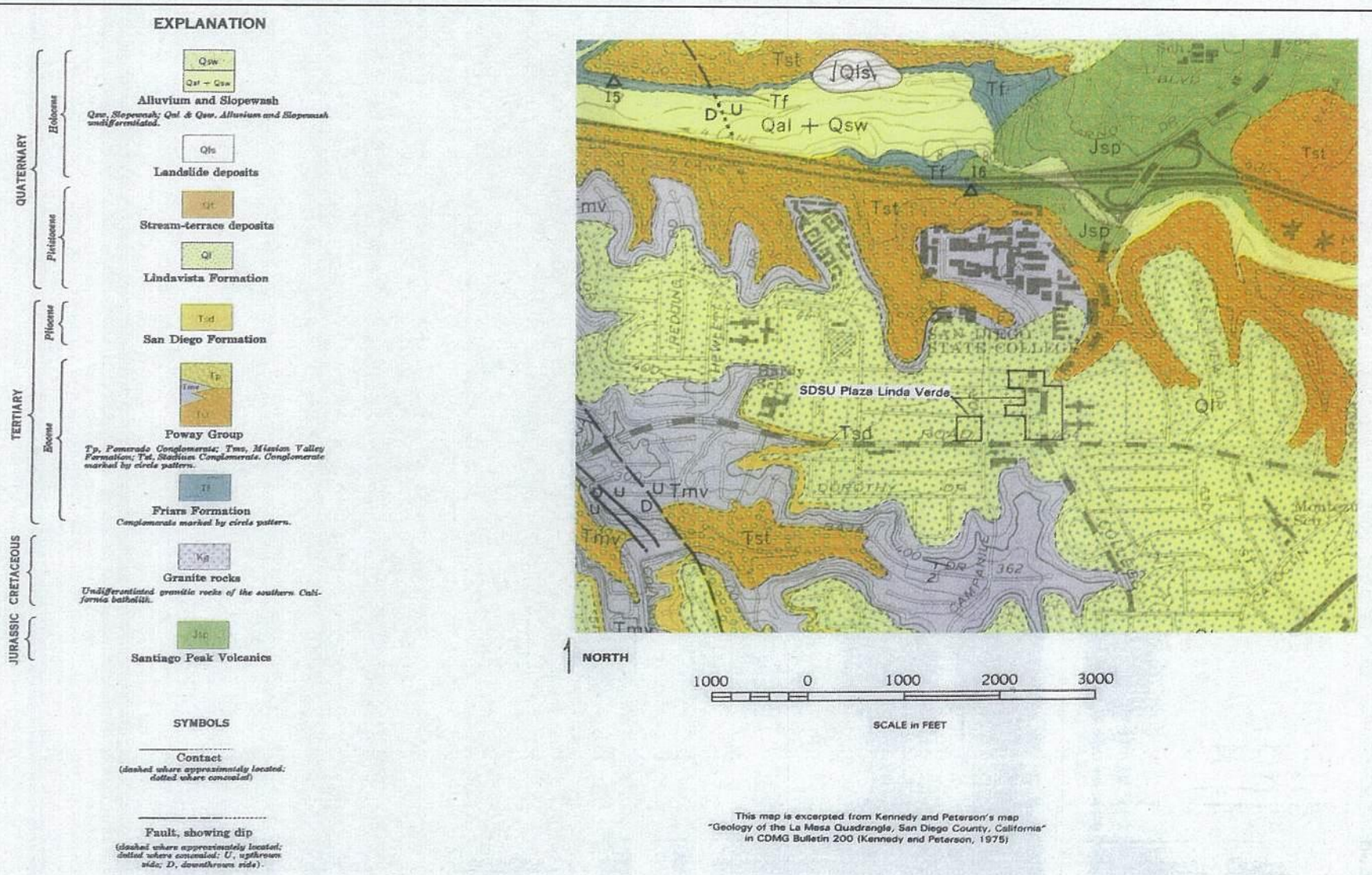

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Figure 3.4-1
Geologic Map

locally-derived materials, ranging in composition from sandy clays to silty and clayey sands, and commonly include abundant gravel/cobbles. Some fill areas also include boulder-sized rock fragments, concrete/asphalt chunks, and debris.

