4.6 Geology and Soils

This section describes existing conditions in the study area and evaluates the potential for the Proposed Project and alternatives to result in significant impacts related to exposing people or structures to unfavorable geologic hazards, soils, and/or seismic conditions. Following a description of the regulatory framework, project components are evaluated for their potential to create or be affected by significant impacts.

4.6.1 Setting

Regional Geology

The study area is located in the northwesterly, or upper, portion of the Coachella Valley in what is known as the Salton Trough. Extensional forces between the American and Pacific tectonic plates have created a large structural depression, the Salton Trough, which extends from the Palm Springs area to the Gulf of California. Southeast of the Coachella Valley, the Salton Trough is occupied by the Salton Sea and the Imperial Valley. The southerly portion of the Salton Sea is an area of high heat flow and several geothermal power plants derive their energy from the hot subsurface brines.

The Salton Trough region is part of the geologic region known as the Colorado Desert geomorphic province.[1] The Colorado Desert encompasses an area that extends from the Transverse Ranges province, south to the Mexican border, and from the Peninsular Ranges province on the west, east to the Colorado River (Norris and Webb, 1990). The province varies in width from 30 to 120 miles, and is dominated by the northwesterly trending Salton Trough.

The Coachella Valley, situated between the San Jacinto-Santa Rosa Mountains on the west and the Little San Bernardino Mountains on the east, is the northwestern extension of the Salton Trough. In general, relatively recent alluvial and lacustrine sediments underlie the Coachella Valley. To the west, the Santa Rosa Mountains consist of Jurassic-age metavolcanic and metasedimentary rocks, and Cretaceous-age igneous rocks of the southern California Batholith. To the east, the Little San Bernardino Mountains generally consist of Precambrian-age metamorphic and metasedimentary rocks, and Cretaceous-age granitic rocks.

Faults

The Colorado Desert is traversed by several major active faults. The Whittier-Elsinore and San Jacinto faults are major active fault systems located southwest of the study area and the San Andreas Fault system is located north of the study area. Major seismic activity is associated with these and other faults that have the potential for generating strong ground motion in the region.

1 A geomorphic province is an area that possesses similar bedrock, structure, history, and age. California has 11 geomorphic provinces.

The closest known active faults to the study area are associated with the San Andreas fault system, with the northwesterly trending Banning and Coachella segments of the fault system mapped in the north, just north of Interstate 10 (I-10). The northwesterly trending Garnet Hill fault is mapped north of Palm Springs, about a half mile south of I-10. The Garnet Hill fault is mapped as a buried fault and is based on a gravity anomaly survey of the Coachella Valley by a major oil company (Proctor, 1968). The Garnet Hill fault is not mapped as offsetting Holocene-age materials (Jennings, 1994) and, therefore, does not display evidence of being active (Hart et al., 1979). Although the California Division of Mines and Geology (California Geological Survey) has not designated it as an active fault, the Garnet Hill fault can act as a plane of weakness and move in response to an earthquake on another nearby fault. Ground fractures associated with the 1986 North Palm Springs earthquake were reported along the trace of the Garnet Hill fault and indicate that a near-surface response of weak surfaces occurred at depth (City of Cathedral City, 2002). The north-south trending Palm Canyon fault is mapped as trending towards Palm Springs from the south, but the fault is not considered active by State maps (Jennings, 1994).

Soils

Soils result from chemical, physical, and biological weathering of sediments and rocks exposed at or near the earth’s surface. Soil can contain both mineral and organic materials. The majority of the Proposed Project, including the subtransmission and transmission line upgrades, and the 115 kV reconfigurations, would be located on sandy alluvial soils. The majority of the existing substation locations are within areas that are already developed. The landforms on which these soils are present include primarily alluvial fans, which are composed of gravelly alluvium derived from igneous rock (USDA, 2008).

The proposed Devers-Coachella Valley 220 kV Loop-In would cross Carsitas gravelly sand and Carsitas cobbly sand. Carsitas soils are excessively drained, with no frequency of flooding or ponding. These soils can be found around 800 feet in elevation, at a zero to nine percent slope. The soil profiles are usually found within the first 10 inches, with gravelly sand from 10 to 60 inches. The Carsitas cobbly sand is an alluvium derived from granite that is excessively drained, with a very low water capacity (about 3.0 inches). Carsitas fine sand has nearly the same composition as the cobbly sand, except it is excessively drained, with low water capacity (about 3.1 inches). Carsitas gravelly sand has a moderate potential for erosion, but mostly on steeper slopes. The westerly and southerly portions of the Alternative 5 alignment also cross over the well-drained Coachella fine sand on zero to two percent slopes. The parent material is alluvium derived from igneous rock. The landforms on which these soils are present include primarily alluvial fans (USDA, 2008).

