D.13 Geology, Mineral Resources, and Soils

D.13.1 Regional Setting and Approach to Data Collection

This section presents a discussion of the regional topography, geology, seismicity, soils, and mineral resources in the project area, followed in Section D.13.2 by a more specific discussion of each of these issues by segment along the proposed route.

Baseline geologic information was collected from published and unpublished geologic, seismic, and geotechnical literature covering the Proposed Project and surrounding areas. The literature review was supplemented by a field reconnaissance of the proposed and alternative routes. The literature review and field reconnaissance focused on the identification of specific geologic hazards, mineral resources, and soil conditions.

D.13.2 Environmental Setting for the Proposed Project – Devers-Harquahala

Regional Physiography

Arizona

The Arizona portion of the Proposed Project lies within the Sonoran Desert Province, a subregion of the Basin and Range Geomorphic Province (also called the Intermontane Division). The Sonoran Desert is characterized by widely separated short mountain ranges in desert plains. The plains form approximately 70 percent of the total area. The mountain ranges trend northwest, north, and northeast, and exhibit advanced stages of erosion and subdued topography. Desert plains and mountains that the project route crosses include: the Tonopah Desert, the Harquahala Plain, the Ranegras Plain, the La Posa Plain, the New Water Mountains, and the Dome Rock Mountains. The project alignment also passes along the edges of the Big Horn and Eagletail mountains.

California

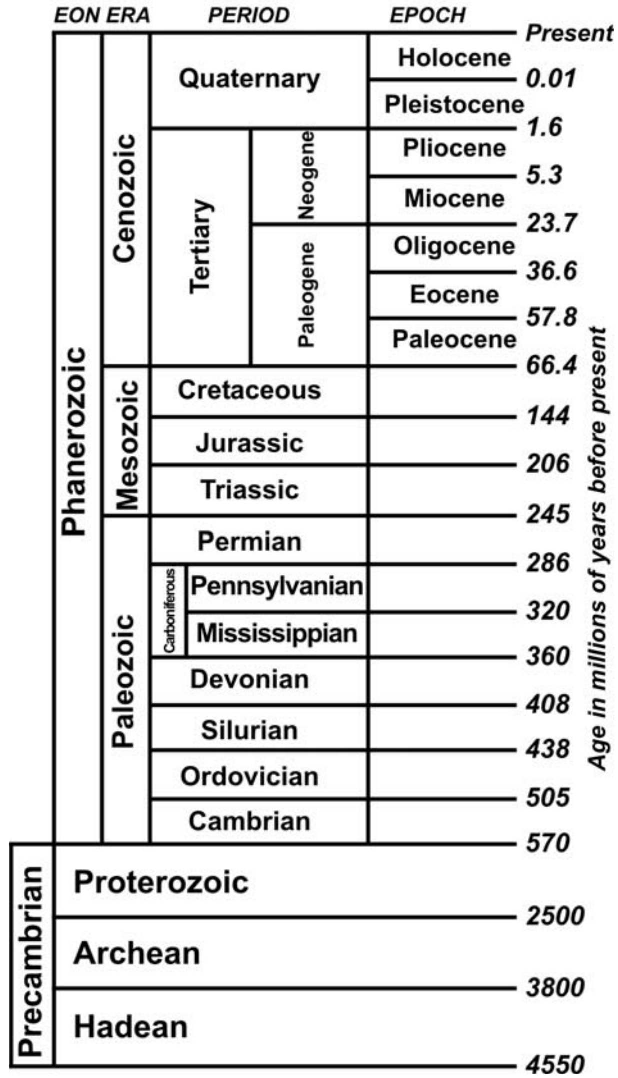
The California portion of the Proposed Project is near the junction of three major physiographic provinces in California: the Colorado Desert, the northern edge of the Peninsular Ranges, and the Transverse Ranges. As such, the region is geologically complex with a variety of rock types, faults, and geologic features. The route skirts the edges of fault-bounded mountain ranges, and crosses desert features such as badlands (i.e., barren dissected and eroded hills and gullies that are formed in semiarid regions with sparse vegetation and that experience high rates of erosion, usually formed in areas underlain by soft or weakly cemented fine grained geologic units), sand dunes, alluvial fans and pediments, and broad desert valleys dissected by numerous arroyos and washes. Mountains in the Transverse Ranges are generally east-west trending and in the project area include the San Bernardino, Little San Bernardino, Cottonwood, and the Indio Hills. The Peninsula Ranges are a northwest trending set of fault-bounded mountains and valleys, south of the Transverse Ranges, and in the project area include the northern end of the San Jacinto Mountains and the hills known as the San Timoteo Badlands. The Colorado Desert region lies mostly at a low elevation and consists of desert basins with interspersed northwest-trending mountain ranges. In the Colorado Desert, the project route traverses several valleys, including the Chuckwalla and Coachella Valleys (desert valleys) and the Palo Verde Valley, which is a river valley of the Colorado River. The proposed route skirts the edge of several mountain ranges, including the Chuckwalla, the Orocopia, and the Mecca Hills.

Geology

The Devers-Harquahala segment of the proposed route is underlain in various areas by sedimentary, volcanic, and metamorphic units ranging in age from Quaternary to Mesozoic. Figure D.13-1 (see enclosed CD) shows the geologic time scale indicating the breakdown of geologic time units and corresponding ages.

The proposed route in Arizona generally traverse alluvial plains, alluvial fans and pediments, and several mountain ranges. The California segments of the route generally cross alluvial plains and valleys, alluvial fans and pediments, mountain passes, and hills. General descriptions of the geologic materials, listed chronologically, crossed by the proposed route are summarized in Table D.13-1.

Figure D.13-1.
GEOLOGIC TIME SCALE



Source: USGS, 2006a.

Slope Stability

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. 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.

Most of the proposed and alternative routes do not cross any areas identified as existing landslide. Unmapped landslides and areas of localized slope instability may be encountered in the hills traversed by the Proposed Project route.

Table D.13-1. Summary of Geologic Units along the Devers-Harquahala 500 kV Segment

Formation or Feature	Age	Description/Comment	Excavation Characteristics[1]
Arizona			
Qs – Undivided Surficial Deposits	Quaternary (Holocene and Pleistocene)	Mixture of alluvial and talus deposits consisting of poorly consolidated sand, silt, gravel. Older units characterized by covering of desert pavement.	Easy
QTs – Younger Sediments	Plio-Pleistocene	Coarse alluvial fan deposits consisting of sand, silt, gravel, and local conglomerate. Surfaces are highly dissected.	Easy
Qb - Basalt	Quaternary	Basalt flows, tuffs, and agglomerates.[2]	Difficult
QTb - Basalt	Plio-Pleistocene (predominantly Pliocene)	Older basalt flows, tuffs, and agglomerates. Locally may include scoria, flow breccias, and phenocrysts of olivine, pyroxene, and plagioclase.	Difficult
Ki – Dikes and Plugs	Cretaceous	Rhyolitic to andesitic intrusive dikes and volcanic plugs.	Difficult
Kr - Rhyolite	Cretaceous ~~(predominantly Miocene)~~	Felsic volcanics consisting of rhyolitic flows, flow breccias, dikes, plugs, and tuffs.	Difficult
Ka - Andesite	Cretaceous ~~(Miocene to Oligocene)~~	Andesite lava flows, breccias, tuffs, and agglomerates. In some areas forms large masses which may be partially intrusive.	Difficult
Ms – Undivided Metasedimentary rocks	Middle to late Mesozoic (Cretaceous or Jurassic)	Metasedimentary rocks including shale, sandstone, and conglomerate, with minor phyllite, and quartzite.	Moderate
Msch - Schist	Mesozoic (Jurassic to Triassic)	Miscellaneous schist units, may include light green, gray, and purple serictie-feldspar to quarts poor schists.	Moderate
Mgn - Gneiss	Mesozoic	Miscellaneous gneissic units.	Difficult
California			
Qs – Recent Dune Sand	Holocene	Wind blown sand, mostly in the form of dunes.	Easy
Qal – Recent Alluvium	Holocene	Unconsolidated alluvial fan, river channel, and stream deposits consisting of silt, sand, clay, and gravel. Also includes recent floodplain deposits of the Colorado River (silt, sand, and clay).	Easy
Qc – Nonmarine Sedimentary Deposits	Pleistocene	Older alluvium and fanglomerate, dissected with well-developed desert pavement and desert varnish in some areas. Consists mostly of clay, siltstone, sand, and gravel.	Easy
Qco – Nonmarine Sedimentary Deposits	Pleistocene	Older folded or uplifted fan deposits, very dissected. Locally extensively folded and faulted. Consists of conglomerate, sandstone, and clay; boulder conglomerate in some areas along margins of the Coachella Valley.	Easy
QP – Nonmarine Sedimentary Deposits	Plio-Pleistocene	Gray to brown conglomerate, arkosic sandstone, siltstone, and red claystone.	Easy
E – Marine Sedimentary Rocks	Eocene	Locally known as Maniobra Formation, consists of marine siltstone, sandstone, conglomerate, and breccia with some sandy limestone.	Moderate
gr – Granitic Rocks	Mesozoic	Granitic rock of several types and may include granite, quartz monzonite, diorite, and granodiorite.	Difficult
gr-m - Granitic and Metamorphic Rocks	Pre-Cenozoic (mostly Mesozoic)	Expected to be encountered only in the subsurface beneath Qal and Qc. Mixed rocks consisting mostly of Mesozoic granites with intruded older (Precambrian) gneisses and schists.	Difficult

Table D.13-1. Summary of Geologic Units along the Devers-Harquahala 500 kV Segment

Formation or Feature	Age	Description/Comment	Excavation Characteristics[1]
p€g - Gneiss	Precambrian	Expected to be encountered only in the subsurface beneath Qal and Qc. Primarily the Pinto Gneiss formation, which consists of gneiss, augen gneiss, Granitic gneiss, with some amphibolite, migmatite, and quartzite.	Difficult

Sources: AZGS, 1960; AZGS, 1957; CGS, 1966; and CGS, 1967.
1 Excavation characteristics are very generally defined as “easy,” “moderate,” or “difficult” based on increasing hardness of the rock unit. Excavation characteristic descriptions are general in nature and the actual ease of excavation may vary widely depending on site-specific subsurface conditions.
2 Agglomerate – volcanic breccia formed by disruption of a solidified crust or hardened plug of lava. Blocks fit together as a loose mosaic or may be completely disordered.

Soils

The soils along the proposed route reflect the underlying rock type, the extent of weathering of the rock, the degree of slope, and the degree of human modification. Most of the route crosses through undeveloped land, while small portions traverse agricultural and rural residential land. A summary of the significant characteristics of the major soil associations traversed by the Devers-Harquahala route segments is presented in Table D.13-2. The soil associations are listed in numerical, not geographic, order.

Table D.13-2. Major Soils along the Proposed Devers-Harquahala 500 kV Transmission Line Route

Unit ID	Soil Association	Description	Shrink/Swell (Expansive) Potential	Risk of Corrosion	
				Concrete	Uncoated Steel
Arizona					
AZ002	Gilman-Rositas-Indio	Soils formed on alluvium, dunes, and dune sheets. Soil types include fine sand, very fine sandy loam[1], silt loam, and loam.	Low to Moderate	Low to Moderate	High
AZ008	Momoli-Carrizo-Denure	Formed on alluvium and alluvial fans and have some areas of desert pavement and desert varnish[2] on the surface. Soil types include very gravelly fine sandy loam, stony and gravelly coarse sand, and gravelly sandy loam.	Low	Low	High
AZ016	Gunsight-Rillito-Chuckwalla	Formed in mixed alluvium. Soils include calcareous gravelly loam, gravelly to gravely sandy loam, and gravelly silt loam to silty clay loam. Local areas of desert pavement.	Low	Low to Moderate	High
AZ017	Cherioni-Hyder-Cipriano	Very shallow soils formed in alluvium over volcanics. Soil types are gravelly fine sandy loam, extremely gravelly sandy loam, and very gravelly loam.	Low	Low	High
AZ018	Ligurta-Cristobal-Gunsight	Formed in alluvial fans of mixed materials. Typically large percentage of surface covered by desert pavement and desert varnish. Soil types are gravelly clay loam and calcareous gravelly loam.	Low to Moderate	Low to High	High
AZ023	Laposa–Rock Outcrop–Schenco	Includes bare rock outcrops. Soils formed in slope derived alluvium/colluvium and include gravelly and channery[3] loam.	Low	Low	High
AZ028	Pahaka-Estrella-Antho	Soils are formed on alluvial fans, terraces, and flood plains. Soil types include sandy loam, gravelly sandy loam, loam, clay loam, and sandy clay loam.	Low to Moderate	Low	High

Table D.13-2. Major Soils along the Proposed Devers-Harquahala 500 kV Transmission Line Route