In general, the Project site consists of a relatively level, mesa-top area and is reported to be underlain by less than approximately three feet of existing fill soils. However, fill soils exceeding three feet in depth likely exist in the backfilled excavations for underground storage tanks that were removed from Project parcels previously developed as fuel/service stations. Fill also exists as backfill in underground utility trenches.

3.4.3.2.2 Lindavista Formation

The Pleistocene-aged Lindavista Formation, which is approximately 5 to 15 feet thick, underlies the majority of the mesa-top portions of the Project area. This geologic/soil unit generally is known to consist of orange-brown gravel/cobble conglomerate with a clayey to silty sandstone matrix. In addition, well-cemented zones locally occur within the Lindavista Formation, and the upper portion is known to locally weather into an expansive residual clay horizon.

3.4.3.2.3 Mission Valley Formation

In the area of the Project site west of College Avenue, the Eocene-aged Mission Valley Formation, which is approximately 3 to 20 feet thick, is mapped as underlying the Lindavista Formation. This geologic/soil unit generally is known to consist of gray silty fine sandstone and conglomerate.

3.4.3.2.4 Stadium Conglomerate

Within the Project site, the Eocene-aged Stadium Conglomerate is mapped as underlying the Lindavista and Mission Valley Formations west of College Avenue, and the Lindavista Formation east of College Avenue. This geologic/soil unit generally is known to consist of yellow-brown to orange-brown gravel/cobble conglomerate, with a silty to clayey sandstone matrix. Occasional boulders and sandstone interbeds also may exist within this geologic unit, which is locally well-cemented.

3.4.3.3 Geologic Structure

The sedimentary formations exposed on the Project site and within the general vicinity are interpreted to be generally flat-lying to very gently dipping with respect to their sedimentary

bedding. No major folding of the on-site geologic units previously has been reported, and folding is not anticipated in the general vicinity of the SDSU campus.

3.4.3.4 Faulting

Evidence of "active" faulting at the SDSU campus was not identified or reported during the previous geologic/geotechnical studies performed on or near the Project area.[1] Instead, the nearest known active faults are the Rose Canyon fault (located approximately 6 miles west of the SDSU campus), Coronado Bank fault (located approximately 20 miles west of the campus and off shore), and Elsinore fault (located approximately 35 miles northeast of the campus). The San Andreas fault is located approximately 80 miles east-northeast of SDSU. **Figure 3.4-2, Regional Fault Map**, depicts the regional faults in southern California and identified herein.

Based on a review of the City of San Diego's 1995 Seismic Safety Study maps, the SDSU campus is located approximately 0.3 mile east-northeasterly of a mapped trace of the La Nacion fault.[2] However, the La Nacion fault generally is not known to displace Quaternary deposits and, therefore, the La Nacion fault currently is interpreted by most geologists not to be an "active" fault based on California Geological Survey criteria. Surficial evidence of on-site active faulting was not observed during site visits conducted in connection with the preparation of this analysis.

In summary, a review of geologic maps and literature pertaining to the Project area indicates that there are no known major or "active" faults on or in the immediate vicinity of the Project site. Additionally, the Project site is not located within a State-delineated "Alquist-Priolo Earthquake Fault Zone."

3.4.3.5 Groundwater

Groundwater seepage was reported in several geotechnical reports for projects on and near the Project site. The groundwater encountered appears to have perched at the fill-natural ground

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1 An "active" fault is defined by the California Geological Survey as one which has "had surface displacement within Holocene time (about the last 11,000 years)."

2 The Geologic Hazards and Faults Sheet 22 of the City of San Diego's 1995 Seismic Safety Study indicates that the Project site is located in Geologic Hazard Category 53, which is assigned a "low to moderate risk" for geologic hazards.