The proposed Farrell-Garnet 115 kV subtransmission line alignment, and the alignments for Alternatives 2, 3, 6 and 7 would cross Carsitas cobbly sand, Carsitas fine sand, Carsitas gravelly sand, and riverwash, as well as alluvium borrow pits associated with mineral excavation. Additionally, the Alternative 6 and 7 alignments cross Coachella fine sand and Myoma fine sand.

Myoma fine sand develops on zero to five percent slopes, is somewhat excessively drained, and develops from wind blown sandy alluvium.

The proposed substransmission line pole reconfiguration on the corner of Date Palm Drive and Varner Road would cross Carsitas gravelly sand and Myoma fine sand. The pole reconfiguration on the corner of Bob Hope Drive and Dinah Shore Drive and the pole replacement at the corner of Gerald Ford Drive and Portola Avenue would be located on Myoma fine sand.

The Garnet, Farrell, and Mirage substations are located on Carsitas gravelly sandy soil.

Local Geology, Drainage, and Groundwater

The majority of the study area is underlain by relatively recent (Holocene-age) surficial deposits with somewhat older Quaternary deposits mapped in limited areas, especially in the northern end of the study area. The surficial deposits are mapped as alluvium (i.e., sediments laid down by flowing water) and eolian (i.e., wind blown) deposits. The surficial and Quaternary deposits are primarily granular (e.g., sand, silt, and gravel) in nature. Other surficial soils present include fill soils associated with existing manmade improvements, such as roadways, utility trench backfills, etc.

With elevations ranging from roughly 400 feet above mean sea level (msl) near Palm Springs to roughly 200 feet above msl near Palm Desert and Thousand Palms, drainage in the study area is generally to the southeast and ultimately towards the Salton Sea, which is some 220 feet below msl. Likewise, groundwater gradients can be expected to fall to the southeast, with flow ultimately towards the Salton Sea. In general, due to the elevation and arid climate of the study area, shallow groundwater levels do not exist, and are measured in the Palm Springs areas at depths in excess of 100 feet.

Geologic Hazards

Seismic Activity

The two most recent fault activities recorded in Palm Springs area include the 1986 North Palm Springs earthquake and the 1992 Landers earthquake. The 1986 quake registered a magnitude of 5.6 and caused minor ground rupturing along the Banning, Mission Creek, and Garnet Hill faults, but these cracks were due to shaking, not surface rupture. The 1992 quake resulted in landslides triggered by long ground-shaking and also caused fractures along the Garnet Hill fault (City of Palm Springs, 2007).

The study area is in a region of high seismic activity as is much of southern California. The study area could be subjected to strong ground shaking due to an earthquake on one of the regions active faults. The closest known active faults are those associated with the southern end of the nearby Coachella Segment of the San Andreas fault system, which could generate a moment magnitude of up to 7.2 (USGS/CGS, 2002).

Liquefaction

Liquefaction of cohesionless soils can be caused by strong vibratory motion due to earthquakes. Research and historical data indicate that loose granular soils and non-plastic silts that are saturated by relatively shallow groundwater (generally less than 50 feet) are susceptible to liquefaction. Liquefaction causes soil to lose strength and "liquefy," triggering structural distress or ground failure due to the dynamic settlement of the ground or a loss of strength in the soils underneath structures.

Subsidence

Land subsidence associated with groundwater-level declines has been recognized as a potential problem in Coachella Valley (Sneed, et al., 2002). Since the early 1920s, groundwater has been a major source of agricultural, municipal, and domestic supply in the valley. Pumping of groundwater resulted in water-level declines as large as 50 feet through the late 1940s. In 1949, the importation of Colorado River water to the lower Coachella Valley began, resulting in a reduction in groundwater pumping and a recovery of water levels during the 1950s through the 1970s. Since the late 1970s, demand for water in the valley has exceeded deliveries of imported surface water, resulting in increased pumping and associated groundwater-level declines and, consequently, an increase in the potential for land subsidence caused by aquifer-system compaction (Sneed, et al., 2002).

Collapsible Soils

Soil collapse, or hydro-consolidation, occurs when soils undergo a rearrangement of their grains and a loss of cementation, resulting in substantial and rapid settlement under relatively low loads. This phenomenon typically occurs in recently deposited Holocene soils in a dry or semiarid environment, including eolian sands and alluvial fan and mudflow sediments deposited during flash floods. The combination of weight from a building or other structure, and an increase in surface water infiltration (such as from irrigation or a rise in the groundwater table) can initiate settlement and cause structural foundations and walls to crack (City of Cathedral City, 2002).

