B.3.6 Geology and Soils

GEOLOGY AND SOILS Would the project:	Potentially Significant Impact	Less than Significant With Mitigation Incorporated	Less than Significant Impact	No Impact
a. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) 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? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☒	☐
ii) Strong seismic groundshaking?	☐	☐	☒	☐
iii) Seismic-related ground failure, including liquefaction?	☐	☒	☐	☐
iv) Landslides?	☐	☐	☒	☐
b. Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐
c. Be located on geologic units 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, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☐	☒	☐	☐
e. Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?	☐	☐	☐	☒

Significance criteria established by CEQA Guidelines, Appendix G.

B.3.6.1 Setting

This section describes geology, soils, seismic, and mineral resource conditions and analyzes environmental impacts related to geologic and seismic hazards that are expected to result from the implementation of the Proposed Project. The following discussion addresses existing environmental conditions in the affected area, identifies and analyzes environmental impacts, and recommends measures to reduce or avoid adverse impacts anticipated from Project construction and operation. In addition, existing laws and regulations relevant to geologic and seismic hazards are described. In some cases, compliance with these existing laws and regulations would serve to reduce or avoid certain impacts that might otherwise occur with the implementation of the Project.

Baseline geologic, seismic, and soils information were collected from published and unpublished literature, GIS data, and online sources for the Proposed Project and the surrounding area. Data sources included the following: the Proponent's Environmental Assessment, geologic literature from the U.S. Geological Survey and California Geological Survey, geologic and soils GIS data, and online reference materials. The study area was defined as the locations of Proposed Project components and the areas of Indian Wells Valley and Searles Valley immediately adjacent to the Proposed Project for most geologic and soils issue areas with the following exception: the study area related to seismically induced ground shaking includes significant regional active and potentially active faults within 50 miles of the Proposed Project.

Regional Geologic Setting

The Proposed Project components and the existing Inyokern-McGen-Searles No. 1 and No. 2 115-kV subtransmission lines are located in and across the southern portion of Indian Wells Valley, Salt Wells Valley (Poison Canyon), and the eastern edge of the Searles Valley. Indian Wells and Searles Valleys are located in the southwestern corner of the Basin and Range geomorphic province. The Basin and Range province is characterized by interior drainage with lakes and playas, and a horst and graben structure of subparallel, fault-bounded ranges separated by down-dropped basins. The horst and graben structure of the Basin and Range province is the result of extensional tectonics throughout the region and has resulted in a topography that is dominated by isolated, north-trending mountain ranges separated by desert basins (CGS, 2002). Indian Wells Valley and Searles Valley are both graben structures and are the most southern and western most of the Basin and Range desert basins. The Indian Wells Valley is bordered by the Sierra Nevada to the west, the Argus Range to the east, the Coso Range to the north, and the El Paso Mountains and Spangler Hills to the south. The Searles Valley is teardrop shaped and is generally bounded on the west by the Argus Range and Spangler Hills, on the east and northeast by the Slate Range, and on the south by the Garlock fault zone. Both the Indian Wells and Searles Valleys are closed topographical depression with drainage from the surrounding hills and mountains directed inward toward China and Searles Lakes, respectively.

Basement rocks in the Proposed Project area consist predominantly of Mesozoic plutonic and metamorphic rocks overlain by consolidated early Tertiary non-marine and marine sedimentary rocks and volcanics. The basement rock in the Indian Wells and Searles Valleys is overlain by a thick sequence of late Tertiary (Miocene and Pliocene) and Quaternary sedimentary rocks, with localized volcanics. During parts of late Pliocene and Pleistocene time, when precipitation and runoff from the east side of the Sierra Nevada into the southwestern Basin and Range area was much greater than at present, a chain of as many as five large lakes was created, which included the areas currently occupied and surrounding China and Searles Lakes. The Pleistocene China Lake was a broad shallow lake that drained into the deeper Searles Lake to the east through Poison Canyon. These basins accumulated thick sequences of Pleistocene lacustrine deposits during this time (Monastero et. al., 2002). Pleistocene and Holocene alluvial fan deposits cover most of the floor and edges of the Indian Wells Valley and large areas of the Searles Valley.

Local Geology

Geologic units underlying the Proposed Project consists primarily of Holocene alluvium in the Indian Wells and Searles Valleys, with smaller areas of Pleistocene alluvium, Pleistocene to early Holocene lake deposits, and Mesozoic granitic rocks underlying portions of the subtransmission/fiber optic telecommunication cable alignments through Salt Wells Valley, Salt Wells Canyon, and along the western edge and foothills of Searles Valley (CDMG, 1963; Smith, 2009). Holocene alluvium underlies all areas of planned ground disturbance for the Proposed Project in the Indian Wells Valley, including trenching for installation of underground substructures for the new fiber optic telecommunications at the Inyokern Substation, Downs Substation, and the Ridgecrest Service Center; and grading, trenching, and excavation at and adjacent to the existing Downs Substation for construction and installation of the new expanded substation facilities and equipment and the new poles. In the Searles Valley, areas of proposed ground disturbance for installation of underground substructures for the new fiber optic telecommunications at Searles and McGen Substations and where replacement of six poles is planned, the alignment traverses a mix of Holocene alluvial fan deposits and Pleistocene to early Holocene lacustrine deposits from Lake Searles (Smith, 2009). The Holocene alluvial fan deposits along the Project alignment in the Searles Valley area likely shallowly overlie the Pleistocene lake deposits.

Topography and Slope Stability

The Indian Wells and Searles Valleys are gently sloping valleys with drainage from the surrounding hill and mountain areas directed inward to enclosed basins without outside drainage, respectively draining to the China Lake and Searles Lake playas. The southern Indian Wells Valley area, where the Proposed Project is located, consists of gently northeast, north, and northwest sloping inter-fingered, moderately dissected alluvial fans and alluvial plains with elevations ranging from approximately 2,700 to 2,100 feet above mean sea level (MSL) along the Proposed Project. The Proposed Project subtransmission/fiber optic telecommunication cable alignments cross below and along the hills of the Argus Range where the Inyokern-McGen-Searles No. 2 alignment passes along the gentle foothill slopes of the Salt Wells Valley and the Inyokern-McGen-Searles No. 1 alignment passes through the moderately sloping hills of the Salt Wells Canyon. Where the Inyokern-McGen-Searles No. 1 and No. 2 115-kV subtransmission lines pass through the Argus Range, the elevations range from approximately 2,100 to 1,700 feet above MSL west to east along the alignments. The Proposed Project within the Searles Valley area crosses gently sloping alluvial fans on the western edge of the Searles Valley and along the foothills of the Argus Range and elevation ranges from 1,850 to 1,650 feet above MSL.