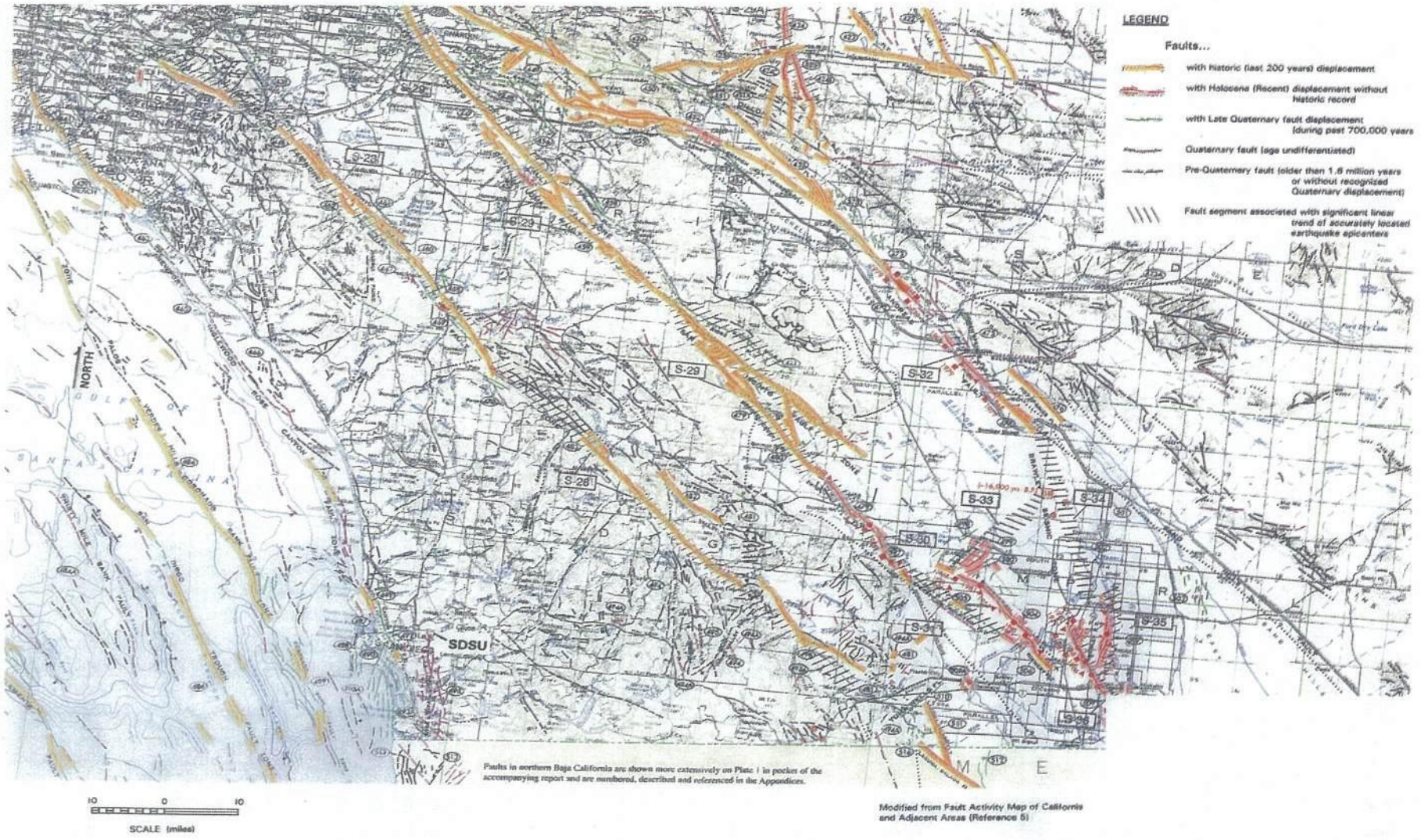

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Figure 3.4-2
Regional Fault Map

contact or perched in permeable sandstone layers in the on-site geologic formations. The likely source of groundwater is infiltration of landscape irrigation waters and precipitation. In addition, seasonal fluctuations of the on-site groundwater conditions may occur.