Expansive Soils

Expansive soils contain significant amounts of clay particles that have the ability to give up water (shrink) or take on water (swell). When these soils swell, the change in volume can exert significant pressures on loads that are placed on them, such as buildings, and can result in structural distress and/or damage (City of Cathedral City, 2002).

Landslides

Due to the relatively low relief, there is virtually no potential for naturally occurring landslides to occur in the vicinity of the Proposed Project and alternative alignments and sites, with the exception of the Alternative 2 alignment. The alignment for Alternative 2 would traverse over the eastern portion of Garnet Hill, which is a low relief hill in a setting generally not prone to landslides. Although surficial sloughing is possible, there is no evidence that deep-seated land slides have occurred on Garnet Hill. Standard geotechnical engineering practices can mitigate/avoid such features should they exist.

Regulatory Context

State

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (formerly the Alquist-Priolo Special Studies Zones Act), signed into law in December 1972, requires the delineation of zones along active faults in California. The main purpose of the Alquist-Priolo Act is to prevent the construction of buildings to be used for human occupancy (i.e., 2,000 person hours or more per year) on the surface trace of active faults. The Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards. Cities and counties must regulate certain development projects within the zones, which includes withholding permits until geologic investigations demonstrate that development sites are not threatened by future ground surface displacement (Hart and Bryant, 1997). Surface fault rupture is not necessarily restricted to the area within a Fault Rupture Hazard Zone, as designated under the Alquist-Priolo Act.

Seismic Hazards Mapping Act

The State Department of Conservation, California Geological Survey (CGS), provides guidance with regard to seismic hazards. Under the CGS Seismic Hazards Mapping Act, seismic hazard zones are to be identified and mapped to assist local governments for planning and development purposes. The intent of the Act is to protect the public from the effects of strong ground shaking, liquefaction, landslides, or other types of ground failure, and other hazards caused by earthquakes. CDMG Special Publication 117 Guidelines for Evaluating and Mitigating Seismic Hazards in California (1997) provides guidance for evaluation and mitigation of earthquake-related hazards for projects within designated zones of required investigations.

Design Standards

Building codes provide specific standards for design and construction of buildings and structures. On January 1, 2008, California officially adopted the 2007 California Building Code (CBC). The purpose of the CBC is to provide minimum standards to safeguard life or limb, health, property, and public welfare by regulating and controlling the design, construction, quality of materials, use, occupancy, location, and maintenance of all buildings and structures within its jurisdiction. The CBC provides criteria for defining expansive soils.

Riverside County

Policies within the Riverside County General Plan Safety Element that may be applicable to the Proposed Project and alternatives include (County of Riverside, 2003):

> *Policy S 2.1*: Minimize fault rupture hazards through enforcement of Alquist-Priolo Earthquake Fault Zoning Act provisions and the following policies:

a. Require geologic studies or analyses for critical structures, and lifeline, high-occupancy, schools, and high-risk structures, within 0.5 miles of all Quaternary to historic faults shown on the Earthquake Fault Studies Zones map.

b. Require geologic trenching studies within all designated Earthquake Fault Studies Zones, unless adequate evidence, as determined and accepted by the County Engineering Geologist, is presented. The County may require geologic trenching of non-zoned faults for especially critical or vulnerable structures or lifelines.

c. Require that lifelines be designed to resist, without failure, their crossing of a fault, should fault rupture occur.

d. Support efforts by the California Department of Conservation, Division of Mining and Geology to develop geologic and engineering solutions in areas of disseminated ground deformation due to faulting, in those areas where a through-going fault cannot be reliably located.

e. Encourage and support efforts by the geologic research community to define better the locations and risks of County faults. Such efforts could include data sharing and database development with regional entities, other local governments, private organizations, utility agencies or companies, and local universities.

Policy S 2.2: Require geological and geotechnical investigations in areas with potential for earthquake-induced liquefaction, landsliding or settlement as part of the environmental and development review process, for any structure proposed for human occupancy, and any structure whose damage would cause harm. (AI 81)

Policy S 2.3: Require that a State-licensed professional investigate the potential for liquefaction in areas designated as underlain by "Susceptible Sediments" and "Shallow Ground Water" for all general construction projects. Pseudo-static stability analyses requires detailed geotechnical investigations, including subsurface soil sampling and laboratory testing.

Policy S 2.4: Require that a State-licensed professional investigate the potential for liquefaction in areas identified as underlain by "Susceptible Sediments" for all proposed critical facilities projects.

