4.5 GEOLOGY AND SOILS

4.5.1 Setting

a. Regional Geology. The City of Scotts Valley is located in the south central Santa Cruz Mountains in the heart of the Central Coast ranges of California. This is a seismically active region that is influenced by numerous named and unnamed faults in the area. The project site is underlain by bedrock of the Purisima Formation, which is comprised of sandstone, diatomaceous siltstone, and shale. Portions of Scotts Valley have been mapped with a "moderate" and "high" liquefaction potential rating. Landslide hazards in the City are concentrated in the hillside areas in the near the western and eastern boundaries of the City, these include active (movement within the past 50 years), dormant (little movement within the past 50 years), and old (little movement within the past 100 years) landslides.

While the City is not within any of the County's identified fault zone areas or 0.5 mile fault zone buffer areas, the City is with the seismically active Santa Cruz Mountains. Major named faults in the area include the Zayante Fault, San Andreas Fault, Butano Fault and Ben Lomond Fault (Scotts Valley General Plan, Safety Element, 1994). The Zayante Fault Zone is located approximately 1.5 miles north of the City of Scotts Valley, and is the closest major fault to the City. The Zayante Fault is tied into the San Andreas Fault system and capable of producing earthquakes of magnitude 7.4 on the Richter scale. A relatively short fault (1.5 miles), the Bean Creek Fault is located along the lower portion of Bean Creek, but insufficient data exists to determine its activity.

b. Site Specific Geology. The GeoCheck summary report provided in the EDR report (Appendix 1, page A-4) of Appendix C – Phase I Environmental Site Assessment indicates that the site is underlain by a stratified sequence of Tertiary-aged sedimentary rocks. According to The Scotts Valley Water District Annual Report for the 2006 Water Year (ETIC Engineering, Inc., April 2007), the geology in the Scotts Valley area consists of crystalline basement rock overlain by a Tertiary-aged sedimentary sequence. The crystalline basement rock that underlies the subject area is primarily composed of granite and quartz diorite of Cretaceous geologic age. The Tertiary-aged sedimentary sequence includes the following geologic units in order from oldest to youngest: Locatelli Formation, Butano Sandstone, Lompico Sandstone, Monterey Formation, Santa Margarita Sandstone, Santa Cruz Mudstone, Purisima Formation, and terrace deposits and alluvium.

The Locatelli Formation is only found in the South Scotts Valley area and is comprised of erosional remnants of a gray, sandy siltstone with a sandstone bed typically found at the base of the unit. The Butano Sandstone consists of sandstone and interbeds of mudstone, shale and siltstone of Eocene geologic age. The Lompico Sandstone is a 200- to 300-foot thick sandstone unit that forms the base of the middle Miocene geologic aged sequence. The Monterey Formation is primarily composed of mudstone, shale and siltstone of middle Miocene geologic age. The Santa Margarita Sandstone generally consists of massive, fine- to medium-grained sandstone of upper Miocene geologic age. The Santa Margarita Sandstone forms a distinctive formation of white and yellow sand that can be observed in cliffs around the area. The Santa Margarita Sandstone is a significant drinking water source for the area and occurs at the surface over a large portion of the upland areas, from the south of Scotts Valley to the Quail Hollow

area near Ben Lomond. In the northern Scotts Valley, the Santa Margarita Sandstone is overlain by either the Quaternary alluvium or the Santa Cruz Mudstone.