Important factors that affect the slope stability of an area include the steepness of the slope, the relative strength of the underlying rock material, and the thickness and cohesion of the overlying colluvium and alluvium. The steeper the slope and/or the less strong the rock, the more likely the area is susceptible to landslides. The steeper the slope and the thicker the colluvium, the more likely the area is susceptible to debris flows. Another indication of unstable slopes is the presence of old or recent landslides or debris flows. No landslides or landslide deposits are mapped along the subtransmission/ fiber optic telecommunication cable alignments where they cross through Salt Wells Canyon and Salt Wells Valley, and the foothills of the Argus Range (CDMG, 1963; Smith, 2009).

Soils

Soils within the Proposed Project area reflect the underlying rock type, the extent of weathering of the rock, the degree of slope, and the degree of human modification. The Proposed Project is located in a mix of undeveloped desert, rural residential land, and developed city area. The National Resource Conservation Service (NRCS) U.S. General Soil Map (STATSGO2) database was reviewed to identify soil units and characteristics underlying the Proposed Project (NRCS, 2006). Detailed soil mapping was not available for the Proposed Project area. Four soil associations are mapped as underlying the Proposed Project, listed in order of prevalence: Wasco-Rosamond-Cajon, Cajon-Arizo, Rosamond-Playas-Gila-Cajon, and Trigger-rock outcrop-Calvista. The major components of these soil associations are all primarily deep to very deep, well drained alluvial soils formed on alluvial fans and floodplains.

The Wasco-Rosamond-Cajon soil association is the predominant soil association underlying the Proposed Project (underlying approximately 67 percent of the Proposed Project) and is mapped underlying most of the Inyokern-McGen-Searles No. 1 and No. 2 115-kV subtransmission lines in the Indian Wells Valley area and underlying the Inyokern and Downs Substations and the Ridgecrest Service Center. The Cajon-Arizo soil association underlies approximately 20 percent of the Proposed Project and is mapped along subtransmission/fiber optic telecommunication cable alignments where they cross the lower slopes of Salt Wells Valley and Salt Wells Canyon, where they are along the northeastern edge of the Searles Valley, and underlying the McGen Substation. The Rosamond-Playas-Gila-Cajon soil association is found underlying portions of the subtransmission/fiber optic telecommunication cable alignments that cross playa and fluvial sediments of the southern edge of China Lake and the southeastern edge of Searles Lake and underlying the Searles Substation (equaling approximately 10 percent of the Proposed Project). The last soil association, the Trigger-rock outcrop-Calvista, underlies only about 3 percent of the Proposed Project and is mapped along the subtransmission/fiber optic telecommunication cable alignments where they cross moderate slopes of Salt Wells Valley and Salt Wells Canyon.

The general description and select physical characteristics of hazards of erosion, and shrink/swell potential for these soils were reviewed to evaluate potential hazards to the Proposed Project related to unsuitable soil conditions. Table B.3.6-1 presents the general susceptibility of the soil associations underlying the Proposed Project to sheet and rill erosion[1], wind erodibility, and shrink-swell potential. Each association is made up of numerous soil units, therefore the table presents a general potential for these characteristics to occur in the association based on the major soil components of these associations.

Table B.3.6-1. Key Characteristics of Soils Underlying the Proposed Project

Soil Association	Susceptibility to Sheet and Rill Erosion [a]	Wind Erodibility [b]	Shrink-Swell Potential [c]
Wasco-Rosamond-Cajon	Low to Moderate	Moderate	Low
Cajon-Arizo	Low	Moderate to High	Low
Rosamond-Playas-Gila-Cajon	Low to Moderate	Moderate to High	Low to Moderate, high clay content Playa soils are High Potential
Trigger-rock outcrop-Calvista	Low	Low to Moderate	Low

Notes:

(a) Based on Erosion factor K (used by the NRCS in the Universal Soil Lose Equation), which indicates the susceptibility of a soil to sheet and rill erosion. Values of K range from 0.02 to 0.69 with higher values being more susceptible to sheet and rill erosion.

(b) Soils are assigned to wind erodibility groups based on their susceptibility to wind erosion, soils assigned to group 1 are the most susceptible and soils assign ted to group 8 are the least susceptible.

(c) Linear extensibility is the method used by the NRCS to determine the shrink-swell potential of soils. Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. The volume change is reported as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3 percent, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed in areas with expansive soils.

Potential soil erosion hazards vary depending on the use, conditions, and textures of the soils. The properties of soil which influence erosion by rainfall and runoff are ones that affect the infiltration capacity of a soil, and those which affect the resistance of a soil to detachment and being carried away by falling or flowing water. Additionally, soils on steeper slopes would be more susceptible to erosion due to the effects of increased surface flow (runoff) on slopes where there is little time for water to infiltrate before runoff occurs. Soils containing high percentages of fine sands and silt and that are low in density, are generally the most erodible. As the clay and organic matter content of these soils increases, the potential for erosion decreases. Clays act as a binder to soil particles, thus reducing the potential for erosion.

Expansive soils are characterized by their ability to undergo significant volume change (shrink and swell) due to variation in soil moisture content. Changes in soil moisture could result from a number of factors,

[1] Sheet and rill erosion is the removal of soil from the land surface by the action of rainfall and runoff. Sheet erosion occurs when water runs over a large uniform area picking up and distributing soil particles. Rill erosion occurs as concentrated surface runoff begins to remove soil along concentrated zones with numerous small, but conspicuous, water channels or tiny rivulets.

including rainfall, landscape irrigation, utility leakage, and/or perched groundwater. Expansive soils are typically very fine grained with a high to very high percentage of clay. Soils with moderate to high shrink-swell potential would be classified as expansive soils.

Seismicity

The Proposed Project is located within the Eastern California Shear Zone (ECSZ), which is a region of active, predominantly strike-slip, deformation east of the San Andreas fault that extends from the southern Mojave Desert along the east side of the Sierra Nevada and into western Nevada. The Eastern California Shear Zone accommodates approximately 25 percent of relative plate motion between the Pacific and North America plates and is bounded on the east by the diffuse extensional deformation of the Basin and Range region and the undeformed tectonic block of Sierra Nevada on the west (Plattner et. al., 2009 and Frankel et. al., 2008). The ECSZ is characterized by numerous geologically young right-lateral strike slip and normal-right oblique slip faults due to this combination of translational and extensional stress. These faults can be classified as historically active, active, potentially active, or inactive, based on the following criteria (CGS, 1999):

- Faults that have generated earthquakes accompanied by surface rupture during historic time (approximately the last 200 years) and faults that exhibit aseismic fault creep are defined as Historically Active.
- Faults that show geologic evidence of movement within Holocene time (approximately the last 11,000 years) are defined as Active.
- Faults that show geologic evidence of movement during the Quaternary time (approximately the last 1.6 million years) are defined as Potentially Active.
- Faults that show direct geologic evidence of inactivity during all of Quaternary time or longer are classified as Inactive.