Unit ID	Soil Association	Description	Shrink/Swell (Expansive) Potential	Risk of Corrosion	
				Concrete	Uncoated Steel
AZ029	Valencia-Estrella-Cuerda	Formed in alluvial fans and flood plains. Soil types include loam, sandy and fine sandy loam, clay loam, and sandy clay loam.	Low to Moderate	Low	High
AZ049	Gran–Rock Outcrop–Lehmans	Includes bare rock outcrop areas. Very shallow to shallow soils formed in alluvium on pediments and overlying volcanics. Soil types include gravelly sandy loam, gravelly clay, and clay loam.	Low to High	Low	High
California					
CA601	Carsitas-Myoma-Carrizo	Formed in alluvial fans and sand blown from alluvial deposits. May include some areas of desert pavement and desert varnish. Soil types include gravelly and gravelly coarse sand, very gravelly sand, stony sand, and fine to very fine sand.	Low	Low	High
CA605	Badland-Beeline-Rillito	These soils are formed in alluvium and vary from shallow gravelly sandy and sandy loams to deep gravelly sandy loam and gravelly loam.	Low	Low to Moderate	Moderate to High
CA653	Gilman-Rositas-Indio	Soils formed on alluvium, dunes, and dune sheets. Includes soils formed on the Colorado River floodplain. Soil types include fine sand, very fine sandy loam[1], silt loam, and loam.	Low to Moderate	Low to Moderate	High
CA654	Aco-Rositas-Carrizo	Soils formed in mixed alluvium and in sandy deposits blown from alluvium. Soil types include sandy to coarse sandy loam, fine sand, stony sand, very gravelly coarse sand, and very stony coarse sand.	Low to Moderate	Low to Moderate	High
CA913	Rock Outcrop–Lithic Torriorthents–Calvista	Includes areas of bare rock outcrop, and very shallow poorly developed soils over bedrock. Calvista soils area shallow formed in material from granitic rock that has seams of calcite and are composed primarily of sandy loam.	Low to Moderate	Low	Moderate to High
CA921	Rositas-Carsitas–Dune Land	Includes sand dune deposits. Soils that are generally formed in alluvium and sandy eolian material from the alluvium. Soil types include gravelly to coarse gravelly sand and fine sand.	Low to High	Low to Moderate	High
CA927	Gunsight-Rillito-Chuckwalla	Formed in mixed alluvium. Soils include calcareous gravelly loam, gravelly to gravelly sandy loam, and gravelly silt loam to silty clay loam. Local areas of desert pavement.	Low	Low to Moderate	High
CA928	Cherioni-Hyder-Cipriano	Very shallow soils formed in alluvium over volcanics. Soil types are gravelly fine sandy loam, extremely gravelly sandy loam, and very gravelly loam.	Low	Low	High

Source: NRCS STATSGO California and Arizona GIS data, 1994; NRCS website, 2006.
1 Loam soil composed of sand, silt, clay, and organic matter in evenly mixed particles of various sizes.
2 A desert pavement is a desert surface that is covered with closely packed, interlocking angular or rounded rock fragments of pebble and cobble size. Desert varnish is the thin red to black coating found on exposed rock surfaces in arid regions. Varnish is composed of clay minerals, oxides and hydroxides of manganese and/or iron. Both desert pavement and desert varnish take thousands of years to form.
3 A descriptive term used for thin and flat limestone, sandstone, or schist fragments up to six inches in length.

Corrosivity of soils is generally related to the following key parameters: soil resistivity; presence of chlorides and sulfates; oxygen content; and pH. Typically, the most corrosive soils are those with the lowest pH and highest concentration of chlorides and sulfates. High sulfate soils are corrosive to concrete and may prevent complete curing reducing its strength considerably. Low pH and/or low resistivity soils could corrode buried or partially buried metal structures.

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. Soils containing high percentages of fine sands and silt and that are low in density are generally the most erodible. These soil types generally coincide with soils such as young alluvium and other surficial deposits, which likely occur in areas throughout the project area. 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. However, while clays have a tendency to resist erosion, once eroded they are easily transported by water. Clean, well-drained, and well-graded gravels and gravel-sand mixtures are usually the least erodible soils. Soils with high infiltration rates and permeabilities reduce the amount of runoff.

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, 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.

Mineral Resources

Arizona

Metallic and non-metallic mineral deposits occur within the general project area. The metallic deposits identified in Arizona include copper, manganese, gold, silver, and iron, and are restricted primarily to areas of exposed bedrock in mountain areas. Metallic ore deposits tend to dominate Arizona's mineral resources. Non-metallic deposits within the general project area include barite, bentonite, sand, and gravel. However, a review of the U.S. Geological Service (USGS) Mineral Resource Data System (MRDS) for the vicinity of the project route indicates that no identified mineral occurrences, or past or current mining activities are located within 1,000 feet of either side of the route (USGS, 2005).

California

Metallic and non-metallic mineral deposits occur within the study area. Metallic mineral deposits are restricted primarily to the areas of exposed bedrock in mountain areas. Gold, copper, and iron are the predominant metallic minerals mined in California; however, no active metallic-mineral deposits mines are located in the project vicinity. Sand, clay, gravel, and rock products are important mineral resources in California and are still activity mined in the project vicinity. Four mineral resource sites were identified by the MRDS within 1,000 feet of the route; two sand and gravel operations and one gold prospect in the Coachella Valley area, and one gold mine on the Palo Verde Mesa. Only the Indio Pit, a sand and gravel quarry in the Indio Hills area located between MPs E205 and E206, is still in operation.

Faults and Seismicity

Arizona

There are no active faults in southwestern Arizona and seismic risk in the area is dominated by its relative proximity to the major fault systems of southern California. Historically strong earthquakes in southern California have been felt in southwestern Arizona. Large historic earthquakes on the Imperial Fault Zone and the Mojave Shear Zone (faults in the Landers area) have been felt throughout southwestern Arizona and have resulted in minor to moderate shaking related damage, ranging from cracked windows and items knocked off shelves, to liquefaction damage in the Yuma area to bridges and canals.

California

The seismicity of the project area is dominated by the northwest trending San Andreas Fault system (see Figure D.13-2 on the enclosed CD). The San Andreas Fault system responds to stress produced by the relative motions of the Pacific and North American Tectonic Plates. This stress is relieved by strain, predominantly as right lateral strike slip faulting on the San Andreas and other related faults. The effects of this strain also include mountain building, basin development, deformation of Quaternary deposits, widespread regional uplift, and the generation of earthquakes (Wallace, 1990).

The southern California area is characterized by numerous geologically young faults. These faults can be classified as historically active, active, potentially active, or inactive, based on the following criteria (CGS, 1999):

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

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. Blind thrust faults do not intersect the ground surface, and thus they are not classified as active or potentially active in the same manner as faults that are present at the earth's surface. The activity classification of blind-thrust faults is predominantly based on historic earthquakes and microseismic activity along the fault.

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 California portion of the proposed transmission line and associated facilities.

Active faults that represent a significant seismic threat to the proposed route are listed in Table D.13-3. All faults listed in this table are located in the California portions of the route west of the Orocopia Mountains; no active faults cross the DPV2 route in eastern California or Arizona. Data presented in this table include fault length, maximum estimated earthquake, type of fault, and slip rates. Figure D.13-2 (see enclosed CD) shows locations of significant active faults and historic earthquakes in the project area and surrounding region, all located in California.

The most significant faults in the project area are faults of the San Andreas Fault Zone. The San Andreas Fault Zone is a 680-mile active right-lateral strike-slip complex of faults that has been responsible for many of the damaging earthquakes in Southern California in historical times. The San Andreas Fault Zone is the longest active fault in California and represents the boundary between the Pacific and North American plates. The Coachella segment of the San Andreas Fault extends from Cajon Pass (near Bakersfield) to the Salton Sea. Historically, the San Andreas Fault has produced "great" earthquakes that have caused significant surface rupture in southern California, such as the January 9, 1857, Magnitude (M) 8 Fort Tejon earthquake. Surface rupture associated with this earthquake originated northwest of Parkfield in Monterey County and pro-

Table D.13-3. Significant Active Faults in the Devers-Harquahala Vicinity

Fault	Fault Length (miles)	Maximum Estimated Earthquake Magnitude	Type of Fault and Dip Direction	Slip Rate (mm/yr)
San Andreas: Coachella Segment	60	7.2	right lateral strike slip, 90°	25.0
San Andreas: San Bernardino Segment	64	7.5	right lateral strike slip, 90°	24.0
Pinto Mountain	46	7.2	Left lateral strike slip, 90°	2.5
Burnt Mountain	13	6.5	right lateral strike slip, 90°	0.6
Eureka Peak	12	6.4	right lateral strike slip, 90°	0.6
Landers	52	7.3	right lateral strike slip, 90°	0.6
North Frontal Fault Zone East	17	6.7	reverse, 45°S	0.5
Lenwood-Lockhart–Old Woman Springs	90	7.5	right lateral strike slip, 90°	0.6
North Frontal Fault Zone West	32	7.2	reverse, 45°S	1.0
Pisgah–Bullion Mountain–Mesquite Lake	55	7.3	right lateral strike slip, 90°	0.6
Helendale–South Lockhart	60	7.3	right lateral strike slip, 90°	0.6
South Emerson–Copper Mountain	34	7.0	right lateral strike slip, 90°	0.6
San Jacinto: Anza Segment	57	7.2	right lateral strike slip, 90°	12.0
San Jacinto: San Jacinto Valley Segment	27	6.9	right lateral strike slip, 90°	12.0

Source: CGS, 2002.

pagated southeastward for over 225 miles along the San Andreas Fault to the Cajon Pass northwest of San Bernardino. The historically seismic dormant (at least since 1769) fault may have an average interval between major recurrent earthquakes on the southern segment of approximately every 145 years (SCEC, 2005).

Fault Rupture

A major factor to be considered in the seismic design of electric transmission lines crossing active faults is the amount and type of potential ground surface displacement along faults. In the Proposed Project area, an extremely complex zone of right-lateral strike-slip, reverse-oblique, and thrust faults occur in the southeastern San Bernardino Mountains. The proposed route crosses several faults capable of significant surface rupture, primarily segments of the San Andreas Fault Zone.

The Devers-Harquahala segments cross one active fault twice, the eastern segment of the Banning Fault. The Banning Fault is a strand of the Coachella segment of the San Andreas Fault. In the Coachella Valley, the proposed route crosses the Banning Fault southwest of the Indio Hills (near the town of Indio) and southeast of Devers Substation and northwest of the Indio Hills. The Banning Fault is approximately 60 miles long and generally parallels Interstate 10 (I-10) from the Indio Hills to the San Jacinto Fault. The eastern, or Coachella Valley, segment of the Banning fault extends from the vicinity of Whitewater Canyon southeastward to the southern Indio Hills, where it merges with the San Andreas Fault. The trace of the fault is well defined by conspicuous linear vegetation traces and forms degraded scarps in alluvial units that are late Pleistocene and Holocene in age (USGS, 1992).

The proposed route crosses two sets of potentially active faults near the eastern edge of the Coachella Valley; an unnamed set of short overlapping faults located just southeast of the Indio Hills, and the Mecca Hills Fault at the north end of the Mecca Hills near Interstate 10. Both of the fault zones are mapped as Late Quaternary in age; however, both are delineated Alquist-Priolo Earthquake Fault Zones (see Section D.13.4.2 for information regarding the Alquist-Priolo Earthquake Fault Zoning Act).

Future earthquakes could occur anywhere along the various strands of the San Andreas Fault Zone and other regional faults (including currently unknown faults), though only earthquakes of magnitude 6.0 or greater are likely to generate surface fault rupture and offset (CGS, 1996).

Strong Groundshaking

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 approximate projected peak ground accelerations for this portion of the proposed route are presented in Table D.13-4.

Table D.13-4. Approximate Peak Ground Accelerations

Approximate Proposed Transmission Line Milepost	Total Length of Segments (miles)	Peak Ground Acceleration
E0–E156.5	156.5	< 0.2g
E156.5–E171	14.5	0.2–0.3g
E171–E182	11	0.3–0.4g
E182–E187.5	5.5	0.4–0.5g
E187.5–E195.5	3	0.5–0.6g
E195.5–E197.5	2	0.6–0.7g
E197.5–E228	30.5	0.7–0.8g

Source: CGS, 2006; USGS , 2006a.

A review of historic earthquake activity from 1800 to 2005 indicates that many earthquakes of M6.0 or greater have occurred within 50 miles of the Proposed Project route (CGS, 2005). The 1986 M5.9 North Palms Springs Earthquake is included on the list due to its close proximity to the Devers Substation and the significant damage caused at the facility. Figure D.13-2 (see enclosed CD) shows locations of historic earthquakes in the project area and surrounding region. A summary of significant M6.0 or greater earthquake events is presented in Table D.13-5.