The Santa Cruz Mudstone consists of organic mudstone beds of upper Miocene geologic age that overlie the Santa Margarita Sandstone. The Purisima Formation consists mostly of fine-grained sandstone, mudstone, and siltstone of Pliocene geologic age. The Pleistocene and Holocene geologic-aged alluvial deposits are mapped in portions of the major stream valleys. These deposits consist of unconsolidated sands and silts along the streambeds of the San Lorenzo River and Carbonera and Bean Creeks. These unconsolidated sediments directly underlie much of the City of Scotts Valley. Figure 4 of Appendix C is taken from the Scotts Valley Water District Annual Report (2007, Figure 3-3) and shows the geology of the Scotts Valley area. Information regarding structural geologic features in Scotts Valley can be found in the Scotts Valley Water District Annual Report (ETIC, 2007).

c. Faulting and Seismic Activity. The U.S. Geological Survey defines active faults as those that have had surface displacement within Holocene time (about the last 11,000 years). Surface displacement can be recognized by the existence of cliffs in alluvium, terraces, offset stream courses, fault troughs and saddles, the alignment of depressions, sag ponds, and the existence of steep mountain fronts. Potentially active faults are ones that have had surface displacement during the last 1.6 million years. Inactive faults have not had surface displacement within the last 1.6 million years.

No known faults cross the project site; however, the site is situated between two major seismically active faults: the San Andreas Fault located seven miles northeast of the site and the San Gregorio Fault, about 11 miles southwest of the site (City of Scotts Valley, 1986). The San Andreas Fault has been predicted to have a major earthquake with a Richter scale magnitude of 7.0 within a 50-100 year interval. The San Andreas Fault is the most likely fault to experience a major earthquake, which would affect the project site. It should be noted that in 1989, Scotts Valley experienced damage due to the Richter Magnitude 7.1 Loma Prieta Earthquake, which originated on the San Andreas Fault about seven miles east of Scotts Valley. The San Andreas Fault has a maximum probable earthquake magnitude of 8.0 and a maximum credible earthquake magnitude of 8.5. Studies by the USGS estimate that the probability of an earthquake of seven occurring in the next 30 years is negligible (USGS, 1990). The recurrence interval for an earthquake of his magnitude is 169 years (City of Scotts Valley, 1990).

The Zayante Fault is located approximately 2,000 feet northeast of the project site and is considered a potentially active fault based on studies of the USGS. The Zayante Fault is capable of producing an earthquake of magnitude 7.4 on the Richter scale, or an intensity of IX on the modified Mercalli scale.

The Butano Fault is located less than a mile from the proposed project site. The Butano Fault is capable of producing a major earthquake of 6.4 on the Richter scale. This implies an intensity of VIII on the modified Mercalli scale, which in turn implies a slight damage to specially designed structures.

Other faults in the area include the Vergales Fault, the San Gregorio Fault and the Bean Creek Fault. The Vergales Fault is believed to be connected to the San Andreas Fault by a diffuse

system of possible faults. The Bean Creek Fault is located about 2,600 feet west of the site. The Bean Creek Fault is a relatively short fault, with insufficient data to classify its activity.

d. Liquefaction. In addition to the possibility of future seismic events from active faults in the region, the possibility for liquefaction in the event of an earthquake is low to moderate (City of Scotts Valley, 1986). Liquefaction is defined as the sudden loss of soil strength due to a rapid increase in soil pore water pressures resulting from seismic ground shaking. Liquefaction potential is dependent on such factors as soil type (e.g. alluvial), depth to ground water, degree of seismic shaking, and the relative density of the soil. When liquefaction of the soil occurs, buildings and other objects on the ground surface may tilt or sink, and lightweight buried structures (such as pipelines) may float toward the ground surface. Liquefied soil may be unable to support its own weight or that of structures, which could result in loss of foundation bearing or differential settlement. Liquefaction may also result in cracks in the ground surface followed by the emergence of a sand-water mixture.

e. Regulatory Setting.

General Plan Policies. The City of Scotts Valley General Plan Safety Element has the following objectives and polices regarding geologic resources:

SO-486 *Objective*
Reduce the risk resulting from seismic and other geologic hazards, by regulating development in areas of high seismic and other geologic hazards.

SP-487 *Policy*
The City utilizes liquefaction and landslide maps prepared by the County (Figures S-3 and S-4) to assess geotechnical hazards within the Planning area. These maps shall be updated as new and more accurate information becomes available.