Although it is difficult to quantify the probability that an earthquake will occur on a specific fault, this classification is based on the assumption that if a fault has moved during the Holocene epoch, it is likely to produce earthquakes in the future. Since periodic earthquakes accompanied by surface displacement can be expected to continue in the study area through the lifetime of the Proposed Project, the effects of strong groundshaking and fault rupture are of primary concern to safe operation of the Proposed Project components.

The Project area will be subject to ground shaking associated with earthquakes on faults of the San Andreas and Garlock systems, and faults of the ECSZ system in the southern Basin and Range and northern Mojave provinces. Figure B.3.6-1 (Regional Active Faults and Historic Earthquakes) shows locations of active and potentially active faults (representing possible seismic sources) and earthquakes in the region surrounding the Proposed Project. Active and potentially active faults within 50 miles of the Project alignments that are significant potential seismic sources relative to the Proposed Project are presented in Table B.3.6-2.

Two active faults systems with recent earthquakes are located in the vicinity of the Proposed Project in the Indian Wells Valley: the Little Lake fault zone and the Airport Lake fault zone. Both of these fault zones are north-striking fault zones consisting of numerous small fault segments mostly less than 6.25 miles long generally trending north to northwest with a smaller number striking northeast

Table B.3.6-2. Significant Active and Potentially Active Faults within 50-miles of the Proposed Project			
Fault Name	Distance [a] (miles)	Closest Project Component(s)	Estimated Maximum Magnitude [b]
Little Lake fault zone	0	Proposed fiber optic transmission line crosses in several locations; Downs Substation Expansion located approximately 730 feet northeast of closest segment	6.9
Southern Sierra Nevada fault	4.4	East of the Inyokern Substation, Haiwee Reservoir section is closest section to the fault	7.5
Garlock fault zone	8.5	South of the Inyokern-McGen-Searles No. 1 115-kV subtransmission line alignment	7.3
Tank Canyon fault	8.8	East of the Inyokern-McGen-Searles No. 1 115-kV subtransmission line alignment, 9.2 miles east of the Searles Substation	6.4
Airport Lake fault zone	9.7	North of the Inyokern-McGen-Searles No. 2 115-kV subtransmission line alignment	5.5-6.5 [c]
Panamint Valley fault zone	13.7	East of the McGen Substation	7.4
Blackwater fault zone	14.1	South of the Inyokern-McGen-Searles No. 1 115-kV subtransmission line alignment	7.1
Lenwood-Lockhart fault zone	25.0	South of the Inyokern-McGen-Searles No. 1 115-kV subtransmission line alignment	7.5
Gravel Hills-Harper Lake fault zone	29.1	South of the Inyokern-McGen-Searles No. 1 115-kV subtransmission line alignment	7.1
Helendale-South Lockhart fault zone	31.5	South of the Inyokern-McGen-Searles No. 1 115-kV subtransmission line alignment	7.4
Southern Death Valley fault zone	38.7	East of the McGen Substation	6.9-7.3
White Wolf fault	45.0	West of the Inyokern Substation	7.2

Notes:

(a) Fault distances obtained from USGS GIS Quaternary fault data (USGS and CGS, 2006).

(b) Maximum Earthquake Magnitude – the maximum earthquake that appears capable of occurring under the presently known tectonic framework, magnitude listed is "Ellsworth-B" magnitude from USGS OF08-1128 (Documentation for the 2008 Update of the United States National Seismic Hazard Maps) unless otherwise noted.

(c) Fault parameters from the Southern California Data Center website (SCEDC, 2011a).

(Bhattacharyya and Lees, 2002). The faults merge in the north with the Sierra Nevada frontal fault near the rupture zone of the 1872 Owens Valley earthquake. The Little Lake and Airport Lake fault zones were both formed by the regional tectonic stress field of the western Basin and Range province (i.e., right-slip shear and east-west extension). The pattern of faulting, though, differs between the Little Lake fault and the Airport Lake fault. The Little Lake fault shows predominantly right slip with a slight normal-slip component toward the central and the southern parts. On the other hand, the Airport Lake fault accommodates predominantly normal slip (Bhattacharyya and Lees, 2002).

Other active and potentially active faults near to the Proposed Project include the Southern Sierra Nevada fault zone, the Garlock fault zone, and the Tank Canyon fault. The Southern Sierra Nevada fault zone is a north-south trending potentially active Quaternary fault, with several segments that have experienced Holocene movement, including the Haiwee Reservoir section of the fault which is located approximately 4.4 miles west of the Proposed Project (USGS, 2011a). The Garlock fault zone is a major active (Holocene), east to northeast-striking left lateral strike-slip fault that forms the boundary between the Tehachapi Mountains, Sierra Nevada, and Basin and Range province on the north and the Mojave Desert province to the south. The Garlock fault zone is divided into three sections, with the