Table D.13-5. Significant Historic Earthquakes Affecting the Devers-Harquahala Vicinity

Date	Earthquake Name or General Location	Fault Involved, if Known	Magnitude[1]	Approximate Closest Distance to Project Route[1]
October 16, 1999	Hector Mine Earthquake	Lavic Lake and Bullion	7.15	48 miles north
June 28, 1992	Landers Earthquake	Johnson Valley, Landers, Homestead Valley, Emerson, Camp Rock, and others	7.3	21 miles north
June 28, 1992	Big Bear Earthquake – aftershock of the Landers Earthquake	Unnamed fault	6.5	20 miles north
April 23, 1992	Joshua Tree	Eureka Peak	6.2	10 miles north
November 24, 1987	Superstition Hills Earthquake	Superstition Hills	6.6	43 miles south
November 23, 1987	Elmore Ranch Fault	Elmore Ranch, Lone Tree, and Kane Spring	6.2	38 miles south
July 8, 1986	North Palms Springs Earthquake	Banning or Garnet Hill	5.9	4.5 miles northwest
April 9, 1968	Borrego Mountain Earthquake	Coyote Creek, part of the San Jacinto Fault Zone	6.6	34 miles south
March 19, 1954	1954 San Jacinto Fault Earthquake	Clark Fault, part of the San Jacinto Fault Zone	6.4	29 miles south
December 4, 1948	Desert Hot Springs Earthquake	Banning or So San Andreas	6.0	7 miles north
October 22, 1942	Fish Creek Mountains Earthquake	Coyote Creek, part of the San Jacinto Fault Zone	6.4	47 miles south
July 22, 1923	North San Jacinto Fault Earthquake	San Jacinto	6.3	39 miles west
April 21, 1918	San Jacinto Earthquake	San Jacinto	6.8	28 miles southwest
December 25, 1899	San Jacinto Fault Earthquake, located southeast of San Jacinto	San Jacinto	6.5	27 miles south

Table D.13-5. Significant Historic Earthquakes Affecting the Devers-Harquahala Vicinity

Date	Earthquake Name or General Location	Fault Involved, if Known	Magnitude[1]	Approximate Closest Distance to Project Route[1]
May 28, 1892	Borrego Mountains, aftershock of the Laguna Salada Earthquake	Coyote Creek, part of the San Jacinto Fault Zone	6.8	35 miles south
February 9, 1890	North end of the Borrego Desert	Assumed on the San Jacinto	6.8	25 miles south

Source: CGS EQ database, 2005; SCEC Website, 2006.
1 Earthquake magnitudes and locations before 1932 are estimated based on reports of damage and felt effects.

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, 1978). In addition, densification of the soil resulting in vertical settlement of the ground can also occur. Due to the generally deep water table in most of the project area (with the exception of immediately adjacent to the Colorado River), liquefaction is not considered a potential hazard in most of the project area.

Seismic Slope Instability/Ground Cracking

Most accounts of major historical earthquakes in the project region relate the occurrence of damaging landslides to earthquake groundshaking. Rockfall hazards and ground cracking are also likely effects of strong groundshaking. Ground cracking may result from several causes, including lateral spreading due to local or widespread liquefaction or similar ground failure, from areas between fault strands experiencing localized extension or dilation, and along ridgelines. Locations susceptible to seismically induced failure include highly weathered and unconsolidated materials on moderate to steep slopes, especially areas of previously existing landslides. Rocks, either as individual boulders or as a mass of loose rocks on steep hillsides, can travel downslope during an earthquake with potentially damaging effects.

D.13.2.1 Harquahala to Kofa National Wildlife Refuge

Geology

The Proposed Project from Harquahala to Kofa National Wildlife Refuge (NWR) lies within the Sonoran Desert Province. The proposed route in this area generally traverse alluvial plains, alluvial fans, and pediments. This segment of the project crosses the Harquahala Plain, the eastern edge of the Tonopah Desert, the southern end of the Little Big Horn Mountains north of Burnt Mountain, the northern edge of the Eagletail Mountains, and the Ranegras Plain. Geologic units crossed by this segment of the project are undivided surficial deposits (Qs), younger sediments (QTs), basalt (Qb), and andesite (Ka); descriptions of these units are listed in Table D.13-1. Approximate locations of these units along the project are listed below.

- Qs: MPs E0–E2.1, E16.7–E40.7, E41.7–E53.3
- QTs: MPs E2.1–E12.6, E14–E14.6, and E15–E16.7
- Ka: MPs E12.6–E14, E14.6–E15, and E40.7–E41.7
- Qb: small outcrops between MPs E34 and E35.

Soils

Four soil associations are mapped along the Harquahala to Kofa NWR segment of the project route. All four of these soils are formed in alluvium, although of differing sources, and are predominantly loamy soils with varying amounts of clay, sand, and gravel. The Momoli-Carrizo-Denure (AZ008) association is present in the western portion of the segment from approximately MPs E0–E2.6, E17.4–E20.0, and E21–E24.2. This soil association has low potential for expansion (shrink/swell) and corrosion to concrete; however, it has a high potential for corrosion to uncoated steel. Momoli-Carrizo-Denure soils are known to include areas of desert pavement.

Soil association Gunsight-Rillito-Chuckwalla (AZ016) is present throughout the segment, and is located at approximately MPs E2.6–E17.4, E20–E21.6, E25.1–E26.9, E33.8–E40, and E51.2–E53.3. Gunsight-Rillito-Chuckwalla soils have a low potential for expansive soil characteristics, low to moderate potential for corrosion to concrete, and high potential for corrosion to uncoated steel. These soils are also known to have local areas of desert pavement.

Soils located primarily in the eastern portion of this segment are the Pahaka-Estrella-Antho association (AZ028) and the Valencia-Estrella-Cuerda association (AZ029), which are both primarily formed on alluvial fans and flood plains. Both soils also have a low to moderate potential for expansive soils, low potential for corrosion to concrete, and a high potential for corrosion to uncoated steel. Pahaka-Estrella-Antho soils are located at approximately MPs E24.2–E25.1, E26.9–E33.8, E40–E41.6, E45.7–E46.7, and E47.7–E51.2. Valencia-Estrella-Cuerda soils are less profuse along the route segment and are located at approximately MPs E41.6–E45.7 and E46.7–E47.7.

Mineral Resources

No known ~~mineral resources or~~ active mines are identified within 1,000 feet of this segment. Two active BLM mining claims are located adjacent to and potentially partially within the SCE ROW between MPs E44 and E45. These claims are not currently being mined though they may have casual use or exploratory activities taking place, and construction and operation of the DPV2 transmission line in the existing SCE ROW is not expected to interfere with future access to any mineral resources within these claims.

Seismicity

There are no known active faults crossing the proposed route segment between Harquahala and the Kofa NWR. The area has been mapped by the AZGS as being in an area of low seismic hazard (AZGS, 2000) and is thus not likely to experience liquefaction, strong groundshaking, or earthquake-induced landslides.

D.13.2.2 Kofa National Wildlife Refuge

Geology

The Devers–Palo Verde 500 kV No. 2 Transmission Project through the Kofa NWR lies within the Sonoran Desert Province. The alignment traverses the southern edge of the New Water Mountains and traverses small alluvial valleys, alluvial fans, and low-lying hills. Geologic units crossed by this segment of the alignment are undivided surficial deposits (Qs), basalt (Qb), Rhyolite (Kr), and undivided metasedimentary rocks (Ms); descriptions of these units are listed in Table D.13-1. Approximate locations of these units along the alignment are listed below.

- Qs: MPs E53.3–E60.4, E64.6–E66.3, E66.5–E67.8, E69–E71.2, and E71.6–E77.6
- Qb: MPs E60.4–E61.2, E61.5–E62.8, E63.1–E64.6, and E66.3–E66.5
- Kr: MPs E63.2–E61.5 and E62.8–E63.1
- Ms: MPs E67.8–E69 and E71.2–E71.6.

Soils

The STATSGO database for Arizona identifies four soil associations in the Kofa NWR segment of the Proposed Project. These soils are formed in alluvium of various compositions from varying sources. Three of these soils are fairly equally distributed along the alignment: the Gunsight-Rillito-Chuckwalla (AZ016) association from MPs E53.3–E58.3, the Ligurta-Cristobal-Gunsight (AZ018) association from MPs E74.9–E77.6 and the Gran–Rock Outcrop–Lehmans (AZ049) association from MPs E60.6–E63.7. These three soils all have high potential for corrosion to uncoated steel; however, potential for corrosion to concrete varies from low for AZ049, from low to moderate for AZ016, and to low to high for AZ018. Expansion potential is also variable with potentials ranging from low for AZ016, low to moderate for AZ018, and to low to high for AZ049.

The predominant soil type along this segment is the Cherioni-Hyder-Cipriano (AZ017) association, which is located at approximately MPs E58.3–E60.6 and E63.7–E74.9. These soils have low potential for expansive soils and corrosion to concrete, and a high potential for corrosion to uncoated steel.

The Gunsight-Rillito-Chuckwalla and Cherioni-Hyder-Cipriano soils are known to include moderate to large areas of desert pavement.

Mineral Resources

No known mineral resources or active mines are identified within 1,000 feet of the Kofa NWR segment.

Seismicity

There are no known active faults crossing the proposed route in the Kofa NWR segment. The area has been mapped by the AZGS as being in an area of low seismic hazard (AZGS, 2000) and is thus not likely to experience liquefaction, strong groundshaking, or earthquake-induced landslides.

D.13.2.3 Kofa National Wildlife Refuge to Colorado River

Geology

The Kofa NWR to the Colorado River segment is also within the Sonoran Desert Province. This segment begins on the east side of the La Posa Plain, crosses the plain and traverses the Dome Rock Mountains through the Copper Bottom Pass area. The segment drops down across the northwest facing pediment that slopes from the Dome Rock Mountains to the Colorado River. The proposed transmission line would cross the current alignment of the Colorado River at the end of this segment. Geologic units crossed by this segment are undivided sedimentary deposits (Qs), younger sediments (QTs), undivided metasedimentary rocks (Ms), and gneiss (Mgn); descriptions of these units are listed in Table D.13-1. Approximate locations of these units along the route segment are listed below.

- Qs: MPs E77.6–E86, E93.2–E96, E97–E97.8, and E101.2–E102
- QTs: MPs E92–E93.2, E96–E97, and E97.8–E101.2
- Ms: MPs E86–E87.2
- Mgn: MPs E87.2–E92.

Soils

Three soil associations were identified along the Kofa NWR to Colorado River segment by the STATSGO database for Arizona: the Ligurta-Cristobal-Gunsight (AZ018), the Laposa–Rock Outcrop–Schenco (AZ023), and the Gilman-Rositas-Indio (AZ002) associations. Descriptions of these soils are presented in Table D.13-2. These soils are primarily formed in alluvium of various compositions from varying sources. The Ligurta-Cristobal-Gunsight association is the dominant soil along the segment, approximately located at MPs E77.6–E85.8 and E92.6–E101.4. These soils have high potential for corrosion to uncoated steel; however, potential for corrosion to concrete varies from low to high. Expansion potential is also variable with a range from low to moderate. A large percentage of the soil surface is covered by desert pavement.

The Laposa–Rock Outcrop–Schenco association is approximately located from MP E85.8–E92.6, and coincides with where the proposed route segment crosses the Dome Rock Mountains. These soils have a high potential for corrosion of uncoated steel, and low potential for corrosion to concrete and for expansive soil characteristics. A small area of Gilman-Rositas-Indio association soils would be crossed near the Colorado River from approximately MP E101.4–E102~~.2~~. Corrosion potential from these soils is high for uncoated steel and varies from low to moderate for concrete. The expansion potential ranges from low to moderate for these soils.

Mineral Resources

No known ~~mineral resources or~~ active mines are identified within 1,000 feet of this segment. One active BLM mining claim is located along the alignment at approximately Milepost E86, and several (4 to 5) active BLM mining claims are along the alignment between MPs E 94.0 to 97.5. These claims are not currently being mined though they may have casual use or exploratory activities taking place, and construction and operation of the DPV2 transmission line in the existing SCE ROW is not expected to interfere with future access to any mineral resources within these claims.

Seismicity

Fault Rupture. There are no known active faults crossing the Kofa NWR to the Colorado River segment of the route.

Groundshaking. Most of the area the segment passes through has been mapped by the AZGS as having low seismic hazard. As the segment approaches the California border, the seismic hazard increases from "low" to "moderate to low" (AZGS, 2000). A "great" earthquake on the San Andreas, San Jacinto, or Imperial Fault Zones could cause strong groundshaking along the western portions of this segment.

Liquefaction. Potential for liquefaction is very low for most of this segment due to low seismic hazard and deep groundwater levels. Although, the portion of the alignment located on the Colorado River floodplain (MP E100.0-102.2) near the California border is underlain by potentially liquefiable Quaternary sediments, due to the low potential for strong groundshaking, liquefaction would likely occur only during a "great" earthquake.

Earthquake-Induced Landslides. Earthquake-induced landslides were reported in southwestern Arizona as a result of several large earthquakes located in southern California and Mexico, particularly from the 1940 M7.1 Laguna Salada Earthquake (also referred to as the Imperial Valley Earthquake). The route segment crosses moderate to steep slopes in the vicinity of the Dome Rock Mountains that may be susceptible to earthquake-induced landslides.

D.13.2.4 Palo Verde Valley (Colorado River to Midpoint Substation)

Geology

The Colorado River to the Midpoint Substation segment is within the Colorado Desert Province, a subregion of the Basin and Range Geomorphic Province. This segment starts at the Colorado River and crosses the Palo Verde Valley. The Palo Verde Valley is a floodplain of the Colorado River, which is now protected from flooding by a series of levees. After crossing the Palo Verde Valley, the segment traverses the eastern edge of and crosses onto the Palo Verde Mesa. Geologic units crossed by this segment are recent alluvium (Qal) and nonmarine sedimentary deposits (Qc); descriptions of these units are listed in Table D.13-1. Approximate locations of these units along the proposed route segment are listed below.

- Qal: MPs E102.3–E112.6, and E113.1–E113.7
- Qc: MPs E112.6–E113.1.