Policy S 2.5: Require that engineered slopes be designed to resist seismically-induced failure. For lower-risk projects, slope design could be based on pseudo-static stability analyses using soil engineering parameters that are established on a site-specific basis. For higher-risk projects, the stability analyses should factor in the intensity of expected ground shaking, using a Newmark-type deformation analysis.

Policy S 2.6: Require that cut and fill transition lots be over-excavated to mitigate the potential of seismically-induced differential settlement.

Policy S 2.7: Require a 100% maximum variation of fill depths beneath structures to mitigate the potential of seismically-induced differential settlement.

Policy S 2.8: Encourage research into new foundation design systems that better resist the County's climatic, geotechnical, and geological conditions.

Policy S 3.1: Require the following in landslide potential hazard management zones, or when deemed necessary by the California Environmental Quality Act:

a. Preliminary geotechnical and geologic investigations.

b. Evaluations of site stability, including any possible impact on adjacent properties, before final project design is approved.

c. Consultant reports, investigations, and design recommendations required for grading permits, building permits, and subdivision applications be prepared by State-licensed professionals.

Policy S 3.2: Require that stabilized landslides be provided with redundant drainage systems. Provisions for the maintenance of subdrains must be designed into the system.

Policy S 3.3: Before issuance of building permits, require certification regarding the stability of the site against adverse effects of rain, earthquakes, and subsidence.

Policy S 3.4: Require adequate mitigation of potential impacts from erosion, slope instability, or other hazardous slope conditions, or from loss of aesthetic resources for development occurring on slope and hillside areas.

Policy S 3.5: During permit review, identify and encourage mitigation of onsite and offsite slope instability, debris flow, and erosion hazards on lots undergoing substantial improvements.

Policy S 3.6: Require grading plans, environmental assessments, engineering and geologic technical reports, irrigation and landscaping plans, including ecological restoration and revegetation plans, as appropriate, in order to assure the adequate demonstration of a project's ability to mitigate the potential impacts of slope and erosion hazards and loss of native vegetation.

Policy S 3.7: Support mitigation on existing public and private property located on unstable hillside areas, especially slopes with recurring failures where County property or public right-of-way is threatened from slope instability, or where considered appropriate and urgent by the County Engineer, Fire, or Sheriff Department.

Policy S 3.8: Require geotechnical studies within documented subsidence zones, as well as zones that may be susceptible to subsidence, as identified in Figure S-7 and the Technical Background Report, prior to the issuance of development permits. Within the documented subsidence zones of the Coachella, San Jacinto, and Elsinore valleys, the studies must address the potential for reactivation of these zones, consider the potential impact on the project, and provide adequate and acceptable mitigation measures.

City of Palm Springs General Plan

Policies within the City of Palm Springs General Plan Safety Element that may be applicable to the Proposed Project and alternatives include (City of Palm Springs, 2007):

Policy SA1.1 Minimize the risk to life and property through the identification of potentially hazardous areas, adherence to proper construction design criteria, and provision of hazards information to all residents and business owners.

Policy SA1.2 Require geologic and geotechnical investigations in areas of potential seismic hazards such as fault rupture, seismic shaking, liquefaction, and slope failure, as part of the environmental and/or development review process for all structures, and enforce structural

> setbacks from faults that are identified through those investigations in accordance with the Seismic Hazards Mapping Act. Require subsurface investigations of the Garnet Hill fault if and as that area of northern Palm Springs is developed.
>
> *Policy* SA1.4 Enforce the requirements of the California Seismic Hazards Mapping and Alquist-Priolo Earthquake Fault Zoning Acts when siting, evaluating, and constructing new projects within the City.
>
> *Policy* SA1.8 Require that lifelines crossing a fault be designed to resist damage in the occurrence of fault rupture.
>
> *Policy* SA1.14 Include liquefaction-mitigation measures in the construction of bridges, roadways, major utility lines, or park improvements in potentially liquefiable areas, such as the Whitewater riverbed or at the mouths of canyons.

City of Cathedral City

Policies within the City of Cathedral City General Plan Geotechnical Element that may be applicable to the Proposed Project and alternatives include (City of Cathedral City, 2002):

> *Policy 1:* All new development shall continue to be constructed, at a minimum, in accordance with the seismic design requirements contained in the most recently adopted edition of the Uniform Building Code/International Building Code.
>
> *Policy 5:* Where development is proposed in areas identified as being subject to geotechnical hazards (including, but not limited to slope instability, soil collapse, liquefaction and seismically induced settlement), the City shall require the preparation of site-specific geotechnical investigations by the applicant prior to development. All such studies shall include mitigation measures that reduce associated hazards to insignificant levels.
>
> *Policy 6:* All grading, earthwork, and construction activities shall be in accordance with applicable fugitive dust control ordinances and regulations, including those established by the City, CVAG, SCAQMD, and other appropriate agencies.