3.4.3.6 Aggregate/Mineral Resources

The California Division of Mines and Geology's Special Report 153 classifies land in western San Diego County according to the presence or absence of construction-grade aggregate resources. The purpose of Special Report 153 was to transmit data to the State Mining and Geology Board and local government planners on the type, quantity, location, and distribution of aggregate resources, as well as projections of future regional need. The classification was completed in accordance with guidelines established by the State Mining and Geology Board, in compliance with the Surface Mining and Reclamation Act of 1975.

The Project area is mapped within "Mineral Resource Zone 3" ("MRZ-3") with respect to construction aggregated resources. Areas mapped as MRZ-3 are "areas containing mineral deposits, the significance of which cannot be evaluated from available data." Given the current land uses at the Project site and in the surrounding area, development of the Project area as a commercial source of construction-grade gravel appears unlikely.

3.4.4 THRESHOLDS OF SIGNIFICANCE

Appendix G of the CEQA Guidelines provides that geotechnical constraints may be potentially significant if the Proposed Project would "expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving":

(a) Rupture of a known earthquake fault (as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault);

(b) Strong seismic ground shaking;

(c) Seismic-related ground failure, including liquefaction; or

(d) Landslides.

Geotechnical constraints also could be considered potentially significant if the project would:

(a) Result in substantial soil erosion or the loss of topsoil;

(b) 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;

(c) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1997), creating substantial risks to life or property; or

(d) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.[3]

3.4.5 PROJECT IMPACTS

The following is a summary of the potential geotechnical/soils impacts of the Proposed Project.

3.4.5.1 Landslides/Slope Instability

There are no known or suspected landslides in the Project area, which is located on a relatively level mesa area. In addition, the geologic formations underlying the Project area generally are not known to be susceptible to landslides. Therefore, impacts associated with landslides are less than significant.

However, temporary slopes may be excavated during Project build-out, which may expose adverse geologic conditions, such as adversely-oriented joints or loosely embedded cobbles/boulders. Such conditions may result in potentially significant impacts as potential slope failures could damage project improvements under construction and adjacent properties.

3.4.5.2 Erosion

Disturbance of the ground surface during construction of proposed facilities may increase or decrease the erosion potential of the Project site. Erosion of exposed soils, if not anticipated and managed, is a potentially significant impact.

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[3] The Project area is served by municipal sewers. Accordingly, criterion (d) is not applicable to the impacts analysis presented herein.

3.4.5.3 Unconsolidated Soils

Unconsolidated soils on the Project site generally consist of existing fill soils, which typically are considered potentially compressible and may possess unacceptable settlement characteristics under structural and fill loads. Improvements built on potentially compressible, unconsolidated soils may crack as a result of soil settlement, and excavations exposing unconsolidated soils may be subject to sloughing; these are potentially significant impacts.

3.4.5.4 Expansive Soils

Expansive soils primarily consist of clayey soils that have a potential for significant volume changes (shrinking and swelling) with moisture fluctuations.[4] Expansive soils in the Project area include clayey existing fill soils and the clayey portions of the on-site geologic formations. If not mitigated, near-surface expansive soils may result in potentially significant impacts, including the uplift and cracking of slabs, pavements, and other improvements. Other expansive soil-related problems include poor drainage and poor establishment of vegetation.

3.4.5.5 Excavatability

The on-site sedimentary geologic formations (i.e., Lindavista Formation, Mission Valley Formation, and Stadium Conglomerate) may include locally well-cemented concretionary horizons. These well-cemented zones may present excavation difficulties during grading and construction activities. Notwithstanding, the geologic formations at the Project site generally are excavatable with suitable construction equipment in good operating condition and impacts are less than significant.

3.4.5.6 Groundwater/Seepage

The reported estimate for the depth of the static groundwater surface is approximately 60 feet below the existing ground surface. However, perched groundwater seeps were reported in some of the previous geotechnical borings on and near the Project area, and also may be encountered during development of the Proposed Project, especially with respect to the proposed below-grade parking levels. This constitutes a potentially significant impact.

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[4] The expansion (shrink-swell) potentials of the on-site soils can be assessed by laboratory testing of representative soil samples obtained during site-specific geotechnical investigation studies. The expansion potential of soils typically is tested in accordance with ASTM test method D4829 and classified based on the "expansion index" test result.