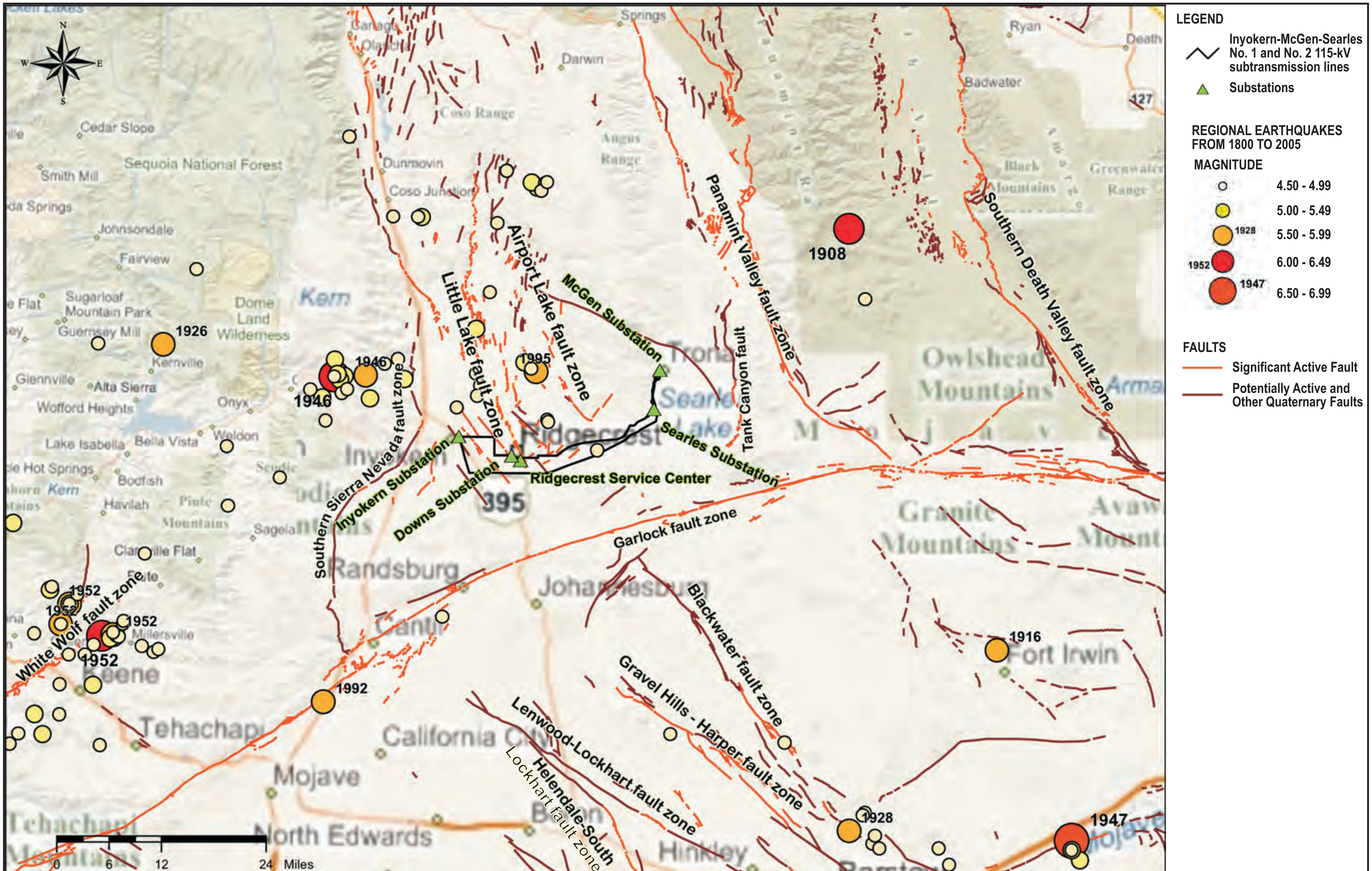


Figure B.3.6-1
Regional Active Faults and Historic Earthquakes

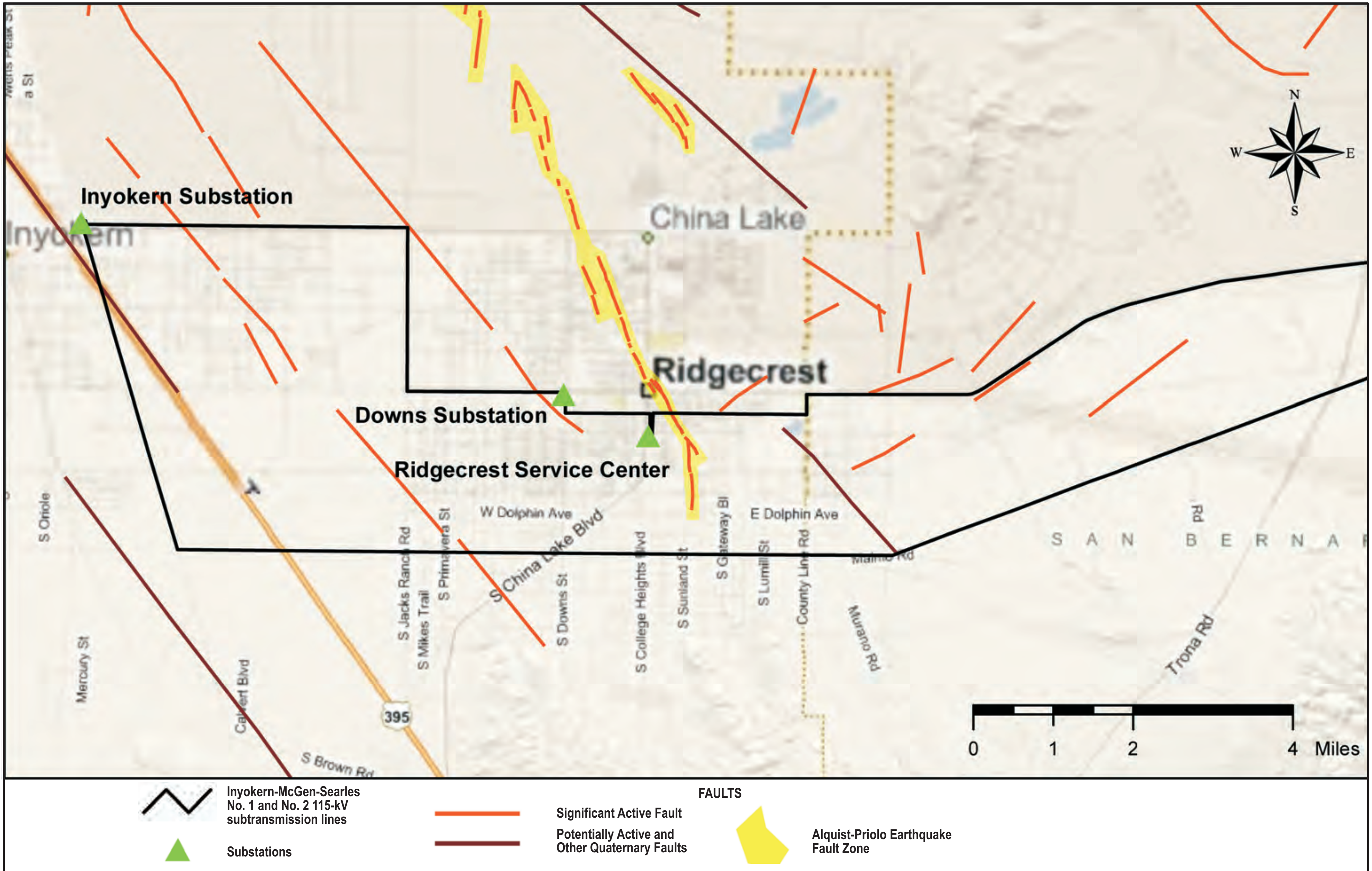
central section being the closest to the Proposed Project. Although, no earthquakes have produced surface rupture on the Garlock fault in historic times, there have been a few large earthquakes recorded along the Garlock fault zone, with the most recent being a Moment Magnitude (M) 5.7 near the town of Mojave on July 11, 1992 (SCEDC, 2011b). The Tank Canyon Fault is a Holocene aged north-south trending range front normal fault located east of Trona on the east side of Searles Lake along the Slate Range range front.