Other Desert Cities

Policies within the City of Rancho Mirage, City of Palm Desert, and City of Indian Wells General Plan Safety or Geotechnical Elements are not directly applicable to the Proposed Project and alternatives (City of Palm Desert, 2004; City of Rancho Mirage, 2006; and City of Indian Wells, 1996).

4.6.2 Significance Criteria

The following significance criteria are adapted from and are consistent with the CEQA Guidelines, Appendix G, Environmental Checklist. In accordance with the CEQA guidelines, the Proposed Project would result in a significant impact with regard to geology, soils, and seismicity if it would:

a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

- Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist (CGS) for the area or based on other substantial evidence of a known fault;
- Strong seismic ground shaking;
- Seismic-related ground failure, including liquefaction; or
- Landslides.

b) Result in substantial soil erosion or the loss of topsoil.

c) 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.

d) Be located on expansive soil, which is defined in the 2007 California Building Code, creating substantial risks to life or property.

e) 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 wastewater.

4.6.3 Applicant Proposed Measures

SCE has committed to implementing the following applicant proposed measures (APM) with regard to geological and soil resources:

APM GEO-1. Seismic Design for Ground Shaking. A geotechnical investigation of site soils and geologic conditions, coupled with engineering design, would identify the hazards and develop recommendations to support appropriate seismic designs to mitigate the effects of ground shaking. Specific requirements for seismic design would be based on the IEEE 693 “Recommended Practices for Seismic Design of Substations.”

APM GEO-2. Subsurface Trenching. Where appropriate, subsurface trenching along active fault traces would be required to ensure tower foundations are not placed on, or immediately adjacent to, these features. In addition, tower locations would be selected to accommodate anticipated fault offset, and minimize excessive tension in lines, should a fault movement occur.

4.6.4 Impacts and Mitigation Measures

a) 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.

Due to the relatively low relief, there is virtually no potential for naturally occurring landslides to occur in the vicinity of the Proposed Project components. Therefore, there would no impact related to landslides (No Impact).

Impact 4.6-1: Ground surface rupture of an active fault could damage the Proposed Project which, in turn, could pose a hazard to nearby structures or people. ***Less than significant*** **(Class III)**

There are no active earthquake faults that are recognized or zoned by the State of California in the immediate vicinity of the Proposed Project alignments and sites. The only fault that would intersect any of the Proposed Project components is the Garnet Hill fault, which is mapped as buried with a location that is postulated across the proposed Farrell-Garnet alignment. Whereas seismic activity is not limited to active faults, ground rupture is typically associated with active faults. However, ground fractures associated with the 1986 North Palm Springs earthquake were reported along the trace of the Garnet Hill fault, but the fractures were a result of ground shaking rather than fault rupture. In addition, pursuant to APM GEO-2, tower locations (in the case of the proposed Farrell-Garnet subtransmission line, *pole* locations) would be selected to accommodate anticipated fault offset, and minimize excessive tension in lines, should a fault movement occur. Therefore, based on the location of the proposed components and the active faults in the region, the potential for surface fault rupture to affect the Proposed Project would be minimal. Potential ground surface rupture impacts are considered to be less than significant.

Mitigation: None required.

Impact 4.6-2: Strong seismic ground shaking could cause damage to Proposed Project structures which, in turn, could pose a risk of loss, injury, or death. ***Less than significant*** **(Class III)**

As discussed in the Setting section above, significant ground shaking in the vicinity of the Proposed Project could occur due to earthquakes caused by the regions active faults. The San Andreas fault system is located approximately one mile northeast of the project area. Ground shaking due to seismic events along this fault system could have strong intensities. However, APM GEO-1 requires that a geotechnical investigation of site soils and geologic conditions be conducted, coupled with an engineering design, that would identify geotechnical hazards and develop recommendations to support appropriate seismic designs to mitigate the effects of ground shaking. Specific requirements for seismic design would be based on the Institute of Electrical and Electronics Engineers (IEEE) 693 “Recommended Practices for Seismic Design of Substations.”