Soils

Only two soil associations are mapped in the Palo Verde Valley segment, the Gilman-Rositas-Indio (CA653) and Aco-Rositas-Carrizo (CA654) associations. Descriptions of these soils are presented in Table D.13-2. The Gilman-Rositas-Indio association is the primary soil association crossed by this segment and is found on the valley floor of the Palo Verde Valley from approximately MP E102.2 to E112.6. Corrosion potential for these soils is high for uncoated steel and ranges from low to moderate for concrete. Expansion potential for these soils ranges from low to moderate. The Aco-Rositas-Carrizo soils are located on the Palo Verde Mesa from approximately MPs E112.6 to E113.7 and have similar corrosive and expansive characteristics as the Gilman-Rositas-Indio soils.

Mineral Resources

No known mineral resources or active mines are identified within 1,000 feet of this segment.

Seismicity

Fault Rupture. There are no known active faults crossing the Palo Verde Valley segment of the proposed route.

Groundshaking. The peak horizontal acceleration for this area is only 0.1 to 0.2g, and thus is not expected to undergo strong groundshaking.

Liquefaction. The portion of the proposed route located within the Palo Verde Valley from MP 102.2–E112.0) is on the Colorado River floodplain and is underlain by potentially liquefiable Quaternary sediments. However, due to the low potential for strong groundshaking, liquefaction would likely occur only during a "great" earthquake.

Earthquake-Induced Landslides. This segment is located on flat river floodplain in the valley and on gently sloping alluvial fans on the mesa that are not susceptible to landslides.

Midpoint Substation

Geology

The Midpoint Substation site is located on the Palo Verde Mesa and is underlain by Qal, recent alluvial fan deposits.

Soils

The substation would be located on soils of the Aco-Rositas-Carrizo association. A summary of this soils association is presented in Table D.13-2. These soils have high corrosion potential for uncoated steel, and low to moderate potential for corrosion to concrete and for expansion.

Mineral Resources

No known mineral resources are identified at or near the proposed Midpoint Substation site.

Seismicity

Fault Rupture. There are no known active faults crossing the Midpoint Substation site.

Groundshaking. The peak horizontal acceleration for this area on the CGS PSHA maps is only 0.1 to 0.2g, and thus is not expected to undergo strong groundshaking.

Liquefaction. The project site has a low potential for liquefaction. Depth to groundwater is expected to be greater than 100 feet and no significant groundshaking is expected to occur in the area.

Earthquake-Induced Landslides. The substation site is located on a flat to gently sloping mesa and is not susceptible to landslides.

D.13.2.5 Midpoint Substation to Cactus City Rest Area

Geology

The Midpoint Substation to the Cactus City Rest Area segment is within the Colorado Desert Province. This segment crosses the Chuckwalla Valley and then enters the mountainous region of the Colorado Desert. The alignment traverses through mountain valleys between the Chuckwalla and Orocopia Mountains to the south and Eagle Mountains to the north. Shavers Valley, a mountain valley, is also traversed, ending at the Cactus City Rest Area. Geologic units crossed by this segment are recent dune sand (Qs), Recent alluvium (Qal), nonmarine sedimentary deposits (Qc), marine sedimentary rocks (E), and granitic rocks (gr); descriptions of these units are listed in Table D.13-1. Approximate locations of these units along the route segment are listed below.

- Qal: MPs E113.7–E117.3, E128–E148.3, E153.6–E155.2, E158.2–E159, E160.4–E161.5, and E161.8–E169.2, E173.2–E185.1, and E186.2–E187.7
- Qs: MPs E117.3–E128 and E157.1–E158.2

- Qc: small pockets of less than 0.1 to 0.3 miles at MPs E140.5–E146.3, MPs E148.3–E149.9, E152.6–E153.6, E155.6–E157.1, E159–E160.4, E161.5–E161.8, E185.1–E186.2, and E187.7–E188.2
- gr: Small outcrops at MPs E149.3–E158.8; E169.2–E170.9, and E171.8–E173.2
- E: small outcrops near MP E176.

Two other geologic units, granitic and metamorphic rocks (gr-m) and gneiss (p□g), that are located close to the proposed route segment may be encountered in excavations beneath shallow layers of Qal and Qc. These units would be encountered at approximately MP E159 to E162 and near MP E186, respectively.

Soils

The Midpoint Substation to Cactus City Rest Area segment crosses numerous soils associations. These associations, in general geographic order, are the Aco-Rositas-Carrizo (CA654), Rositas-Carsitas-Dune Land (CA921), Cherioni-Hyder-Cipriano (CA928), Gunsight-Rillito-Chuckwalla (CA927), Rock Outcrop–Lithic Torriorthents–Calvista (CA913), and Badland-Beeline-Rillito (CA605). Descriptions of these soils are presented in Table D.13-2. Approximate locations of these soil associations along this segment are listed below.

- CA654: MPs E113.7–E115.5
- CA921: MPs E117.5–E128.4
- CA928: multiple locations from MPs E128.4–E148.7, E150.1–E169.3, E170.6–E172.1, and E173.1–E187.7
- CA927: MPs E148.7–E150.1
- CA913: MPs E169.3–E170.6 and E172.1–E173.1
- CA605: MPs E187.7–E188.2.

Corrosion potential to uncoated steel for these soils is high, with the exceptions of CA913 and CA605, which both have moderate to high potential for corrosion to uncoated steel. Additionally most of the soil associations have low to moderate corrosion potential to concrete, except CA913 and CA928 which have low potential. Expansion potential of these soil associations is highly variable with the following groupings: low potential for CA605, CA927, and CA928; low to moderate potential for CA654 and CA913; and low to high potential for CA921. Gunsight-Rillito-Chuckwalla (CA927) soils have local areas of desert pavement.

Mineral Resources

One mineral resource site was identified by the MRDS within 1,000 feet of the proposed route segment, a gold mine on the Palo Verde Mesa near MP E117 that is no longer in operation. No other mineral resources are identified in the area.

Seismicity

Fault Rupture. There are no known active fault crossings of the proposed route segment between the Midpoint Substation and the Cactus City Rest Area.

Groundshaking. The San Andreas Fault Zone is in relatively close proximity on the western end of this segment. The peak horizontal acceleration for most of this segment is less than 0.4 g, and these areas should not undergo strong groundshaking. The western end of the segment from MP E182 to the end of the segment (MP E188.2) is mapped in a zone of 0.4 to 0.5g, and may experience moderate groundshaking due to an earthquake on the San Andreas Fault Zone.

Liquefaction. The portion of the segment primarily located within the Chuckwalla Valley and on the edges of several mountain ranges is underlain by Quaternary sediments and small areas of bedrock. Groundwater elevations in this region are very deep and are expected to be greater than 100 feet along most of the alignment, thus liquefaction is not likely even in the areas vulnerable to moderate groundshaking.

Earthquake-Induced Landslides. This segment of the route is located on flat to gently sloping alluvial fans, alluvial plains, and low-lying foothills that are not susceptible to landslides.

D.13.2.6 Cactus City Rest Area to Devers Substation

Geology

This segment of the Proposed Project begins just north of the Mecca Hills, east of the Coachella Valley, then traverses northwest across the northern flank of Coachella Valley to just west of North Palm Springs. For nearly the entire segment, towers and facilities of the Proposed Project would be sited on Quaternary sedimentary deposits. The proposed route crosses an area where granite outcrops are mapped at the southern end of the Little San Bernardino Mountains. Geologic units crossed by this segment are recent dune sand (Qs), recent alluvium (Qal), nonmarine sedimentary deposits (Qc), marine sedimentary deposits (E), granitic rocks (gr). Descriptions of these units are listed in Table D.13-1. Approximate locations of these units along the route segment are listed below.

- Qco: MPs E188.2–E199.2, and E216.7–E221.6 which has areas of surficial sand cover; and crosses a small outcrop at approximately E228
- gr: Several outcrops at MPs E189.8–E190.6
- Qal: in washes and drainages at MPs E192–E199.7; MPs E199.2–E201.5, E205.4–E216.7, and E221.6–E227.8
- Qs: one small deposit at approximately MP E209.2.

Soils

Three soil associations are mapped along this segment of the Proposed Project. The two main soil associations are the Badland-Beeline-Rillito (CA605) and Carsitas-Myoma-Carrizo (CA601), which are both primarily formed in alluvial fans. These two associations are interfingered along the route segment. Badland-Beeline-Rillito soils are located along the route segment from approximately MPs E188.2–E189.4, E190.3–E191.8, E192.1–E199.1, E201.5–E205.4, and E217.0–E223.6. Corrosion potential for the Badland-Beeline-Rillito soils is variable: moderate to high for uncoated steel and low to moderate for concrete. Expansion potential for these soils is low.

Carsitas-Myoma-Carrizo soils are approximately located from MPs E191.8–E192.1, E199.1–E201.5, E205.4–E217, and E223.6 to the Devers Substation at MP E228. These soils have high potential to corrode uncoated steel and have a low potential to corrode concrete and exhibit shrink/swell characteristics. These soils include areas of desert pavement.

The third soil association, Rock Outcrop–Lithic Torriorthents–Calvista (CA913), occurs only in the hills just west of the Rest Area and generally consist of poorly developed to shallow soils over granitic bedrock. CA913 soils are found northwest of the Cactus City Rest Area from approximately MP E189.4 to E190.3. Corrosion potential for these soils is also variable with moderate to high corrosion potential for uncoated steel and low to moderate corrosion potential for concrete. Expansion potential for these soils ranges from low to moderate.

Mineral Resources

Three mineral resource sites were identified by the MRDS within 1,000 feet of the route segment: two sand and gravel operations and one gold prospect in the Coachella Valley area. Only one site is still in operation, the Indio Pit sand and gravel quarry in the Indio Hills area. The Cactus City Rest Area to Devers Substation segment crosses the Indio Pit between MPs E205 and E206. No other mineral resources were identified along this segment of the Proposed Project.

Seismicity

Fault Rupture. This segment crosses the northern tip of the Alquist-Priolo zones for the Mecca Hills fault at approximately MP E193. Although this fault is a late Quaternary age fault, it could have triggered surface rupture due to an earthquake in the adjacent San Andreas Fault Zone. A set of short late Quaternary fault series within an Alquist-Priolo Fault Zone is crossed between approximately MPs E197.3–E200.5. This area is also mapped with several fault traces that are Late Quaternary age. These faults are most likely shear faults splaying off the San Andreas Fault in a northerly direction formed by the transfer of displacement to the active faults to the north (Homestead Valley Fault Zone). If one of these faults ruptures, it can be expected to have right-lateral offset of a few feet.

This segment of the proposed route crosses the Banning Fault twice, between approximately MPs E205 and E206 and at approximately MP E224.5. The Banning Fault is part of the Coachella segment of the San Andreas Fault Zone. The fault is within an Alquist-Priolo Fault Zone at both of these locations. Potential fault offset associated with a rupture along this active trace could be as much as 15 feet of right-lateral displacement that may be distributed across a zone several hundred to a thousand feet long.

At about MP E228, just before entering the Devers Substation, the proposed route crosses a short A-P zone. The small fault segment in the zone is not named, but is likely an accommodation fault taking up movement between the Banning Fault to the south and the Mission Creek Fault to the north. This small fault is not expected to generate a significant earthquake on its own; however, it may rupture during a large earthquake event on the nearby active Banning or Garnet Hill Faults.

Groundshaking. The proposed route segment is in close proximity to the San Andreas Fault Zone for most of its length. Strong groundshaking caused by an earthquake on any of the faults in the vicinity of this segment should be expected. The peak horizontal for this segment ranges from 0.5g to 0.8g.

Liquefaction. Potential for liquefaction in this area is low because the depth to groundwater is generally much greater than 100 feet below the ground surface. During large storms or a wet season, the water table may rise temporarily and sections of the proposed segment that lie in and near the San Gorgonio Wash may be moderately susceptible to liquefaction if a strong earthquake occurs while the valley floor sediments are saturated.

Earthquake-Induced Landslides. Most accounts of historical earthquakes in this area describe damaging landslides resulting from earthquake groundshaking. However, this segment of the proposed route does not cross through areas with significant slopes.

Devers Substation

Geology

Devers Substation lies on very low topography in the northern Coachella Valley. The site is underlain by recent alluvium (Qal).

Soils

Soils in the vicinity of the Devers Substation are described as belonging to the Carsitas-Myoma-Carrizo soil association (CA601) that is formed primarily in alluvial fans. A description of these soils is presented in Table D.13-2. These soils have high potential for corrosion to uncoated steel and low potential for corrosion to concrete and for expansive (shrink/swell) characteristics. These soils include areas of desert pavement.

Mineral Resources

No mineral resources are identified in the immediate vicinity of Devers Substation.

Seismicity

Fault Rupture. Devers Substation lies between two active branches of the San Andreas Fault Zone, the adjacent Banning Fault to the south and the Mission Creek Fault located approximately four miles to the north-northeast. The Banning Fault is located within a few hundred feet of the substation, and the Alquist-Priolo Zone for the fault is the located adjacent to the southern end of the facility. The northern edge of the substation is also adjacent to the end of the A-P zone for an unnamed fault segment, discussed in the Fault Rupture section above for the Cactus City Rest Area to the Devers Substation segment, that trends northeast-southwest towards the facility. The substation could be affected by fault rupture caused by distributed fault offset or coseismic shearing associated with a major rupture on the adjacent Banning fault or on the nearby Mission Creek Fault.