SP-489 *Policy*
In a geologic hazard area, development shall be approved only after a detailed geotechnical evaluation is completed by a registered geologist, and only if adequate measures are provided to avoid or substantially reduce any identified hazard.

Policy SP-489 in the Scotts Valley General Plan Safety Element requires detailed geotechnical evaluations for proposed development in a geologic hazard area (as identified on maps presented in the General Plan), as well as measures to avoid or substantially reduce any identified hazard. Geologic hazards maps in the General Plan include Liquefaction Potential, Landslide Deposits, and Slopes. The entire proposed Specific Plan area is located within an area of moderate to high potential for liquefaction.

Scotts Valley Municipal Code. Chapter 15 of the Scotts Valley Municipal Code "sets forth rules, regulations and minimum standards to control excavation, grading, erosion, and sediment; requires control of all existing and potential conditions of accelerated erosion..." The grading ordinance states that "No person shall cause or allow the persistence of a condition on any site that could cause accelerated erosion." Under the ordinance, a permit is required for

grading activities, and approval of the permit "shall require the abatement of any existing human-induced or accelerated erosion problems on the property." The ordinance sets forth design standards for cuts and fills, including limits on slopes and heights, provisions for stockpiles, vegetative protection, ground preparation for fills, requirements for the use of keys, and requirements for compaction (among others). The ordinance also includes standards for cut and fill setbacks, drainages and terraces, and erosion and sediment control. Sections 15.06.090 and 15.06.100 require approval from the Planning Commission for any cut or fill slopes steeper than 3:1, and City Council approval for any cuts and/or fills in excess of 40 feet vertical height.

4.5.2 Impact Analysis

a. Methodology and Impact Criteria. In order to determine whether a project will have a significant effect on the environment, *State CEQA Guidelines* identify criteria that may be deemed to constitute a substantial or potentially substantial adverse change in physical conditions. Appendix G of the *State CEQA Guidelines* states that a project may have a significant geologic impact if the project would:

- *Expose people or structures to potential substantial adverse effects, including the strong seismic ground shaking, seismic ground failure including liquefaction or landslides, or the risk of injury or death.*
- *Be located on a geologic unit or soil that is unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.*
- *Be located on expansive soil, as defined in Table 1-B of the Uniform Building Code, creating substantial risks to life or property.*

Potential impacts related to erosion or loss of topsoil is addressed in Section 4.7, *Hydrology and Water Quality.*

b. Project Impacts and Mitigation Measures.

Impact G-1 Due to the presence of active faults in the vicinity, the Specific Plan area is subject to strong ground shaking, both of which have the potential to cause damage to structures, property, utilities and road access, and potentially result in injury or death. This is considered a Class II, *significant but mitigable impact*.

No known faults cross the project site; however, the site is situated between two major seismically active faults: the San Andreas Fault located seven miles northeast of the site and the San Gregorio Fault, about 11 miles southwest of the site (City of Scotts Valley, 1986). The San Andreas Fault has a maximum probable earthquake magnitude of 8.0 and a maximum credible earthquake magnitude of 8.5. The Zayante Fault is located approximately 2,000 feet northeast of the project site and is considered a potentially active fault based on studies of the USGS. The Zayante Fault is capable of producing an earthquake of magnitude 7.4 on the Richter scale. The

Butano Fault is located less than a mile from the proposed project site. The Butano Fault is capable of producing a major earthquake of 6.4 on the Richter scale.

A seismic event is considered likely during the useful life of any structures planned under the proposed project. This can potentially jeopardize public safety, including safety both to structures and people within the project area.

Besides the direct physical damage to structures caused by the ground shaking, marginally stable landslides, slopes, and inadequately compacted fill material could move and cause additional damage. Gas, water, and electrical lines can be ruptured during the ground shaking, or broken during movement of earth caused by the earthquake, which can jeopardize public safety. Impacts are potentially significant.