Strong ground shaking could cause wires to swing and contact each other causing short-circuiting. However, observations from past earthquakes have shown that overhead transmission lines can typically accommodate strong ground shaking. In fact, the required separation distance to reduce the potential for wires to touch during strong wind is considered sufficient to accommodate movement associated with ground shaking. Although ground shaking could cause wires to swing, existing design criteria for wind loads are adequate to preclude wires from contacting each other or other structures. Thus, this impact is less than significant.

Substation improvements and new towers and poles would be designed in accordance with the CBC and the seismic design criteria developed using the site specific seismic design criteria calculated for the substation, tower, and pole locations. Use of standard seismic engineering design criteria, and accepted construction methods would ensure that potential impacts associated with strong ground shaking at the substations and new pole and tower locations would be less than significant.

Mitigation: None required.

Impact 4.6-3: Seismic-related ground failure, including liquefaction, could cause damage to the Proposed Project and, subsequently, create a risk of loss, injury, or death. *Less than significant* (Class III)

In order for liquefaction to occur, there needs to be relatively shallow groundwater conditions, generally at depths of less than 50 feet below the ground surface. Shallow groundwater conditions do not exist in the project area and the Proposed Project would not cause the groundwater table to rise. Regardless, the potential for liquefaction or other phenomena resulting in dynamic ground settlement, if even present, can be easily reduced with adequate geotechnical and foundation engineering. Therefore, with the implementation of standard engineering practices, any potential impacts associated with liquefaction, if discovered during geotechnical investigations that would be conducted for the Proposed Project, would be reduced to less than significant levels. The potential impact related to seismic-related ground failure, including liquefaction, would be less than significant.

Mitigation: None required.

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b) Results in substantial soil erosion or the loss of topsoil.

Impact 4.6-4: Ground disturbance by man-made activities can result in accelerated erosion and the loss of topsoil. *Less than significant* (Class III)

Earthwork for the Proposed Project would be expected to consist primarily of the construction of access and spur roads, pole and tower pads, and drilling for pole and tower foundations. These construction activities would disturb surface soils potentially exposing them to the effects of wind or water erosion. Impacts related to ground disturbance could be reduced with restoration of temporarily disturbed areas to the pre-construction conditions at the completion of the Proposed Project. Further, permanent access roads and pole/tower pads would need to be constructed with soils that are adequately compacted (typically 90 percent or more of the laboratory maximum compaction based on American Society for Testing and Materials Test Method D 1557). Furthermore, drainage provisions would need to be constructed and maintained so that water does not pond or drain away in an uncontrolled manner causing erosion.

Standard geotechnical and construction practices associated with the construction of the Proposed Project components, such as those described above, would ensure that the potential for erosion would be minimized. In addition, SCE would be required to prepare a Storm Water Pollution Prevention Plan for the Proposed Project as required by the State Water Resources Control Board as part of the National Pollutant Discharge Elimination System (NPDES) permit program for construction (see Section 4.8, *Hydrology and Water Quality* for information related to NPDES requirements). Therefore, with implementation of standard practices and permit requirements, potential erosion impacts due to ground disturbance from construction of the Proposed Project would be less than significant.

Mitigation: None required.

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c) 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

Impact 4.6-5: Adverse conditions could arise if the Proposed Project components were located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Proposed Project and potentially result in lateral spreading, subsidence, or collapse. *Less than significant* (Class III)

Lateral spreading is a phenomenon associated with liquefaction, which is discussed above, under Impact 4.6-3. Considering the relatively deep depth to groundwater in the project area, the potential for liquefaction or related lateral spreading is considered to be very low.

The Proposed Project should not contribute to subsidence because it would not involve the withdrawal of subsurface fluids. However, due to the composition, deposition, and relatively youthful age of the on-site earth materials, the soils may be subject to collapse (or hydro-consolidation). The effects of collapsible soils can be neutralized through proper foundation engineering for the structural improvements. Deep foundations that extend through zones of collapsible soils into competent underlying materials are a means to eliminate the effects of collapsible soils. Therefore, incorporation of geotechnical engineering recommendations, as is standard practice for a construction project of this nature, would reduce the potential for collapse or any other unstable soil conditions. The impact of potentially unstable soils would be less than significant.

Mitigation: None required.

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d) Located on expansive soil, which is defined in the 2007 California Building Code, creating substantial risks to life or property

Impact 4.6-6: Structural improvements, especially concrete slabs, placed on expansive soils can be subject to distress and damage. ***Less than significant*** **(Class III)**

Due to the granular nature of the on-site soils (primarily sands), appreciable amounts of expansive soils in the project area are unlikely to occur. The extent and potential affects of expansive soils, if present, would be explored during the geotechnical design evaluations that would be needed to properly design and construct the Proposed Project. Typical methods for dealing with expansive soils, in the unlikely event that they are present, are the removal of the expansive soils and replacement with non-expansive soils. The potential impact of expansive soils would therefore be less than significant with implementation of standard geotechnical design evaluations.