Groundshaking. Extreme groundshaking from an earthquake on one of the nearby faults should be anticipated, estimated peak horizontal acceleration for this area is 0.7 to 0.8g. Historically, the substation has sustained damage from nearby earthquakes. The 1986 M5.9 North Palm Springs earthquake knocked out power and resulted in significant damage to Devers Substation that took ten days to repair (Borchardt, 1986).

Liquefaction. Liquefaction is not considered a potential hazard here because depth to groundwater is anticipated at greater than 50 feet.

Earthquake-Induced Landslides. The substation is located in a flat to gently sloping alluvial plain and it is unlikely landslides would result in the area.

D.13.3 Environmental Setting for the Proposed Project – West of Devers

Regional Physiography

West of Devers, the proposed route exits the low desert of the Colorado Desert geomorphic province to skirt the southern foothills of the San Bernardino Mountains. These mountains lie along the southern boundary of the Transverse Ranges geomorphic province (Norris and Webb, 1990). The route makes some excursions onto the floor of the valley occupied by the cities of Banning and Beaumont. The valley between the San Bernardino Mountains on the north, and the San Jacinto Mountains of the Peninsular Ranges geomorphic province on the south, is known as the San Gorgonio Pass. At the west end of the valley, the proposed route crosses I-10 and then crosses the southern end of San Timoteo Canyon to enter the San Timoteo Badlands. The route parallels the canyon until the northern end of the Badlands hills. At San Bernardino Junction the route splits with the north-south section crossing out of the hills into the southern San Bernardino Valley. The east-west section crosses the San Jacinto Fault before exiting the hills into the southern San Bernardino Valley near Riverside. Both endpoints of the route nearly reach the Santa Ana River.

Geology

The West of Devers portion of the proposed route is underlain primarily by sedimentary units ranging in age from Holocene to Pliocene, with lesser amounts of Cretaceous granitic rocks near the western end. It generally traverses alluvial plains, alluvial fans and pediments, badlands, and hills. General descriptions of the geologic materials, listed chronologically, crossed by the proposed West of Devers segments are summarized in Table D.13-6.

Table D.13-6. Summary of Geologic Units along the West of Devers Segment

Formation	Age	Description/Comment	Excavation Characteristics[1]
Qw – Wash Deposits	Holocene	Alluvial deposits occurring in modern washes of rivers and streams.	Easy
Qyf – Younger Fan Deposits	Holocene	Fan deposits of sand and gravel.	Easy
Qya – Younger Alluvium	Holocene	Slightly dissected alluvial deposits of sand and gravel.	Easy
Qal – Recent Alluvium	Holocene	Unconsolidated alluvial fan, river channel, and stream deposits consisting of silt, sand, clay, and gravel. Also includes recent floodplain deposits of the Colorado River (silt, sand, and clay).	Easy
Qow – Older Wash Deposits	Holocene	Alluvial deposits of abandoned washes or intermittently active alluvium of older washes.	Easy
Qc – Nonmarine Sedimentary Deposits	Pleistocene	Older alluvium and fanglomerate, dissected with well-developed desert pavement and desert varnish in some areas. Consists mostly of clay, siltstone, sand, and gravel.	Easy
Qco – Nonmarine Sedimentary Deposits	Pleistocene	Older folded or uplifted fan deposits, very dissected. Locally extensively folded and faulted. Consists of conglomerate, sandstone, and clay; boulder conglomerate in some areas along margins of the Coachella Valley.	Easy
QP –Nonmarine Sedimentary Deposits	Plio-Pleistocene	Gray to brown conglomerate, arkosic sandstone, siltstone, and red claystone.	Easy
Pc/QTst – San Timoteo Formation	Pleistocene/ Pliocene	Nonmarine sandstone, siltstone, conglomerate, and shale, forms extensive badlands in the Redlands area.	Easy to Moderate
Kgr – Granitic Rocks	Cretaceous	Granitic rock of several types, primarily quartz monzonite and granodiorite.	Difficult

Source: CGS, 1966 & 1986.

1 Excavation characteristics are very generally defined as "easy," "moderate," or "difficult" based on increasing hardness of the rock unit. Excavation characteristic descriptions are general in nature and the actual ease of excavation may vary widely depending on site-specific subsurface conditions.

Slope Stability

Most of the proposed route west of Devers Substation crosses gently sloping to flat terrain and does not cross any large areas identified as existing landslide or landslide hazard. Unmapped landslides and areas of localized slope instability may be encountered in the hills traversed by the Proposed Project alignment.

Soils

The soils along the route reflect the underlying rock type, the extent of weathering of the rock, the degree of slope, and the degree of human modification. A summary of the significant characteristics of the major soil associations traversed by the West of Devers segments are listed in numerical not geographic order, as presented in Table D.13-7.

Table D.13-7. Major Soils along the Proposed West of Devers Transmission Line Routes

Unit ID	Soil Association	Description	Shrink/Swell Potential	Risk of Corrosion	
				Concrete	Uncoated Steel
CA601	Carsitas-Myoma-Carrizo	Formed in alluvial fans and sand blown from alluvial deposits. May include some areas of desert pavement and desert varnish[1]. Soil types include gravelly and gravelly coarse sand, very gravelly sand, stony sand, and fine to very fine sand.	Low	Low	High
CA605	Badland-Beeline-Rillito	These soils are formed in alluvium and vary from shallow gravelly sandy and sandy loam[2] to deep gravelly sandy loam and gravelly loam.	Low	Low to Moderate	Moderate to High
CA609	Ramona-Greenfield-Linne	Formed in alluvium weathered from Granitic rocks and in material weathered from sandstone and shale. Soil types include fine sandy to sandy loam, sandy clay loam, and sandy clay to clay loam.	Low to High	Low to Moderate	Moderate to High
CA614	Greenfield-Hanford-Gorgonio	Granitic rocksand consists of fine sandy loam, sandy loam, and gravelly loamy fine sand.	Low to Moderate	Low to Moderate	Low to High
CA620	Cieneba–Rock Outcrop–Sesame	Includes outcrops of bare rock. Shallow to moderately deep soils formed in material weathered from Granitic rocks. Soil types include fine gravelly loam, gravelly loam, and sandy to sandy clay loam.	Low to Moderate	Low to Moderate	Low to High
CA639	Tujunga–Urban Land–Hanford	Formed in alluvium derived primarily from granitics and includes fine sandy loam, sand, and loamy sand.	Low to Moderate	Low to Moderate	Low to High
CA648	Badland–San Timoteo–Xerorthents	Formed in material primarily weathered from shale, sandstone. Soil types include loam, sandy loam, and silt loam.	Low to Moderate	Low to Moderate	Moderate to High

Source: NRCS STATSGO California GIS data, 1994; NRCS website, 2006.

1 A desert pavement is a desert surface that is covered with closely packed, interlocking angular or rounded rock fragments of pebble and cobble size. Desert varnish is the thin red to black coating found on exposed rock surfaces in arid regions. Varnish is composed of clay minerals, oxides and hydroxides of manganese and/or iron. Both desert pavement and desert varnish take thousands of years to form.

2 Loam soil composed of sand, silt, clay, and organic matter in evenly mixed particles of various sizes.

Mineral Resources

Maps of the occurrence and location of mineral resources were reviewed for portions of San Bernardino and Riverside Counties (Matti, 1982; Matti, Cox and Iverson, 1983; Greene and Calzia, 1995; Calzia, Matti, Gantenbein, 1995). Map coverage was not complete. However, the proposed route does not appear to cross any areas of interest for mining other than those areas used for quarrying sand and gravel and areas used for landfill purposes. Additionally, a review of mineral resource occurrence data was conducted which identified several mineral resource sites within 1,000 feet of the proposed route, all identified as sand and gravel operations. See the route segment discussions below for more information about the sand and gravel operations.

Faults and Seismicity

Active faults that represent a significant seismic threat to the West of Devers route segments are listed in Table D.13-8. Data presented in this table include estimated earthquake magnitudes, type of fault, and slip rates. Figure D.13-2 (see enclosed CD) shows locations of significant active faults and historic earthquakes in the project area and surrounding region.

Table D.13-8. Significant Active Faults in the West of Devers Transmission Route Vicinity

Fault	Fault Length (km)	Maximum Estimated Earthquake Magnitude	Type of Fault and Dip Direction	Slip Rate (mm/yr)
Cucamonga	17	6.9	reverse, 45°N	5.0
Cleghorn	16	6.5	left lateral strike slip, 90	3.0
San Andreas: Mojave Segment	64	7.0	right lateral strike slip, 90°	30.0
San Jose	12	6.4	left lateral right oblique, 75°NW	0.5
Whittier	24	6.8	right lateral strike slip, 90°	2.5
Elsinore: Glen Ivy Segment	22	6.8	right lateral strike slip, 90°	5.0
Burnt Mountain	13	6.5	right lateral strike slip, 90°	0.6
Eureka Peak	12	6.4	right lateral strike slip, 90°	0.6
Helendale–South Lockhart	60	7.3	right lateral strike slip, 90°	0.6
Landers	52	7.3	right lateral strike slip, 90°	0.6
Lenwood-Lockhart-Old Woman Springs	90	7.5	right lateral strike slip, 90°	0.6
North Frontal Fault Zone - East	17	6.7	reverse, 45°S	0.5
North Frontal Fault Zone - West	32	7.2	reverse, 45°S	1.0
Pinto Mountain	46	7.2	left lateral strike slip, 90°	2.5
Pisgah–Bullion Mountain–Mesquite Lake	55	7.3	right lateral strike slip, 90°	0.6
San Andreas: Coachella Segment	60	7.2	right lateral strike slip, 90°	25.0
San Andreas: San Bernardino Segment	64	7.5	right lateral strike slip, 90°	24.0
San Jacinto: Anza Segment	57	7.2	right lateral strike slip, 90°	12.0
San Jacinto: San Jacinto Valley Segment	27	6.9	right lateral strike slip, 90°	12.0
South Emerson–Copper Mountain	34	7.0	right lateral strike slip, 90°	0.6

Source: CGS, 2002.

Fault Rupture

A major factor to be considered in the seismic design of electric transmission lines crossing active faults is the amount and type of potential ground surface displacement along faults. In the Proposed Project area, an extremely complex zone of right-lateral strike-slip, reverse-oblique, and thrust faults occur in the southeastern San Bernardino Mountains. The West of Devers route segments crosses several faults capable of significant surface rupture, including from west to east, the Banning, Garnet Hill, San Gorgonio, and San Jacinto fault zones

The Garnet Hill, Banning, and San Gorgonio Pass faults are all part of the San Andreas Fault Zone. The Holocene to late Quaternary Garnet Hill Fault is approximately 16 miles in length and passes near the communities of Whitewater, Palm Springs, and North Palm Springs. The San Gorgonio Fault Zone is an approximately 22-mile thrust fault located near the communities of Banning, Cabazon, and Beaumont and is Holocene to late Quaternary in age. The San Gorgonio Pass area is characterized by fractured segments of the San Andreas Fault intermingling with other faults, including segments of the San Jacinto Fault Zone. The Banning Fault generally parallels I-10 north of the San Gorgonio Fault Zone for approximately 25 miles. The fault passes close to the communities of Banning, Cabazon, and Whitewater. The Banning Fault's most recent rupture was during Holocene time.

Heading northwest, parallel to I-10, the proposed route passes a series of arcs that are collectively known as the Crafton Hills Fault Zone. This fault zone consists of approximately 10 normal faults, each approximately six miles long or less, that have been formed by the regional extension created near the intersection of two right-lateral faults, the San Andreas and San Jacinto fault zones.

Near the communities of Loma Linda and Grand Terrace, the proposed route crosses segments of the San Jacinto Fault Zone. The San Jacinto Fault is one of the major faults of Southern California, approximately 130 miles in length and generally parallel and west of the San Andreas fault. It is an active right-lateral strike-slip complex of faults that has been responsible for many of the damaging earthquakes in Southern California in historical times. Future earthquakes could occur anywhere along the various strands and associated faults (including currently unknown faults) of this zone, though only strike-slip earthquakes of magnitude 6.0 or greater are likely to generate surface fault rupture and offset (CGS, 1996). The average recurrence interval between major ruptures is between 100 to 300 years. The last major rupture was April 9, 1968, on a more southern segment of the fault.

Strong Groundshaking

The projected peak ground accelerations for the West of Devers portion of the proposed route are presented in Table D.13-9. A review of historic earthquake activity from 1800 to 2005 indicates that many earthquakes of magnitude M6.0 or greater have occurred within 50 miles of the Proposed Project alignment (CGS, 2005). A summary of significant M6.0 or greater earthquake events is presented in Table D.13-10.

Table D.13-9. Approximate Peak Ground Accelerations

Approximate Proposed Transmission Line Milepost	Total Length of Segments (miles)	Peak Ground Acceleration
W33.5–W43.5 and V0–V4.8	14.8	> 0.8 g
W0–W3 and W32–W33.5	4.5	0.7–0.8g
W3–W10.5, W~~14.5~~14.7–W17.5, and W28.5–W32	14	0.6–0.7g
W17.5–W28.5	11	0.5–0.6g

Source: CGS, 2006.