Fault Rupture. Fault rupture is the surface displacement that occurs when movement on a fault deep within the earth breaks through to the surface. Fault rupture and displacement almost always follows preexisting faults, which are zones of weakness, however not all earthquakes result in surface rupture (i.e., earthquakes that occur on blind thrusts do not result in surface fault rupture). Rupture may occur suddenly during an earthquake or slowly in the form of fault creep. In addition to damage cause by ground shaking from an earthquake, fault rupture is damaging to buildings and other structures due to the differential displacement and deformation of the ground surface that occurs from the fault offset leading to damage or collapse of structures across this zone.

The proposed new fiber optic telecommunication cable alignments cross and are in close proximity to several strands of the Little Lake fault zone, with an Alquist-Priolo zoned segment crossing the Inyokern-McGen-Searles No. 2 115-kV subtransmission alignment along East Church Street near South Fire Opal Street, as shown in Figures B.3.6-1 and B.3.6-2. The Proposed Downs Substation Expansion site is also located close to several segments of the Little Lake fault zone; with the closest segment located approximately 730 feet southwest of the expansion area boundary and the next closest (the Alquist-Priolo zoned segment) located approximately 5,400 feet east of the Downs Substation. Although the Proposed Project crosses and is located close to segments of the Little Lake fault zone, no new structures are planned in the areas where the Little Lake fault segments cross the new telecommunications alignments along the Inyokern-McGen-Searles No. 1 and No. 2 115-kV subtransmission lines.

Ground Shaking. An earthquake is classified by the amount of energy released, which traditionally has been quantified using the Richter scale. Recently, seismologists have begun using a Moment Magnitude (M) scale because it provides a more accurate measurement of the size of major and great earthquakes. For earthquakes of less than M 7.0, the Moment and Richter Magnitude scales are nearly identical. For earthquake magnitudes greater than M 7.0, readings on the Moment Magnitude scale are slightly greater than a corresponding Richter Magnitude.

The intensity of the seismic shaking, or strong ground motion, during an earthquake is dependent on the distance between the Project area and the epicenter of the earthquake, the magnitude of the earthquake, and the geologic conditions underlying and surrounding the Project area. Earthquakes occurring on faults closest to the Project area would most likely generate the largest ground motion. The intensity of earthquake induced ground motions can be described using peak site accelerations, represented as a fraction of the acceleration of gravity (g). The USGS National Seismic Hazard (NSH) Maps were used to estimate approximate peak ground accelerations (PGAs) in the Proposed Project area. The NSH Maps depict peak ground accelerations with a 2 percent probability of exceedence in 50 years which corresponds to a return interval of 2,475 years for a maximum considered earthquake. The estimated approximate peak ground acceleration from large earthquakes for the Proposed Project ranges from approximately 0.45g to 0.56g for earthquake recurrence interval 2,475 years (USGS, 2011b), which corresponds to moderate to strong ground shaking.



Aspen Environmental Group

Figure B.3.6-2
Little Lake Fault Zone

The Indian Wells Valley has a long history of seismic activity with earthquake swarms occurring related to both tectonic and geothermal activity with most of the earthquakes in the area being of less than M 3.0. Larger earthquakes, greater than M 4.9, have been recorded in the region on an approximate 20 year interval, in 1938, 1961, 1982, and 1995 (Bhattacharyya and Lees, 2002). The M 5 1938, M 5.2 1961, and the M 4.9 1982 sequences were on the Little Lake fault zone. The 1995 Ridgecrest earthquake sequence started with a M 5.4 quake on August 17, 1995, centered 11 miles north of the town of Ridgecrest on the Airport Lake fault zone, and spawned over 2,500 aftershocks over the course of the following five weeks. On September 20, 1995, a M 5.8 earthquake occurred centered approximately 1.25 miles southeast of the August 17, 1995 shock. The M 5.8 was at that time the largest earthquake to hit southern California since the January 17, 1994, Northridge earthquake, and still is the largest earthquake ever recorded in the immediate area, though larger quakes are possible along some of the nearby fault zones such as the Garlock fault zone. Over 1,900 aftershocks were recorded in the first two weeks following the September 20, 1995 quake and several thousand more aftershocks have been recorded in the area since the main earthquake on that date (SCEDC, 2011c). Previous earthquake activity and this swarm of aftershocks showed some spatial migration, with earthquakes occurring both northeast and southeast of the original epicentral region. At least four small faults in the southern portion of the Airport Lake fault zone slipped in the course of the two main shocks and the larger aftershocks. About one centimeter of total surficial triggered right-oblique slip was seen on an approximately 1.9-mile long fault segment roughly 1.9 miles northwest of the epicentral area. No obvious surface rupture was found along the fault segment believed to have caused the two main shocks (SCEDC, 2011c).

Liquefaction. Liquefaction is the phenomenon in which saturated granular sediments temporarily lose their shear strength during periods of earthquake-induced strong groundshaking. The susceptibility of a site to liquefaction is a function of the depth, density, and water content of the granular sediments and the magnitude and frequency of earthquakes in the surrounding region. Saturated, unconsolidated silts, sands, and silty sands within 50 feet of the ground surface are most susceptible to liquefaction. Liquefaction-related phenomena include lateral spreading, ground oscillation, flow failures, loss of bearing strength, subsidence, and buoyancy effects (Youd and Perkins, 1978). In addition, densification of the soil resulting in vertical settlement of the ground can also occur.

In order to determine liquefaction susceptibility of a region, three major factors must be analyzed. These include: (a) the density and textural characteristics of the alluvial sediments; (b) the intensity and duration of groundshaking; and (c) the depth to groundwater.

In the southern Indian Well Valley area groundwater is relatively deep, with depths ranging from 70 to 300 feet below ground surface (bgs) from east to west along the general trend of the Proposed Project (Couch et. al., 2003). Groundwater levels in the Salt Wells Canyon basin range from approximately 20 to 80 feet bgs (DWR, 2011). In the Searles Valley area groundwater levels are very shallow (less than 10 feet bgs) east of Highway 178 in the vicinity of Searles Lake; however, on the west side of the highway groundwater levels are generally somewhat deeper ranging from near ground surface to approximately 60 feet bgs (DWR, 2011). Thus loose alluvial sediments in the Salt Wells Canyon and Searles Valley may be susceptible to liquefaction in the event of earthquake-induced strong ground shaking.