Mitigation: None required.

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e) 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 wastewater

The Proposed Project does not include any septic tanks or other alternative wastewater disposal system. Therefore, there would be no impact (No Impact).

4.6.5 Cumulative Impacts

Impacts on geology and soils are generally localized and do not result in regionally cumulative impacts. Geologic conditions can vary significantly over short distances creating entirely different effects elsewhere. Other future development would be constructed to current standards, which could potentially exceed those of existing improvements within the region, which reduces the potential impacts to the public.

The impact of the Proposed Project on geology and soils is localized and is incrementally less than significant. Therefore, the Proposed Project would not affect the immediate vicinity surrounding the study area. The Proposed Project components would all be constructed in accordance with the most recent version of the California Building Code seismic safety requirements and recommendations contained in the Proposed Project's specific geotechnical reports. Therefore, incremental impacts to area geology and soils resulting from construction and operation of the Proposed Project would not contribute to a cumulatively considerable impact (Class III).

4.6.6 Alternatives

No Project Alternative

For the purposes of this analysis, the No Project Alternative includes the following two assumptions: 1) the project would not be implemented and the existing conditions in the study area would not be changed; and 2) new subtransmission and transmission lines and/or additional power generation would be constructed in or near the study area to supply power to the Electrical Needs Area. Given the highly speculative nature of the No Project Alternative assumptions, this analysis is qualitative.

Under the No Project Alternative, none of the facilities or infrastructure upgrades associated with the Proposed Project evaluated in this EIR would be constructed by SCE. However, SCE would be required to design a new project in order to satisfy the objectives of the Proposed Project. Depending on the location/route of a new project, there could be concerns related to geotechnical hazards. However, it can be assumed that any project constructed by SCE would be appropriately engineered per geotechnical investigations that would be conducted as applicable. Therefore, it can be assumed that similarly to the Proposed Project, implementation of appropriate geotechnical engineering measures as well as APM GEO-1 and APM GEO-2 would reduce potential impacts associated with geology, soils and seismicity to less than significant (Class III).

Alternative 2

Impacts related to geology, soils, and seismicity for Alternative 2 would be similar to the proposed Farrell-Garnet subtransmission line because the alternative would be located primarily in flat terrain underlain by similar materials. However, a portion of the Alternative 2 alignment traverses over the eastern portion of Garnet Hill, which is low relief hill. Although future minor surficial sloughing on Garnet Hill is possible, there is no evidence that deep-seated land slides have or will occur on the Garnet Hill. Standard geotechnical engineering practices would avoid adverse affects to poles due to surficial sloughing. Due to the relatively low relief along Garnet Hill, there is little potential for naturally occurring landslides to occur in the vicinity of the Alternative 2 alignment. Therefore, potential impacts related to landslides along the Alternative 2 alignment would be greater than those associated with the Proposed Project, but would nevertheless be less than significant (Class III).

Alternative 2 would require trenching to place the line underground for approximately three miles thereby increasing the risk of excessive settlement and/or erosion of trench backfills. The trench excavation for Alternative 2 would need to be backfilled with properly compacted materials to mitigate the potential for excessive settlement and/or erosion of trench backfills. Topsoil excavated for trenches would be stockpiled for replacement at the completion of the backfill operations. Therefore, with implementation of standard practices and permit requirements, potential erosion impacts due to ground disturbance from construction of Alternative 2 would be less than significant (Class III).

As with the Proposed Project, overall impacts related to geology, soils, and seismicity from implementation of Alternative 2 would be less than significant with implementation of APM GEO-1 and APM GEO-2 (Class III).

Alternative 3

Impacts related to geology, soils, and seismicity for Alternative 3 would be similar to the proposed Farrell-Garnet subtransmission line because the alternative would be located primarily in flat terrain underlain by similar materials. Alternative 3 would require trenching to place the line underground for approximately 3.6 miles thereby increasing the risk of excessive settlement and/or erosion of trench backfills. The trench excavation for Alternative 3 would need to be backfilled with properly compacted materials to mitigate the potential for excessive settlement and/or erosion of trench backfills. Topsoil excavated for trenches would be stockpiled for replacement at the completion of the backfill operations. Therefore, with implementation of standard practices and permit requirements, potential erosion impacts due to ground disturbance from construction of Alternative 3 would be less than significant (Class III).