Mitigation Measures. The philosophy in the California Building Code is to prevent structural collapse and thereby mitigating life safety issues. By definition, significant structural damage is acceptable in Code-conforming structures; although it has been found by experience that single-family, wood-frame structures properly built to the latest building codes generally perform well in response to strong ground shaking where ground failure is not involved. The following measures would help to ensure that any structures planned as a result of the proposed Scotts Valley Town Center Specific Plan would be mitigated, to the extent possible, against possible ground shaking.

G-1(a) **CBC Compliance**. Above-ground structures shall be designed and constructed according to the latest California Building Code (CBC) Seismic standards.

Any proposed development plans submitted to the City of Scotts Valley for land use clearance within the Specific Plan area shall have a note printed on the plans which specify CBC Seismic standards for all above-ground structures. Building plans submitted in an application for a Building Permit shall include documentation that these standards are met. Final project plans shall be submitted which include the required design specifications prior to approval any entitlements. Building plans which meet CBC standards shall be provided to the Building Division prior to issuance of Building Permits.

Prior to approval of any entitlements for specific projects within the area, City staff shall review project plans and verify that the CBC Seismic requirements are printed on the plans. Building Division staff shall verify that CBC standards are met prior to issuance of Building Permits. Building inspectors shall conduct site inspections to assure that construction occurs consistent with approved plans.

Significance After Mitigation. Through the implementation of the proposed mitigation measures, impacts would be considered less than significant.

Impact G-2 Seismic activity could produce sufficient ground shaking which may result in liquefaction. On-site soils proposed for future development of residential uses and commercial facilities are subject to a low to moderate potential for liquefaction. This is considered a Class II, *significant but mitigable* impact.

Liquefaction is a process whereby ground shaking causes saturated granular soils to become liquid-like. This type of phenomenon occurs when saturated rocks are vibrated, which increases the pore pressure and separates the grains. The project site has a low to moderately low potential for liquefaction (City of Scotts Valley, 1986). A geotechnical study has not been prepared for the project site, such that in absence of such characterization, the potential impacts related to liquefaction are considered to be significant.

Mitigation Measures. The following mitigation measure is recommended:

G-2(a) **Geotechnical Study.** In conjunction with any development within the Specific Plan area, a geotechnical study shall be prepared by a registered civil or geotechnical engineer. This report shall include a soils report and an analysis of the liquefaction potential of the underlying materials. If a particular development site is confirmed to be in an area prone to seismically-induced liquefaction, appropriate techniques to minimize liquefaction potential shall be prescribed and implemented. Any structures proposed under the Specific Plan shall comply with applicable methods of the CBC.

Suitable measures to reduce liquefaction impacts could include: specialized design of foundations by a structural engineer; removal or treatment of liquefiable soils to reduce the potential for liquefaction; drainage to lower the groundwater table to below the level of liquefiable soils, in-situ compaction of soils; or other alterations to the ground characteristics. In areas prone to liquefaction, current structural engineering methods for foundation design may not be sufficient to prevent a building's foundation from failing in a larger earthquake, which would result in stronger and longer ground shaking.

The required geotechnical report shall be provided with any building plans proposed for the Specific Plan area and shall evaluate soil engineering properties. The applicant shall notify the Community Development Department prior to commencement of grading. The geotechnical report shall be provided to the Public Works Department for review and approval prior to issuance of building permits. Measures to reduce liquefaction shall be implemented prior to issuance of any building permits. Engineering staff shall review and approve the required report prior to issuance of the building permit. Building inspectors shall make site inspections to assure

implementation of approved plans. Grading inspectors shall monitor technical aspects of any grading activities.

Significance After Mitigation. Through the implementation of the proposed mitigation measures, impacts would be considered less than significant.

c. Cumulative Impacts. Grading and seismic issues are site-specific and must therefore be addressed on a case-by-case basis to mitigate impacts resulting from individual projects. 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 geologic issues present on an individual development site would be limited to that site and would not contribute to any cumulative impacts to the rest of the community. Therefore, cumulative geologic impacts would be considered less than significant.