Seismic Slope Instability. The other form of seismically-induced ground failure which may affect the Project area includes seismically-induced landslides. Landslides triggered by earthquakes have been a significant cause of earthquake damage; in southern California large earthquakes such as the 1971 San Fernando and 1994 Northridge earthquakes triggered landslides that were responsible for destroying or damaging numerous structures, blocking major transportation corridors, and damaging life-line infrastructure. Areas that are most susceptible to earthquake-induced landslides are steep slopes in poorly cemented or highly fractured rocks, areas underlain by loose, weak soils, and areas on or adjacent to existing landslide deposits. The only portions of the Proposed Project that are located on or adjacent to hill slope areas are the new subtransmission/fiber optic telecommunication cable alignments along the Inyokern-McGen-Searles No. 1 and No. 2 115-kV subtransmission lines where they cross along and below gentle to moderate slopes of Salt Wells Canyon and Salt Wells Valley, and the foothills of the Argus Range. These areas are generally underlain by granitic bedrock with a mantle of lacustrine and alluvial deposits that are not likely to generate substantial landslides in the event of an earthquake.

Applicable Standards and Regulations

Federal. *The Clean Water Act* establishes the basic structure for regulating discharges of pollutants into the waters of the United States. The Act authorized the Public Health Service to prepare comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries and improving the sanitary condition of surface and underground waters with the goal of improvements to and conservation of waters for public water supplies, propagation of fish and aquatic life, recreational purposes, and agricultural and industrial uses. The Proposed Project construction would disturb a surface area greater than one acre; therefore, SCE would be required to obtain under Clean Water Act regulations a National Pollution Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activity. Compliance with the NPDES would require that the applicant submit a Storm Water Pollution Prevention Plan (SWPPP).

The *International Building Code (IBC)* is published by the International Code Council (ICC), the scope of this code covers major aspects of construction and design of structures and buildings, except for three-story one- and two-family dwellings and town homes. The International Building Code has replaced the Uniform Building Code as the basis for the California Building Code and contains provisions for structural engineering design. The 2009 IBC addresses the design and installation of structures and building systems through requirements that emphasize performance. The IBC includes codes governing structural as well as fire- and life-safety provisions covering seismic, wind, accessibility, egress, occupancy, and roofs.

The *Institute of Electrical and Electronics Engineers (IEEE) 693 "Recommended Practices for Seismic Design of Substations"* was developed by the Substations Committee of the IEEE Power Engineering Society, and approved by the American National Standards Institute and the IEEE-SA Standards Board. This document provides seismic design recommendations for substations and equipment consisting of seismic criteria, qualification methods and levels, structural capacities, performance requirements for equipment operation, installation methods, and documentation. This recommended practice emphasizes the qualification of electrical equipment. IEEE 693 is intended to establish standard methods of providing and validating the seismic withstand capability of electrical substation equipment. It provides detailed test and analysis methods for each type of major equipment or component found in electrical substations. This recommended practice is intended to assist the substation user or operator in providing substation equipment that will have a high probability of withstanding seismic events to predefined ground acceleration levels. It establishes standard methods of verifying seismic withstand capability, which gives the substation designer the ability to select equipment from various manufacturers, knowing that the seismic withstand rating of each manufacturer's equipment is an equivalent measure. Although most damaging seismic activity occurs in limited areas, many additional areas could experience an earthquake with forces capable of causing great damage. This recommended practice should be used in all areas that may experience earthquakes.

State. The *California Building Code, Title 24, Part 2* (CBC, 2010) provides building codes and standards for design and construction of structures in California. The 2010 CBC is based on the 2009 International Building Code with the addition of more extensive structural seismic provisions. As the Proposed Project lies within Seismic Zone 4, provisions for design should follow the requirements of Chapter 16 of the CBC, which contains definitions of seismic sources and the procedure used to calculate seismic forces on structures.

The *Alquist-Priolo Earthquake Fault Zoning Act* of 1972, Public Resources Code (PRC), sections 2621–2630 (formerly the Special Studies Zoning Act) regulates development and construction of buildings intended for human occupancy to avoid the hazard of surface fault rupture. While this act does not specifically regulate transmission and telecommunication lines; it does help define areas where fault rupture is most likely to occur. This Act groups faults into categories of active, potentially active, and inactive. Historic and Holocene age faults are considered active, Late Quaternary and Quaternary age faults are considered potentially active, and pre-Quaternary age faults are considered inactive. These classifications are qualified by the conditions that a fault must be shown to be “sufficiently active” and “well defined” by detailed site-specific geologic explorations in order to determine whether building setbacks should be established.

The *Seismic Hazards Mapping Act* (the Act) of 1990 (Public Resources Code, Chapter7.8, Division 2, sections 2690–2699.) directs the California Department of Conservation, Division of Mines and Geology [now called California Geological Survey (CGS)] to delineate Seismic Hazard Zones. The purpose of the Act is 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. The Act requires that site-specific geotechnical investigations be performed prior to permitting most urban development projects within seismic hazard zones.

California Public Utilities General Order 95 (GO95) and *General Order 128* (GO128) contain State of California rules formulated to provide uniform requirements for overhead electrical line construction and underground electrical supply and communication systems, respectively, to insure adequate service and secure safety to persons engaged in the construction, maintenance, operation or use of overhead electrical lines and underground electrical supply and communication systems and to the public. GO95 and GO 128 are not intended as complete construction specifications, but to embody requirements which are most important from the standpoint of safety and service. Construction shall be according to accepted good practice for the given local conditions in all particulars not specified in the rules. GO95 applies to all overhead electrical supply and communication facilities which come within the jurisdiction of the California Public Utilities Commission, located outside of buildings, including facilities that belong to non-electric utilities, as follows: Construction and Reconstruction of Lines, Maintenance of Lines, Lines Constructed Prior to This Order, Reconstruction or Alteration, Emergency Installation, and Third Party Nonconformance. GO128 applies to (a) all underground electrical supply systems used in connection with public utility service; when located in buildings, the vaults, conduit, pull boxes or other enclosures for such systems shall also meet the requirements of any statutes, regulations or local ordinances applicable to such enclosures in buildings; and (b) all underground communication systems used in connection with public utility service located outside of buildings. GO128 applies to the following activities related to underground electrical supply and communication systems: Construction and

Reconstruction of Lines, Maintenance, Systems Constructed Prior to These Rules, Reconstruction or Alteration, and Third Party Nonconformance.

City of Ridgecrest. The city of Ridgecrest contracts with Kern County to conduct inspections; the County permit requirements identify that foundation and soils investigation would likely be required per CBC Chapter 18 and that most commercial projects must be designed, and all plans and documents stamped, by a qualified architect or engineer licensed by the State of California prior to issuance of a building permit. The City and County currently use the 2010 CBC.

Kern County. Construction and operation of the Proposed Project is subject to policies and regulations contained within General and Specific Plans including the Kern County General Plan, the Kern County Zoning Ordinance, and the Kern County Code of Building Regulations, which include policies for the avoidance of geologic hazards and/or the protection of unique geologic features. The Safety Element (Chapter 4) of the Kern County General Plan (County of Kern, 2009) provides policies and measures to minimize injuries and loss of life and reduce property damage from seismic and geologic hazards. The main policy relevant to the Proposed Project is "The County shall encourage extra precautions be taken for the design of significant lifeline installations, such as highways, utilities, and petrochemical pipelines". Proper design of the Project facilities, including any and all mitigation measures outlined in this document, would comply with this policy and would be consistent with the Safety Element.