Table D.13-10. Significant Historic Earthquakes Affecting the West of Devers Project Vicinity

Date	Earthquake Name or General Location	Fault Involved, if Known	Magnitude	Approximate Closest Distance to Project Alignment
October 16, 1999	Hector Mine Earthquake	Lavic Lake and Bullion	7.15	48 miles northeast
June 28, 1992	Landers Earthquake	Johnson Valley, Landers, Homestead Valley, Emerson, Camp Rock, and others	7.3	20 miles northeast
June 28, 1992	Big Bear Earthquake – aftershock of the Landers Earthquake	Unnamed fault	6.5	15 miles north
April 23, 1992	Joshua Tree	Eureka Peak	6.2	15 miles northeast
July 8, 1986	North Palms Springs Earthquake	Banning or Garnet Hill	5.9	4.5 miles northwest
December 4, 1948	Desert Hot Springs Earthquake	Banning or So San Andreas	6.0	11 miles east
March 11, 1933	Long Beach Earthquake	Newport-Inglewood	6.4	46 miles southwest
July 22, 1923	North San Jacinto Fault Earthquake	San Jacinto	6.3	2 miles south
April 21, 1918	San Jacinto Earthquake	San Jacinto	6.8	14 miles south
May 15, 1910	Elsinore Earthquake	Elsinore	6.0	25 miles southwest
December 25, 1899	San Jacinto Fault Earthquake, located southeast of San Jacinto	San Jacinto	6.5	11 miles south
July 22, 1899	Cajon Pass Earthquake	Uncertain	6.4	21 miles northwest
February 2, 1890	San Jacinto or Elsinore Fault region	Uncertain	Estimated 6.5 to 6.8	40 miles southeast
December 8, 1812	Wrightwood Earthquake	San Andreas	7.5	29 miles northwest

Source: SCEC Website, 2006.
Notes: Magnitude is moment magnitude (MW) for earthquakes after 1911. For earthquakes before 1911, magnitudes are estimated from observed shaking intensity. Earthquake magnitudes and locations before 1932 are estimated based on reports of damage and felt effects.

Liquefaction

Due to the generally deep water table in the project area, liquefaction is not considered a potential hazard. However, in the San Bernardino Valley, water tables are high and liquefaction is a known geologic hazard.

Seismic Slope Instability/Ground Cracking

Most accounts of major historical earthquakes in the region relate the occurrence of damaging landslides caused by earthquake induced groundshaking. Rockfall hazards and ground cracking are also likely effects of strong groundshaking in the area. Locations susceptible to seismically induced failure include highly weathered and unconsolidated materials on moderate to steep slopes, especially areas of previously existing landslides. Rocks, either as individual boulders or as a mass of loose rocks on steep hillsides, can travel downslope during an earthquake with potentially damaging effect.

D.13.3.1 Devers Substation to East Border of Banning

Geology

This section of the Proposed Project crosses from the northern Coachella Valley through San Gorgonio Pass along the southern flank of the San Bernardino Mountains, to Banning at the western end of the Pass. For nearly the entire section, towers and facilities of the Proposed Project would be sited on Quaternary alluvium (Qal) or Pleistocene nonmarine deposits (Qco). Descriptions of these units are listed in Table D.13-6. Approximate locations of these units along the route segment are listed below.

- Qal: MPs W0–W2.7, W3.4–W3.9, W6.4–W9.5, W10.3–W10.8, and W11.3 to 14.3
- Qco: MPs W2.7–W3.4, W3.9–W6.4, W9.5–W10.3, and W10.8–W11.3.

Soils

Five soil associations are mapped along this segment of the route. The primary associations are Carsitas-Myoma-Carrizo (CA601), Greenfield-Hanford-Gorgonio (CA614), and Badland–San Timoteo–Xerorthents (CA648). Minor amounts of Badland-Beeline-Rillito (CA605) and Tujunga–Urban Land–Hanford (CA639) are located in the White Water area. Descriptions of these soils are presented in Table D.13-7. Approximate locations of these soil associations along this segment are listed below.

- CA601: MPs W0–W2.7 and W6.5–W9.7
- CA605: MPs W2.7–W3.5
- CA639: MPs W3.5–W3.9
- CA648: MPs W3.9–W6.5, W9.7–W10.5, and W10.9–W11.4
- CA614: MPs W10.5–W10.9 and W11.4–W14.3.

Corrosion potential for these soils varies widely between and within the soil associations (see Table D.13-7). Expansion potential is low for the Carsitas-Myoma-Carrizo and Badland-Beeline-Rillito soils and low to moderate for the remaining three associations. The Carsitas-Myoma-Carrizo soils may have local areas of desert pavement.

Mineral Resources

One mineral resource site is mapped by the MRDS database along this segment within 1,000 feet of the route segment. The proposed route segment crosses through the Whitewater quarry located on the west side of the Whitewater River at approximately MP W3.3–W3.5. This quarry is owned by Metropolitan Water District and is no longer active. The site is currently in the planning stages for restoration. No other known mineral resource sites are identified in the area. Therefore, there is no potential impact from loss or inaccessibility of mineral resources for this segment.

Seismicity

Fault Rupture. This segment crosses the active trace of the Banning Fault just west of Devers Substation at an oblique angle near MP W0.4, and the Alquist-Priolo Earthquake Zone for this fault at approximately MP W0–W0.6. Potential fault offset along this active trace could be as much as 15 feet of right-lateral displacement. The alignment crosses a strand of the Garnet Hill Fault at an oblique angle near approximately MP W4.5 with an associated Alquist-Priolo Earthquake Zone from MP W4.3 to W4.8. The segment crosses, at an oblique angle, a portion of an Alquist-Priolo Earthquake Zone for a second strand of the Garnet Hill fault from MP W5.4 to W6.2; however, it does not cross the fault associated with this Alquist-Priolo Earthquake Zone.

Between MP W9.3 and MP W14.3, the proposed route crosses and is approximately parallel to the complex San Gorgonio Fault Zone. The route segment crosses the San Gorgonio Fault a total of five times within this distance. This fault zone is primarily comprised of active thrust faults with designated Alquist-Priolo Earthquake Hazard Zones (CGS, 2000).

Groundshaking. Strong groundshaking caused by an earthquake on any of the faults in the vicinity of this segment should be expected. The peak horizontal accelerations for the area range from 0.6g to 0.8g; although, in the vicinity of the San Gorgonio Fault Zone, the directionality of peak ground acceleration may be more vertical than horizontal because the San Gorgonio Fault Zone is likely to generate a thrust earthquake.

Liquefaction. Potential for liquefaction in this area is low due to anticipated depth to groundwater being greater than 50 feet.

Earthquake-Induced Landslides. Most accounts of historical earthquakes in this area describe damaging landslides resulting from earthquake groundshaking. The portions of the proposed route segment near the foothills of the San Bernardino Mountains could be damaged by landslides, rock avalanches, and rockfalls originating on the slopes north (upslope) of the proposed route.

D.13.3.2 Banning and Beaumont

Geology

This section of the Proposed Project continues the traverse of San Gorgonio Pass along the southern flank of the San Bernardino Mountains to the western outlet of San Timoteo Canyon. West of MP W18, the proposed route enters low hills known as the Banning Bench. Several active desert washes are crossed in this segment of the Proposed Project. The San Gorgonio River wash is present from MP W15.25 to W15.45 and again from MP W17.6 to W17.8.

The proposed alignment route would be sited on Recent alluvium (Qal), nonmarine sedimentary deposits (Qc), and San Timoteo Formation (Pc). Descriptions of these units are listed in Table D.13-6. Approximate locations of these units along the alignment are listed below.

- Qal: MPs W14.3–W17, W17.6–W18.4, and pockets at W24.2 and W24.7
- Pc: MPs W17–W17.6, W18.3–W18.6, and W19.8–W20.3
- Qc: MPs W18.6–W19.8 and W20.3–W28.9; pockets between W19.8 and W20.1.

Soils

Two soil associations are mapped along this segment, the Greenfield-Hanford-Gorgonio (CA614) and Ramona-Greenfield-Linne (CA609). Greenfield-Hanford-Gorgonio soils are formed in alluvium and alluvial fans, and the Ramona-Greenfield-Linne association soils are formed in alluvium and in material weathered from sandstone and shale. These soils are located approximately at MPs W14.3–W18.5 and W18.5–W29.6, respectively.

Greenfield-Hanford-Gorgonio association soils have corrosion potentials of low to moderate for concrete and low to high for uncoated steel. Expansion potential of Greenfield-Hanford-Gorgonio soils ranges from low to moderate. Ramona-Greenfield-Linne association soils have corrosion potentials of low to moderate for concrete and moderate to high for uncoated steel. Expansion potential of Ramona-Greenfield-Linne soils ranges from low to high.

Mineral Resources

One mineral resource site was identified by the MRDS database within 1,000 feet of this segment, a sand and gravel pit located at approximately MPs W16. The quarry is owned by Robertson's Ready Mix and is located along the proposed route between MP W16.5 and W17.1 on the northeast side of Banning. No other known mineral resources were identified in this segment.

Seismicity

Fault Rupture. This segment of the proposed route tracks sub-parallel to the active trace of the complex San Gorgonio Pass Fault Zone between MP W14.3 and MP W20.2 and which has been designated as Alquist-Priolo zone. The segment crosses the fault at approximately MP W17.2. The likely type of faulting to occur in this area is thrust faulting with an up-on-the-north sense of displacement and shortening in the north-south direction. The amount of fault offset will likely be a few feet, some of which may be vertical.

Groundshaking. Strong groundshaking could be caused by an earthquake on any of the faults in the vicinity of this segment. The peak horizontal accelerations for the area ranges from 0.5g to 0.7g; although, in the vicinity of the San Gorgonio Fault Zone, the directionality of peak ground acceleration may be more vertical than horizontal as the San Gorgonio Fault Zone is likely to generate a thrust earthquake with primarily vertical movement. Groundshaking can become focused along favorably aligned ridgelines and hilltops causing higher than normal accelerations and ground movements.

Liquefaction. Potential for liquefaction in this area is low due to groundwater depths of greater than 50 feet. During storms or a wet season, the water table may rise and sections of the proposed route segment that lie near the San Gorgonio River Wash may be moderately susceptible to liquefaction if a strong earthquake occurs while the valley floor sediments are saturated.

Earthquake-Induced Landslides. Seismically induced landsliding and ridgetop spreading are likely along the steeper parts of the proposed route such as from MP W17 to W21 where the route segment crosses several mesas cut by deep valleys and from MP W27.0 to W29.6 where the segment crosses several ridges and valleys. The other portions of the segment are located primarily on flat to gently sloping terrain where landslides are not likely.

D.13.3.3 Calimesa and San Timoteo Canyon

Geology

This segment of the proposed route follows Sam Timoteo Canyon from southeast to northwest along the northeastern flank of the San Timoteo Badlands to San Bernardino Junction. These hills form the high point of the gap between the San Jacinto Mountains on the south and the San Bernardino Mountains on the north. The Calimesa and San Timoteo Canyon segment of the route is primarily underlain by San Timoteo Formation (Pc/QTst), except where the segment crosses San Timoteo Canyon and in small side drainages that are underlain by Recent/Younger Alluvium (Qal/Qya) in the San Timoteo Badlands hills. Numerous small to medium-sized landslides are mapped where slopes are steep.

Soils

Two soil associations are mapped along the Calimesa and San Timoteo Canyon segment. The main soil association is the Badland–San Timoteo–Xerorthents association (CA648), located between MPs W30–W40.1. Minor amounts of Ramona-Greenfield-Linne association (CA609) soils are located between approximately MPs 29.6 and 30, in San Timoteo Canyon. Descriptions of these soil associations are presented in Table D.13-6. Both of these soil associations have moderate to high potential for corrosion to uncoated steel and low to moderate potential for corrosion to concrete. Expansion potential for the Badland–San Timoteo–Xerorthents association soils is low to moderate and low to high for Ramona-Greenfield-Linne association soils.

Mineral Resources

No known mineral resources were identified for this segment.

Seismicity

Fault Rupture. This segment crosses the potentially active Loma Linda Fault, a splay of the San Jacinto Fault Zone, at an oblique angle near the San Bernardino Junction. This fault does not have a mapped Alquist-Priolo Zone associated with it.

Groundshaking. Much of this segment of the proposed route runs sub-parallel to the San Jacinto Fault Zone and is less than a mile northeast of the easternmost trace. The San Jacinto Fault is a Class A fault that may generate up to a M6.9 earthquake. Strong groundshaking caused by an earthquake on any of the faults in the vicinity of this segment should be expected. Peak ground accelerations along this segment range from 0.6 to 0.7 g at the eastern end to greater than 0.8g at the western end.

Liquefaction. Potential for liquefaction in this area is low due to anticipated groundwater depths of greater than 50 feet and the lack of noncohesive granular material in the uppermost 50 feet of the subsurface. Minor areas of liquefaction potential may be present in the alluvial sediments in San Timoteo Canyon near the creek; however, no towers are planned for this area.

Earthquake-Induced Landslides. Strata in the vicinity of the junction are strongly folded with dips ranging from 80° north to 35° southwest within 600 feet. Landslides are common in the poorly consolidated strata that dip steeply and are disrupted by faults. A mapped landslide in the area, and other unmapped slides, could have been mobilized during an earthquake, especially if the ground was saturated.