3.4.5.7 Flood Inundation

Flood inundation of the Proposed Project is not likely due to the site elevation and distance from natural drainage channels susceptible to flooding during precipitation events. Similarly, the site elevation and distance from vulnerable areas of inundation by dam failure (e.g., Lake Murray) protect the Proposed Project from flood inundation. Therefore, impacts are less than significant.

3.4.5.8 Liquefaction

Liquefaction is caused by strong vibratory motion (typically due to earthquakes) and may occur in areas underlain by loose granular soils and a near-surface groundwater table. Soils that liquefy may settle. Further, improvements underlain by soils that liquefy also may settle and suffer damage. The potential for seismically-induced liquefaction at the Project site is considered very low due to the density and grain-size characteristics of the geologic/soil units in the Project area and the depth of the static groundwater surface (reported to be approximately 60 feet below the existing ground surface). Therefore, impacts are less than significant.

3.4.5.9 Fault Rupture

Ground rupture typically is associated with moderate to large earthquakes occurring on active faults. The hazard associated with ground rupture is potential damage to structures situated across a ruptured fault trace. Since no mapped active fault traces are known to cross the Project site, the potential for surface rupture (ground breakage along fault traces) is considered very low, and impacts are less than significant.

3.4.5.10 Seismic Shaking

Southern California is a seismically active region. Ground shaking due to earthquakes on active regional faults should be expected at the Project site and may result in a potentially significant impact to the proposed improvements. However, as noted above, the nearest known fault (La Nacion) is not known as an active fault.

3.4.5.11 Tsunami

Tsunamis are sea waves generated by submarine earthquakes, landslides, or volcanic action. Due to the distance from the coastline and elevation of the Project site, the possibility of inundation of the Proposed Project by a tsunami is considered very low, and impacts are less than significant.

3.4.5.12 Seiche

Seiche are periodic oscillations of a body of water. Due to the distance from bodies of water and elevation of the Project site, the possibility of inundation of the Proposed Project from a seiche is considered very low, and impacts are less than significant.

3.4.5.13 Mudflows

A mudflow is a flowing mass of soil with a high fluidity during movement. The Project site is located on a relatively level mesa top in an urbanized area with minimally exposed soil surfaces. The possibility of inundation of the Proposed Project by mudflows after completion of construction is considered low, and impacts are less than significant. However, impacts may be potentially significant while construction is ongoing.

3.4.6 MITIGATION MEASURES

Site-specific measures for potential geotechnical constraints are developed during the geotechnical design studies phase of project development.[5] The scope of geotechnical design studies may include, but is not limited to, consideration of: project design; site constraints; anticipated geotechnical conditions; the consultant's experience; preliminary soil investigations; engineering geologic investigations; and/or ground-response reports. Specific geotechnical investigation tasks may include, but are not limited to, subsurface exploration, geotechnical laboratory testing, and geotechnical analyses.

The following chapters of the currently-adopted edition of the California Building Code ("CBC;" California Building Standards Commission, 2007) and corresponding, referenced standards of the International Building Code ("IBC;" International Code Council, 2006) include applicable requirements for evaluation of potential geotechnical impacts during project-specific geotechnical investigations:

- Chapter 16, Structural Design;
- Chapter 18, Soils and Foundations;
- Chapter 31, Special Construction; and

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5 Geotechnical studies are undertaken by State of California-licensed and registered Civil Engineers (practicing soils engineering), Geotechnical Engineers, Professional Geologists (formerly known as registered geologists), and certified Engineering Geologists.

- Chapter 35, Referenced Standards.

In addition, the "Greenbook" (i.e., the *Standard Specifications for Public Works Construction* (BNi Building News, 2009)) also provides specifications that have applicability to public works projects that may be applied to private projects, as well.