San Bernardino County. Construction and operation of the Proposed Project is subject to policies and regulations contained within the San Bernardino County Development Code, and the San Bernardino General Plan which include policies and regulations for the avoidance of geologic hazards and/or the protection of unique geologic features. The Safety Element section of the San Bernardino County General Plan (County of San Bernardino, 2007) provides for mitigation of geologic hazards through a combination of engineering, construction, land use and development standards. The Plan addresses the geologic hazards present within the county, including fault rupture, ground shaking, liquefaction, seismically-generated subsidence, seiche and dam inundation, landslides/mudslides, non-seismic subsidence, erosion and volcanic activity. The county has prepared Hazard Overlay Maps to address fault rupture, liquefaction hazards and landslide hazards. Special consideration, including possible engineering/geologic evaluation, is required for development of sites designated on the maps. Additionally, the County Building and Safety Department enforces Building Standards adopted by the State of California and the County of San Bernardino including the California Building Code contained in Title 24 of the California Code of Regulations.

B.3.6.2 Environmental Impacts and Mitigation Measures

a. ***Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:***

   i) ***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? Refer to Division of Mines and Geology Special Publication 42.***

LESS THAN SIGNIFICANT. The proposed new overhead fiber optic telecommunication cable alignments cross and are in close proximity to several strands of the Little Lake fault zone in the Indian Wells Valley, with an Alquist-Priolo zoned segment crossing the Inyokern-McGen-Searles No. 2 115-kV subtransmission alignment along East Church Street near South Fire Opal Street in Ridgecrest, as shown in Figures B.3.6-1 and B.3.6-2. However, the only new infrastructure that would be installed in the areas where the alignments cross these faults segments in the Indian Wells Valley is the fiber optic telecommunication cable that is proposed to be installed on to the existing 115-kV subtransmission poles. These poles have been designed to a wind loading standard that generally also exceeds seismic loading criteria, thus reducing the risk of a pole failing during a seismic event and it is not expected that the addition of the fiber optic cable to the existing poles would add substantial instability to the existing overhead structures in the Indian Wells Valley area. Additionally, only short portions of the 115-kV subtransmission lines (and fiber optic telecommunication cable) would cross the active segment of the Little Lake fault zone.

With the exception of the new overhead fiber optic telecommunication cable alignments in the Indian Wells Valley area, none of the new structures to be constructed as part of the Proposed Project, including the Downs Substation expansion equipment and the associated new poles; underground substructures for the new fiber optic telecommunications at the Inyokern Substation, Downs Substation, Searles Substation, McGen Substation, and the Ridgecrest Service Center; and the six replacement wood poles along the Inyokern-McGen-Searles No. 1 115-kV subtransmission line in the Searles Valley are located across or near to any mapped fault traces. Therefore, there is no potential for damage to Project structures or hazards to people from the Proposed Project from surface fault rupture. The impact from surface fault rupture for the Proposed Project would be less than significant and no mitigation is required.

ii) Strong seismic ground shaking?

LESS THAN SIGNIFICANT. The majority of the Proposed Project area is located in an area mapped as likely to experience moderate to strong ground shaking in the event of a large earthquake. The area has historically experienced minor to moderate groundshaking due to the numerous earthquakes that have occurred in the Indian Wells Valley. Although the Proposed Project is located in an area that may experience strong groundshaking due to large local or regional earthquakes, new structures at the Downs Substation would be designed as required by the Institute of Electrical and Electronic Engineers per guidelines in IEEE 693 (Recommended Practices for Seismic Design of Substations), and the structures for the Proposed Project's new 115-kV subtransmission line segments, new poles, and new underground substructures for the new fiber optic telecommunications cable at the substations and service center would be designed as required by California Public Utilities Commission General Orders 95 and 128 (overhead electrical line construction requirements and underground electrical supply and communication systems requirements, respectively). Design of these new structures to the above referenced guidelines and standards would reduce any potential damage from groundshaking to these features to less than significant.

The remainder of the Proposed Project consists of the installation of the fiber optic telecommunications cable on the existing poles of the Inyokern-McGen-Searles No. 1 and No.2 115-kV subtransmission lines. Six of the existing poles on the Inyokern-McGen-Searles No. 1 115-kV subtransmission line are being replaced as part of the Proposed Project because they do not meet wind loading design requirements with the addition of the fiber optic cable. These six poles are being replaced to ensure wind loading design loading criteria is met with the additional weight of the fiber optic telecommunication cable. The existing and new poles will be and have been designed to a wind loading standard that generally also exceeds seismic loading criteria, thus reducing the risk of a pole failing during a seismic event. It is not expected that the addition of the fiber optic cable to the existing and replacement poles would add substantial instability to the existing overhead structures; the potential for earthquake-induced groundshaking damage to the poles along most of the overhead transmission/fiber optic telecommunications alignment would not change from the current conditions, resulting in a less-than-significant impact.

iii) Seismic-related ground failure, including liquefaction?

LESS THAN SIGNIFICANT WITH MITIGATION INCORPORATED. The portions of the Proposed Project located in the Indian Wells Valley area have low to no potential for liquefaction due to the anticipated deep groundwater in the area (depths ranging from 70 to 300 feet from east to west) and would not suffer damage due to seismically related ground failure or liquefaction. Additionally, the areas of Ridgecrest the Proposed Project passes through are mapped outside of city of Ridgecrest "potential liquefaction hazard" areas (City of Ridgecrest, 1994). However, portions of the Proposed Project located within loose alluvial sediments of Salt Wells Canyon and Searles Valley, where there is a potential for shallow groundwater, may be subject to liquefaction in the event of strong ground shaking. Generally, the addition of fiber optic telecommunication cable along existing poles in these potentially liquefiable areas is not expected to add substantial instability to the existing overhead structures, with the exception of the six poles to be replaced in the Searles Valley because they do not meet CPUC GO95 wind loading requirements and/or SCE design standards with the addition of the fiber optic cable. The potential for liquefaction related damage to the existing poles along most of the overhead transmission/fiber optic telecommunications alignment in Salt Canyon and Searles Valley would not change from the current conditions with the addition of the fiber optic cable, resulting in a less-than-significant impact for this portion of the Proposed Project.