As with the Proposed Project, overall impacts related to geology, soils and seismicity from implementation of Alternative 3 would be less than significant with implementation of APM GEO-1 and APM GEO-2 (Class III).

Alternative 5

Impacts related to geology, soils, and seismicity for Alternative 5 would be similar to the proposed Mirage-Santa Rosa subtransmission line because the alternative would be located primarily in flat terrain underlain by similar materials. Alternative 5 would require trenching to place the line underground from Mirage Substation, west on Ramon Road, south on Monterey Avenue, then southeasterly on Varner Road to a point where it would rise above the ground surface and cross over I-10. The trench excavation for Alternative 5 would need to be backfilled with properly compacted materials to mitigate the potential for excessive settlement and/or erosion of trench backfills. Topsoil excavated for trenches would be stockpiled for replacement at the completion of the backfill operations. Therefore, with implementation of standard practices and permit requirements, potential erosion impacts due to ground disturbance from construction of Alternative 5 would be less than significant (Class III).

As with the Proposed Project, overall impacts related to geology, soils, and seismicity from implementation of Alternative 5 would be less than significant with implementation of APM GEO-1 and APM GEO-2 (Class III).

Alternative 6

Impacts related to geology, soils, and seismicity for Alternative 6 would be similar to the proposed Farrell-Garnet subtransmission line because the alternative would be located primarily in flat terrain underlain by similar materials. Alternative 6 would require trenching to place underground line for one mile along Vista Chino between Landau Boulevard and Date Palm Drive. The trench excavation for Alternative 6 would need to be backfilled with properly compacted materials to mitigate the potential for excessive settlement and/or erosion of trench backfills. Topsoil excavated for trenches would be stockpiled for replacement at the completion of the backfill operations. Therefore, with implementation of standard practices and permit requirements, potential erosion impacts due to ground disturbance from construction of Alternative 6 would be less than significant (Class III).

As with the Proposed Project, overall impacts related to geology, soils, and seismicity from implementation of Alternative 6 would be less than significant with implementation of APM GEO-1 and APM GEO-2 (Class III).

Alternative 7

Impacts related to geology, soils, and seismicity for Alternative 7 would be similar to the proposed Farrell-Garnet subtransmission line because the alternative would be located primarily in flat terrain underlain by similar materials. Therefore, overall impacts related to geology, soils, and seismicity from implementation of Alternative 7 would be less than significant with implementation of APM GEO-1 and APM GEO-2 (Class III).

References – Geology and Soils

California Division of Mines and Geology (CDMG). 1997. Guidelines for Evaluating and Mitigating Seismic Hazards in California: Special Publication 117.

City of Cathedral City. 2002. General Plan Geotechnical Element: adopted July 31, 2002.

City of Indian Wells. 1996. General Plan Safety Element: adopted February 1, 1996.

City of Palm Desert. 2004. General Plan Geotechnical Element: adopted March 15, 2004.

City of Palm Springs. 2007. General Plan Safety Element: adopted October 24, 2007.

City of Rancho Mirage. 2006. General Plan Safety Element: adopted January 2006.

County of Riverside. 2003. Riverside County General Plan. Adopted October 7, 2003

Hart, E.W., Smith, D.P., and Saul, R.B. 1979. Summary Report: Fault Evaluation Program, 1978 Area (Peninsular Ranges-Salton Trough Region): California Division of Mines and Geology, Open File Report 79-10.

Hart, E.W., and Bryant, W.A. 1997. Fault-Rupture Hazard Zones in California: California Division of Mines and Geology, Special Publication 42 (Supplements 1 and 2 added 1999).

Jennings, C.W. 1994. Fault Activity Map of California and Adjacent Areas with Locations and Ages of Recent Volcanic Eruptions: California Division of Mines and Geology, Geologic Data Map No.6, Scale 1:750,000.

Norris, R.M., and Webb, R.W. 1990. Geology of California: John Wiley & Sons, Inc.

Proctor, R.J. 1968. Geology of the Desert Hot Springs-Upper Coachella Valley Area, California: California Division of Mines and Geology, Special Report 94.

Sneed, M., Stork, S.V., and Marti, I.E. 2002. Detection and Measurement of Land Subsidence Using Global Positioning System and Interferometric Synthetic Aperture Radar, Coachella Valley, California, 1998-2000: United States Geological Survey, Water-Resources Investigations Report 02-4239.

United States Department of Agriculture, Natural Resources Conservation Service (USDA). 2008. Web Soil Survey (accessed August 2008).

United States Geological Survey (USGS)/California Geological Survey (CGS). 2002. Probabilistic Seismic Hazard Assessment (PSHA) Model: Revised April 2003.