D.13.3.4 San Bernardino Junction to Vista Substation

Geology

This section of the proposed route goes west from San Bernardino Junction crossing the northern end of the Badlands hills, the San Jacinto Fault, Reche Canyon, terraces on the northern end of Blue Mountain, a part of the Santa Ana River wash, and ending at Vista Substation on an older river terrace. The route segment crosses San Timoteo Formation (QTst) from the San Bernardino Junction (MP V0) to approximately MP V2.6. Reche Canyon and the Santa Ana River wash are underlain by younger fan deposits (Qyf), from about MPs V2.3 to V3.3 and MPs V3.7 to V4.2, respectively. The terraces on the northern end of Blue Mountain are underlain by granitic rocks (Kgr) at about MPs V3.3 to V3.7. The end of the segment and Vista Substation, MPs V4.2 to V4.8, are underlain by older wash deposits (Qow).

Soils

Four soil associations are mapped along the San Bernardino Junction to Vista segment. Soils from the San Bernardino Junction to about MP V2.8 are of the Badland–San Timoteo–Xerorthents association (CA648). West of the San Timoteo Badlands hills, in the Reche Canyon area, at about MPs V2.8 to V3.1, the soils are mapped as Greenfield-Hanford-Gorgonio (CA614). East of Reche Canyon the route segment passes across soils mapped as Cieneba–Rock Outcrop–Sesame (CA620), which are shallow soils formed on the underlying granitic rocks from approximately MPs V3.1 to V3.8. The end of the segment and the Vista Substation located in the San Bernardino Valley, MPs V3.8 to V4.8, are located on soils mapped as Tujunga–Urban Land–Hanford (CA639).

All of these soils have low to moderate expansion potential and low to moderate potential for corrosion to concrete. Potential for corrosion to uncoated steel ranges from low to high for all these soil associations, except the Greenfield-Hanford-Gorgonio association that has moderate to high potential for corrosion to uncoated steel.

Mineral Resources

No mineral resources other than potential sources of sand and gravel near the Santa Ana River wash are identified along this segment of the proposed route.

Seismicity

Fault Rupture. This segment crosses the potentially active Loma Linda Fault, a splay of the San Jacinto Fault Zone, at and near San Bernardino Junction and then crosses the active trace of the San Jacinto Fault between MPs V1.8 and V2.0. The San Jacinto Fault is located in an Alquist-Priolo Fault Rupture Zone in this area.

Groundshaking. The proposed route lies in close proximity to the San Jacinto Fault Zone for its entire length and is located in a seismically active area. This segment of the proposed route and the Vista Substation may be subject to strong groundshaking from any of the active faults in the region. Estimated peak horizontal accelerations are greater than 0.8g for the entire length of this segment.

Liquefaction. This segment is located primarily on semi-consolidated sedimentary units not expected to be liquefiable. Although the route segment does cross several river/stream drainages underlain by liquefiable alluvial and wash deposits, it is not anticipated that towers would be located in these areas.

Earthquake-Induced Landslides. A small landslide in the San Timoteo beds is mapped just east of the San Bernardino Junction at about MP W40.1–W40.2 (Matti et al., 2003). This landslide overlaps a trace of the Loma Linda Fault. Landslides and ground cracking are likely to occur near the San Bernardino Junction as well as along the remaining portions of the route that occur on steeper slopes.

D.13.3.5 San Bernardino Junction to San Bernardino Substation

Geology

This segment of the Proposed Project exits Sam Timoteo Canyon at the San Bernardino Junction and goes due north across the San Bernardino Valley towards San Bernardino Substation. This segment crosses several Quaternary sedimentary units: Wash Deposits (Qw), Younger Fan Deposits (Qyf), Younger Alluvium (Qya), and San Timoteo Formation (QTst). Descriptions of these units are listed in Table D.13-6. Approximate locations of these units along the route segment are listed below.

- QTst: MPs W40.1–W40.4
- Qyf: MPs W40.4–W41.1
- Qw: MPs W 41.1–W41.4 and at W42.3
- Qya: MPs W41.4–W43.5.

Soils

North of San Bernardino Junction, the proposed route traverses down hills and onto the San Bernardino Valley floor to the San Bernardino Substation. The soils on the hills (MPs W40.1–W40.4) are classified as soil association CA648, the Badland–San Timoteo–Xerorthents; and those in the valley (MPs W40.4–

W43.5) are classified as CA614, the Greenfield-Hanford-Gorgonio association. General characteristics of these soils are described in Table D.13-7. The Badland–San Timoteo–Xerorthents and Greenfield-Hanford-Gorgonio associations both have low to moderate potential for corrosion to concrete and for expansion. The Badland–San Timoteo–Xerorthents association soils have a moderate to high and the Greenfield-Hanford-Gorgonio association has a low to high potential for corrosion of uncoated steel.

Mineral Resources

No mineral resources other than potential sources of sand and gravel near the Santa Ana River wash are identified along this segment of the proposed route.

Seismicity

Fault Rupture. This segment crosses the northwestern end of the potentially active Loma Linda Fault (a segment of the San Jacinto Fault Zone) near the San Bernardino Junction location. This fault is not designated as an Alquist-Priolo Earthquake Fault Zone and has been obscured by development in some areas.

Groundshaking. This segment of the proposed route is between several known active faults and thus is subject to strong groundshaking in the event of a local earthquake. Estimated PGA values for this segment are greater than 0.8g.

Liquefaction. Liquefaction is susceptible on the San Bernardino Valley near the Santa Ana River due to the high water table and the occurrence of granular, unconsolidated materials in the subsurface (Matti and Carson, 1991). The northern end of the proposed route lies in an area identified as having moderate susceptibility to liquefaction in the event of an M8 earthquake on the San Andreas Fault or an M7 earthquake on the San Jacinto Fault.

Earthquake-Induced Landslides. Landslides and ground cracking are likely to occur in the sedimentary deposits of the hills near the San Bernardino Junction.

D.13.4 Applicable Regulations, Plans, and Standards

Geologic resources and geotechnical hazards are governed primarily by local jurisdictions. The conservation elements and seismic safety elements of city and county general plans contain policies for the protection of geologic features and avoidance of hazards, but do not specifically address transmission line construction projects. Relevant, and potentially relevant, statutes, regulations and policies are discussed below.

D.13.4.1 Federal

Uniform Building Code. Published by the International Conference of Building Officials, the UBC provides complete regulations covering all major aspects of building design and construction relating to fire and life safety and structural safety. This is the code adopted by most western states. The provisions of the 1997 Uniform Building Code, Volume 1, contain the administrative, fire and life-safety, and field inspection provisions, including all nonstructural provisions and those structural provisions necessary for field inspections. Volume 2 contains provisions for structural engineering design, including those design provisions formerly in the UBC Standards. Volume 3 contains the remaining material, testing and installation standards previously published in the UBC Standards.

Clean Water Act. See Section D.12.4 (Water Resources) for information about erosion control requirements associated with Storm Water Pollution Prevention Plans (SWPPPs).

D.13.4.2 State

Arizona. The State of Arizona, Arizona Department of Building and Safety maintains and enforces standards of quality and safety for manufactured homes, mobile homes, factory-built buildings, and recreational vehicles and establishes public safety and welfare by reducing hazards to life and property through the maintenance and enforcement of the State fire code. All other building standards and regulations for structures are deferred to local counties and cities, which rely primarily on the UBC.

Arizona Department of Mining and Mineral Resources (ADMMR) is a non-regulatory State agency that aids in the promotion and development of Arizona's mineral resources. This is accomplished through technical research, field investigations, disseminating information through publications and personal contacts, and by maintaining the Arizona Mining and Mineral Museum. The objectives of the department are to promote the development of the mineral resources of the State through technical and educational processes including field investigations, public seminars, publications, conferences, mineral displays, and by providing mining, metallurgical and other technical information and assistance to prospectors, operators of small mines, the mineral industry, and to all others interested in the mineral resources of the State.

California. The Alquist-Priolo Earthquake Fault Zoning Act of 1972 (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 overhead transmission 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) directs the California Department of Conservation (DOC), Division of Mines and Geology (DMG) [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.

The California Building Code (CBC, 2001) is based on the 1997 Uniform Building Code, with the addition of more extensive structural seismic provisions. Chapter 16 of the CBC contains definitions of seismic sources and the procedure used to calculate seismic forces on structures. As the Proposed Project route lies within UBC Seismic Zone 3, provisions for design should follow the requirements of Chapter 16.

D.13.4.3 Local

The safety elements of General Plans for the cities and the Counties along the proposed route contain policies for the avoidance of geologic hazards and/or the protection of unique geologic features. A survey of general plans along the proposed route indicated that most municipalities require submittal of construction and operational safety plans for proposed construction in areas of identified geologic and seismic hazards for review and approval prior to issuance of permits. County and local grading ordinances establish detailed procedures for excavation and grading required for underground construction.

D.13.5 Significance Criteria and Approach to Impact Assessment

This section explains how impacts are assessed in Section D.13, and in Section D.13.5.1 presents the significance criteria on which impact determinations are based. In addition, Section D.13.5.2 lists the Applicant Proposed Measures relevant to Section D.13, and Section D.13.5.3 lists all impacts identified for the Proposed Project and alternatives.

D.13.5.1 Significance Criteria

Geologic conditions were evaluated with respect to the impacts the project may have on local geology, as well as the impact that specific geologic hazards may have upon the proposed transmission line and its related facilities. The significance of these impacts was determined on the basis of NEPA and CEQA statutes, guidelines and appendices, thresholds of significance developed by local agencies, government codes and ordinances. Impacts of the project on the geologic environment would be considered significant and require additional mitigation if project construction or operation would result in any of the following criteria being met:

- Erosion could be triggered or accelerated by project construction or disturbance of landforms.
- Activities associated with the Proposed Project would render known mineral and/or energy resources inaccessible.
- Project construction could trigger or accelerate geologic processes such as landslides.

Impacts of the geologic environment on the project would be considered significant and require additional mitigation if project construction or operation would result in any of the following criteria being met:

- Project structures could be damaged if there is an earthquake on an active earthquake fault along the transmission line route.
- Project structures could be damaged by seismically induced groundshaking that results in landslides, liquefaction, settlement, lateral spreading, and/or surface cracking.
- Project structures could be damaged during project operation by landslides, earthflows, and debris flows on existing unstable slopes.
- Project structures could be damaged if there is a presence of unsuitable soils, including corrosive, expansive, and compressible soils.

D.13.5.2 Applicant Proposed Measures

Applicant Proposed Measures (APMs) were identified by SCE in its Application to the CPUC. Table D.13-11 presents the APMs that are relevant to this section. Impact analysis assumes that all APMs will be implemented as defined in the table; additional mitigation measures are recommended in this section if it is determined that APMs do not fully mitigate the impacts for which they are presented.

Table D.13-11. Applicant Proposed Measures – Geology, Mineral Resources, and Soils

APM No.	Description
APM W-3	Erosion control and hazardous material plans will be incorporated into the construction bidding specifications to ensure compliance.
APM W-7	Runoff from roadways will be collected and diverted from steep, disturbed, or otherwise unstable slopes.
APM W-8	Ditches and drainage concourses will be designed to handle the concentrated runoff, will be located to avoid disturbed areas, and will have energy dissipations at discharge points.
APM W-9	Cut and fill slopes will be minimized by a combination of benching and following natural topography where possible.
APM W-11	Erosion control and hazardous material plans would be incorporated into the construction bidding specifications to ensure compliance.
APM L-5	Along Link 10 in the Palo Verde Valley, H-frame structures, similar to the existing DPV1 structures, would be installed in this segment to reduce the amount of farmland permanently removed from production and minimize impacts to farm operations. Where feasible, additional mitigation measures would include matching tower spans, and aligning towers adjacent or parallel to field boundaries.
APM L-8	Link 14 crosses an open pit gravel operation. Potential impacts would be mitigated during construction by coordinating with the owner/operator to avoid critical mining periods and high volume earth-moving days. Operational mitigation would include spanning the mine.
APM G-1	The line will be located to minimize the disruption of any active mining operations.
APM G-2	Individual ~~T~~transmission towers will not be sited on nor straddle the mapped traces of any known fault that has been designated active or potentially active. In areas where known faults are present, the Holder[5] will visually check the tower site area before clearing, and will check the tower footing holes for any trace of a previously unmapped fault. If manifestations of a fault are found, construction will immediately stop at that site and the Holder will consult with the Holder's Geologist and the BLM Authorized Officer. The Holder's Geologist and the BLM Authorized Officer will determine if it is a fault trace and if so, will ascertain if it is active, potentially active, or inactive.
APM G-3	Towers will be located so that the line will span the surface traces of active and potentially active faults such that a relative lateral surface displacement would shorten the span between towers, and thus avoid potential line breaks. Where this is not feasible, the Holder will incorporate slack spans to bridge the fault(s) such that the projected lateral surface displacement, as forecast by the Holder's ~~geologist~~ Geologist and accepted by the BLM Authorized Officer, will not structurally affect the associated towers.
APM G-4	~~Appropriate tower design will be used to mitigate the potential for very strong seismic groundshaking.~~ In general, an appropriate tower design, which accounts for lateral wind loads and conductor loads, ~~during line stringing~~ exceeds any credible seismic loading (groundshaking).
APM G-5	Towers will be located to avoid areas of highly sensitive dune sand areas. Where these areas cannot be avoided, towers will be located to minimize disturbance to the deposits at a site approved by the BLM Authorized Officer. (BLM B-2.5. Note: Text here omits references to specific figures and maps in the original.
APM G-6	Wherever ~~possible~~ feasible to minimize the potential for slope instability, towers will be located to avoid gullies or active drainages, and over-steepened slopes.
APM G-7	SCE will provide a list of sites where helicopter construction is recommended. The Authorized Officer may require, on a site-specific basis, helicopter assisted construction in sensitive areas. Sensitive areas are those that exhibit both (1) high erosion potential and/or slope instability; and (2) a lack of existing ~~access~~ stub roads within a reasonable distance of the tower site ~~(generally no more than ¼ mile)~~, or existing access that is not suitable for upgrading to accommodate conventional tower construction or line stringing equipment, and where it is determined that, after field review, the issues of erosion and/or slope instability cannot be successfully mitigated through implementation of accepted engineering practices.
APM G-8	Mitigation of potentially significant impacts to the western end of the proposed transmission line due to (1) potential surface fault rupture along the Banning, Mission Creek, and Mecca Hills faults, and (2) potential for severe seismic shaking can be achieved by standard design methods listed below: a. Individual ~~T~~towers will be sited so as not to straddle active fault traces. b. The alignment will be designed to cross an active fault such that future rupture on the fault would not cause excessive stress on the line or the towers. c. Standard foundation and structural design measures will be utilized to minimize the impact from severe seismic shaking.
APM G-9	Appropriate design of tower foundations will be used to reduce the potential for settlement and compaction.