However, the new project structures proposed to be constructed in the Searles Valley area, including the six replacement poles and the new underground substructures for the fiber optic telecommunications cable at the Searles and McGen Substation, are located in an area with potentially liquefiable alluvial sediment and could potentially suffer liquefaction related damage in a large earthquake if not properly designed. As required by California Public Utilities Commission General Orders 95 and 128 these structures would be designed to withstand seismic loading; however, to ensure that impacts associated with seismically induced ground failures or liquefaction would be less than significant, Mitigation Measure G-1 (Conduct geotechnical investigations for liquefaction) shall be implemented prior to final project design to ensure that people or structures are not exposed to hazards associated with earthquake-induced liquefaction.

Mitigation Measure for Seismic-related Ground Failure and Liquefaction

G-1 **Conduct geotechnical investigations for liquefaction.** Because seismically-induced liquefaction related ground failure has the potential to damage or destroy Project components, the design-level geotechnical investigations to be performed by the SCE shall include investigations designed to assess the potential for liquefaction to affect the new Project structures within Searles Valley in areas with potential liquefaction-related impacts. Where these hazards are found to exist, appropriate engineering design and construction measures shall be incorporated into the Project designs as deemed appropriate by the project engineer. Design measures that would mitigate liquefaction-related impacts could include ground improvement of liquefiable zones, installation of flexible bus connections, and incorporation of slack in cables to allow ground deformations without damage to structures. Study results and proposed solutions to mitigate liquefaction shall be provided to the CPUC and BLM, as appropriate, for review and approval at least 60 days before final Project design.

iv) Landslides?

LESS THAN SIGNIFICANT. Most of the Proposed Project crosses the gently sloping alluvial fans of the Indian Wells Valley and western Searles Valley. However, the Proposed Project subtransmission/fiber optic telecommunication cable alignment along the Inyokern-McGen-Searles No. 1 alignment passes through the moderately sloping hills of the Salt Wells Canyon. This area is generally underlain by granitic bedrock with a mantle of lacustrine and alluvial deposits that are not likely to generate substantial landslides in the event of an earthquake. Additionally, no landslides or landslide deposits are mapped along the subtransmission/fiber optic telecommunication cable alignments where they cross through Salt Wells Canyon and Salt Wells Valley, or the foothills of the Argus Range (USGS, 1963; Smith, 2009). Therefore, the impact from landslides for the Proposed Project would be less than significant and no mitigation is required.

b. Would the project result in substantial soil erosion or the loss of topsoil?

LESS THAN SIGNIFICANT IMPACT. Increased rates of soil erosion are not expected to result from the installation of poles for the new proposed 115-kV subtransmission line segments or replacement of six existing wood poles on the existing Inyokern-McGen-Searles No. 1 115-kV subtransmission line route due to the limited amount of surface ground disturbance anticipated for construction of these features. Additionally, installation of the fiber optic telecommunication cable in areas of existing overhead structures is not expected to create substantial ground disturbance that would cause increased levels of soil erosion.

Areas of trenching and grading for the Downs Substation expansion, and for installation of the new underground substructures for the fiber optic telecommunications cables at the Inyokern, Downs, Searles, and McGen Substations and the Ridgecrest Service Center would present the highest risk of adverse impacts. The soils in these areas with the highest ground disturbance for the Proposed Project have low to moderate susceptibility for sheet and rill erosion and moderate to high wind erodibility. However, the Stormwater Pollution Prevention Plan (SWPPP), which would be required in accordance with the Clean Water Act, would limit erosion from the construction sites. This would result in a less-than-significant impact with no additional mitigation required.

c. Would the project be located on geologic units 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?

LESS THAN SIGNIFICANT IMPACT. As discussed above in Section B.3.6.2 a) iii - Liquefaction, portions of the Proposed Project where new project structures would be constructed in the Searles Valley area are located in an area with potentially liquefiable alluvial sediment and could potentially suffer liquefaction related damage; however, implementation of Mitigation Measure G-1 (Conduct geotechnical investigations for liquefaction) prior to final project design would ensure that people or structures are not exposed to hazards associated with earthquake-induced liquefaction reducing the impact to less than significant. Additionally, as discussed above in Section B.3.6.2 a) iv – Landslides, a portion of the subtransmission/fiber optic telecommunication cable alignment along the Inyokern-McGen-Searles No. 1 alignment passes through the moderately sloping hills of the Salt Wells Canyon that is generally underlain by granitic bedrock with a mantle of lacustrine and alluvial deposits that are not likely to generate substantial landslides in the event of an earthquake. Additionally, the only work in this area would consist of the installation of the fiber optic telecommunications cable on the existing poles, which is not likely to trigger landslides or create unstable slopes. Therefore, the impact from landslides for the Proposed Project would be less than significant and no mitigation is required.

d. Would the project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

LESS THAN SIGNIFICANT WITH MITIGATION INCORPORATED. Expansive soils would only be a problem for components of the Proposed Project where new structures are being installed at or below the ground surface. Soils underlying most of the new components for the Proposed Project are the Wasco-Rosamond-Cajon and Cajon-Arizo soil associations, which have low shrink-swell potential due to their low clay content. However, the mapped soil association underlying the proposed new underground substructures for the fiber optic telecommunications cable at and adjacent to the Searles Substation is the Rosamond-Playas-Gila-Cajon association, which has a shrink-swell potential that ranges from low to high depending on the amount of high clay playa soils present within the local soil profile. Unidentified expansive soils could damage project structures and facilities resulting in a significant impact. Implementation of Mitigation Measure G-2 (Conduct geotechnical studies for expansive soils) is required to ensure that impacts associated with expansive soils are reduced to less-than-significant levels.

Mitigation Measure for Expansive Soils

G-2 **Conduct geotechnical studies for expansive soils**. Because expansive soils have the potential to cause damage or destroy new Project components at and near the Searles Substation, the design-level geotechnical studies to be performed by SCE shall identify the presence, if any, of areas with potentially expansive soils and include appropriate design features, including excavation of potentially expansive soils during construction and replacement with engineered backfill, ground-treatment processes, and redirection of surface water and drainage away from expansive soils. Studies shall conform to industry standards of care and American Society for Testing and Materials (ASTM) standards for field and laboratory testing. Study results and proposed solutions shall be provided to the CPUC for review and approval at least 60 days before final project design.

e. Would the project have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?

NO IMPACT. The Proposed Project would include permanent new restroom facilities at the proposed Downs Substation expansion site if connections to the city of Ridgecrest sewer system are available. If a sewer connection is not available at the Downs Substation expansion site, a portable chemical restroom would be located within the Downs Substation perimeter fencing in the event that an alternate public restroom or SCE facility with restroom facilities does not exist within 1.5 miles of the site. No septic system would be installed at this site. No other components of the Proposed Project would require new connections to a sewer or septic system. Thus, there would be no impact from disposal of wastewater.