Based on the analysis conducted, the geotechnical conditions in the Project area would not significantly impact the development and implementation of the Proposed Project if appropriate geotechnical design recommendations developed from site-specific geotechnical investigations are included in the design and construction of the Proposed Project. The incorporation of these site-specific recommendations into the design and construction of the Project components would reduce any potentially significant impacts to a level below significant. On that basis, the following mitigation measures are proposed to reduce the potentially significant geotechnical effects of the Proposed Project to a less-than-significant level:

GEO-1 Prior to the commencement of design and construction activities relating to the Proposed Project, CSU/SDSU, or its designee, shall conduct, or cause to be conducted, a geotechnical investigation in conformance with the requirements of the California Building Code ("CBC") and International Building Code ("IBC"). The site-specific geotechnical investigations will include, to the extent required by the CBC and IBC, subsurface exploration, laboratory testing, and geotechnical analysis. The investigations will address the potential for landslides/slope instability, erosion, unconsolidated soils, expansive soils, groundwater seepage, flood inundation and seismic shaking. An evaluation of the suitability of the on-site soils and rock for use as fill also shall be made during the site-specific geotechnical studies. (Reference shall be made to Section 300 of the "Greenbook," which provides specifications of typical fill materials and their typical maximum allowed dimensions.)

Based on the results of the site-specific investigations, geotechnical design recommendations shall be developed and included in the design and construction of the Proposed Project in conformance with applicable regulatory guidelines, including CBC and IBC requirements.

GEO-2 During project design and construction activities, CSU/SDSU, or its designee, shall use proper grading techniques (with appropriate compaction efforts) and stormwater pollution prevention devices (per regulatory agency

guidelines), revegetate disturbed areas, and construct appropriate drainage provisions to reduce the potential for erosion on the Project site, in conformance with applicable regulatory guidelines, including CBC and IBC requirements. Additionally, CSU/SDSU, or its designee, shall periodically remove accumulated eroded soils and debris from surface drains, as needed.

GEO-3 During grading activities associated with development of the Proposed Project, CSU/SDSU, or its designee, shall require that compressible soils present on the site be removed where structural fill areas are underlain by unconsolidated soils and replaced with properly compacted or deep foundation systems, which extend through the compressible soils and are supported by the underlying firm natural soils, in conformance with applicable regulatory guidelines, including CBC and IBC requirements.

GEO-4 During grading activities associated with development of the Proposed Project, CSU/SDSU, or its designee, shall prohibit the placement of expansive soils within the upper few feet of finished grade, or mandate that "special" deepened and/or stiffened foundation systems for proposed structures be utilized, in conformance with applicable regulatory guidelines, including CBC and IBC requirements. Surface and subsurface drainage provisions also may be implemented to reduce moisture fluctuations in subgrade soils.

GEO-5 To the extent the geotechnical investigation conducted pursuant to Mitigation Measure GEO-1 concludes that groundwater/seepage issues are present on the Project site, CSU/SDSU, or its designee, shall design and construct subsurface and surface drains in filled areas and behind retaining walls, in conformance with applicable regulatory guidelines, including CBC and IBC requirements. In addition, the shoring and dewatering of excavations, as needed, shall be undertaken to reduce the potential for caving of excavations due to groundwater seeps.

GEO-6 During design of the Proposed Project, CSU/SDSU, or its designee, shall adhere to current design parameters of the CBC (including, but not limited to, CBC Chapters 16 and 18) in order to reduce the effects of seismic shaking.

GEO-7 During site grading activities associated with Proposed Project build-out, CSU/SDSU, or its designee, shall require the appropriate control of surface waters and soil containment on disturbed ground surfaces in conformance

with applicable regulatory guidelines, including CBC and IBC requirements, in order to reduce construction-related mudflows.

3.4.7 CUMULATIVE IMPACTS

Impacts relative to geology and soils generally are confined to the Project site; the effects of two or more projects that occur at different locations are not affected by, and would not impact, the same piece of land. Furthermore, as discussed above, mitigation is proposed to reduce any of the Proposed Project's potential impacts relative to geology and soils to a level below significant. Therefore, the Proposed Project would not result in significant cumulative impacts to geology and soils.

3.4.8 LEVEL OF SIGNIFICANCE AFTER MITIGATION

With implementation of the proposed mitigation measures identified in this section, the potential impacts relative to geology and soils would be reduced to a level below significant.