Table D.13-11. Applicant Proposed Measures – Geology, Mineral Resources, and Soils

APM No.	Description
APM G-10	New access roads and soil disturbance will be avoided or minimized in all areas designated as having high erosion hazards or potential slope instability. If the Authorized Officer, after consultation and review of alternatives (including helicopter or helicopter assisted construction), deems the proposed new access road feasible, design plans must be submitted for approval, in writing, prior to construction.
APM G-11	New access roads, which are required, will be designed to minimize ground disturbance from grading. They will follow natural ground contours as closely as possible and include specific features for road drainage, including water bars on slopes over 25 percent. Other measures could include drainage dips, side ditches, slope drains, and velocity reducers. Where temporary crossings are constructed, the crossings will be restored and repaired as soon as possible after completion of the discrete action associated with construction of the line in the area.
APM G-12	Side casting of soil during grading will be minimized. Excess soil and excavated soil will be properly stabilized or, ~~if necessary, end-hauled to an approved disposal site~~ dispersed around tower construction sites or on stub or access roads.
APM G-13	During grading operations, care would be exercised to minimize side casting. No earth would be removed below final elevations, and no cuts would be made deeper than necessary for clearing and road construction.
APM G-14	Upon completion of construction, any drainage deficiencies would be corrected to prevent future erosion. Trees and brush would be cleared only when necessary to provide electrical clearance, line reliability, or suitable access for maintenance and construction.
APM G-15	Counterpoise may need to be installed if the local soil conditions indicate that the soil has a resistance above 30 ohms. This is accomplished by attaching a 0.375-inch cable to the tower steel. The cable is installed 1 foot underground and extends approximately 100 feet within the ROW from two or more footings.
APM G-16	The line would be located to minimize the disruption of any active mining operations.
APM G-17	Appropriate tower design would be used to mitigate the potential for impacts from very strong seismic groundshaking. In general, an appropriate tower design which accounts for lateral wind loads and conductor loads during line stringing exceeds any credible seismic loading (groundshaking).
APM G-18	Whenever possible to minimize the potential for slop instability, towers would be located to avoid gullies or active drainages, and over-steepened slopes.
APM G-19	New access roads, where required, would be designed to minimize ground disturbance from grading. They would follow natural ground contours as closely as possible and include specific features for road drainage, including water bars on slopes over 25 percent. Other measures could include drainage dips, side ditches, slope drains, and velocity reducers. Where temporary crossings are constructed, the crossings would be restored and repaired as soon as possible after completion of the discrete action associated with construction of the line. Side casting of soil during grading would be minimized. Excess soil would be properly stabilized, or if necessary, hauled to an approved disposal site.

D.13.5.3 Impacts Identified

A wide range of potential impacts, including loss of mineral resources, slope instability including landslides, debris flows and slope creep, and seismic hazards including surface fault rupture, strong groundshaking, liquefaction, and seismically induced landslides, was considered in this analysis. Each of these potential geologic and soils impacts is discussed in the following sections. Table D.13-12 lists the impacts identified for the Proposed Project and alternatives, along with the significance of each impact. Detailed discussions of each impact and the specific locations where each is identified are presented in the following sections. Impacts are classified as Class I (significant, cannot be mitigated to a level that is less than significant), Class II (significant, can be mitigated to a level that is less than significant), Class III (adverse, but less than significant), and Class IV (beneficial).

Table D.13-12. Impacts Identified – Geology, Mineral Resources, and Soils

Impact No.	Description	Impact Significance
Proposed Project		
G-1	Construction could accelerate erosion	Class II and III
G-2	Project structures could be damaged by problematic soils	Class II
G-3	Excavation or grading during construction could cause slope instability.	Class II
G-4	Project structures could be damaged by landslides, earthflows, and/or debris flows	Class II
G-5	Project structures could be damaged by seismically included groundshaking and ground failure	Class II and III
G-6	Construction activities would render known mineral resources inaccessible.	Class II
G-7	Project structures could be damaged by surface fault rupture at crossings of active and potentially active faults.	Class II
SCE Harquahala-West Alternative		
G-1	Construction could accelerate erosion	Class II
G-2	Project structures could be damaged by problematic soils	Class II
SCE Palo Verde Alternative		
G-1	Construction could accelerate erosion	Class II
G-2	Project structures could be damaged by problematic soils	Class II
Harquahala Junction Switchyard Alternative		
G-1	Construction could accelerate erosion	Class II
G-2	Project structures could be damaged by problematic soils	Class II
G-7	Project structures could be damaged by surface fault rupture at crossings of active and potentially active faults.	Class II
Desert Southwest Transmission Project Alternative		
G-1	Construction could accelerate erosion	Class II
G-2	Project structures could be damaged by problematic soils	Class II
G-5	Project structures could be damaged by seismically included groundshaking and ground failure	Class III
G-7	Project structures could be damaged by surface fault rupture at crossings of active and potentially active faults.	Class II
Alligator Rock–North of Desert Center Alternative		
G-1	Construction could accelerate erosion	Class II
G-2	Project structures could be damaged by problematic soils	Class II
Alligator Rock–Blythe Energy Transmission Alternative		
G-1	Construction could accelerate erosion	Class III
G-2	Project structures could be damaged by problematic soils	Class II
Alligator Rock–South of I-10 Frontage Alternative		
G-1	Construction could accelerate erosion	Class III
G-2	Project structures could be damaged by problematic soils	Class II
Devers-Valley No. 2 Alternative		
G-1	Construction could accelerate erosion	Class II
G-2	Project structures could be damaged by problematic soils	Class II
G-3	Excavation or grading during construction could cause slope instability.	Class II
G-4	Project structures could be damaged by landslides, earthflows, and/or debris flows	Class II
G-5	Project structures could be damaged by seismically included groundshaking and ground failure	Class II
G-7	Project structures could be damaged by surface fault rupture at crossings of active and potentially active faults.	Class II

D.13.6 Environmental Impacts and Mitigation Measures for the Proposed Project – Devers-Harquahala

This section presents discussion of impacts and mitigation measures for the 500 kV portion of the Proposed Project. The discussion is divided into six geographic areas, three in Arizona and three in California. Within each area, both construction impacts and operational impacts are addressed.

D.13.6.1 Harquahala to Kofa National Wildlife Refuge

There would be no impacts related to mineral resources because there are no active mines identified within 1,000 feet of the segment.

Construction Impacts

Impact G-1: Construction could accelerate erosion (Class II)

Excavation and grading for tower and switchyard foundations, series capacitor banks, work areas, access roads, and spur roads could loosen soil and accelerate erosion. Implementation of APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) would reduce the amount of erosion that would result from construction. In addition, a Stormwater Pollution Prevention Plan (SWPPP) that would limit erosion from the construction site would be required in accordance with Arizona Department of Environmental Quality (ADEQ) guidelines.

However, the APMs do not specifically address the potential disturbance of desert pavement areas, which is a special concern in the desert areas of the proposed route. Desert pavement is a unique geologic/soil feature that takes thousands to tens of thousands of years to form and protects the underlying silty and sandy soils from excessive wind and water erosion. Damage to desert pavement could result in an extreme acceleration of erosion. At least two soil associations along this segment of the proposed route are known to include areas of desert pavement. Therefore, Mitigation Measure G-1a is recommended to protect desert pavement at MPs E0–E24.2, E25.1–E26.9, E33.8–E40, and E51.2–E53.3. Implementation of Mitigation Measure G-1a, as well as the APMs identified above, would result in less than significant impacts (Class II).

Mitigation Measures for Impact G-1: Construction could accelerate erosion

G-1a **Protect desert pavement.** Grading for new access roads or work areas in areas covered by desert pavement shall be avoided if possible. If avoidance of these areas is not possible, the desert pavement surface shall be protected from damage or disturbance from construction vehicles by use of temporary mats on the surface~~, or by other suitable means~~. A plan for identification and avoidance or protection of sensitive desert pavement shall be prepared and submitted to the CPUC ~~and~~ , BLM, and USFWS for review and approval at least 60 days prior to start of construction.

Operational Impacts

There are no known active faults crossing the proposed route segment between Harquahala and the Kofa NWR and the area is considered to have a low potential for seismic hazard. Therefore, there would not likely be any impacts along this segment related to fault rupture, liquefaction, strong groundshaking, or earthquake-induced landslides.

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Corrosive subsurface soils may exist in places along the proposed route. Corrosive soils could have a detrimental effect on concrete and metals. Depending on the degree of corrosivity of subsurface soils, concrete and reinforcing steel in concrete structures and bare-metal structures exposed to these soils could deteriorate, eventually leading to structural failures. Expansive soils can also cause problems to structures. Soils that exhibit shrink-swell behavior are clay-rich and react to changes in moisture content by expanding or contracting. Some of the natural soil types identified within this segment of the project area have moderate to high clay contents and many have moderate to high shrink-swell potential. Expansive soils may cause differential and cyclical foundation movements that can cause damage and/or distress to structures and equipment. In addition, potential impacts associated with loose sands or other compressible soils include excessive settlement, low foundation-bearing capacity, and limitation of year-round access to project facilities.

Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

Mitigation Measure for Impact G-2: Project structures could be damaged by problematic soils

G-2a **Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design.** Design-level geotechnical studies shall be performed by the Applicant to identify the presence, if any, of potentially detrimental soil chemicals, such as chlorides and sulfates. Appropriate design measures for protection of reinforcement, concrete, and metal-structural components against corrosion shall be utilized, such as use of corrosion-resistant materials and coatings, increased thickness of project components exposed to potentially corrosive conditions, and use of passive and/or active cathodic protection systems. The geotechnical studies shall also identify areas with potentially expansive or collapsible soils and include appropriate design features, including excavation of potentially expansive or collapsible soils during construction and replacement with engineered backfill, ground-treatment processes, and redirection of surface water and drainage away from expansive foundation soils. Study results and proposed solutions shall be provided to the CPUC and BLM, as appropriate, for review and approval at least 60 days before construction.

D.13.6.2 Kofa National Wildlife Refuge

There would be no impacts related to mineral resources because there are no active mines identified within 1,000 feet of the segment.

Construction Impacts

Impact G-1: Construction could accelerate erosion (Class II)

Excavation and grading for tower foundations, work areas, access roads, and spur roads could loosen soil and accelerate erosion. In addition, this route segment contains at least two soil associations that are known to include moderate to large areas of desert pavement. APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) would apply in this area to reduce erosion. However, implementation of Mitigation Measure G-1a (Protect desert pavement) would be required at MPs E53.3–E60.6 and E63.7–E74.9 to reduce impacts to less than significant levels (Class II).

Impact G-3: Excavation or grading during construction could cause slope instability (Class II)

Construction consisting of grading and excavation along the foothills at the edge of the New Water Mountains from MP E60 to E61 could cause slope instability. Destabilization of natural or constructed slopes could occur as a result of construction activities due to excavation and/or grading operations. Excavation operations associated with tower foundation construction and grading operations for temporary and permanent access roads and work areas could result in slope instability, resulting in landslides, soil creep, or debris flows. Slope instability including landslides, earth flows, and debris flows has the potential to undermine foundations, cause distortion and distress to overlying structures, and displace or destroy project components. SCE has proposed APMs G-6, G-7, G-10, and G-18 (see Table D.13-11) to reduce impacts related to slope instability. However, to ensure that slope instability impacts would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-3a is required from MP E60 to E61 in addition to the APMs stated above.

Mitigation Measures for Impact G-3: Excavation or grading during construction could cause slope instability

G-3a **Conduct geotechnical surveys for landslides.** The Applicant shall perform design-level geotechnical surveys in areas crossing and adjacent to hills and mountains. These surveys will acquire data that will allow identification of specific areas with the potential for unstable slopes, landslides, earth flows, and debris flows along the approved transmission line route and in other areas of ground disturbance, such as grading for access and spur roads. The investigations shall include an evaluation of subsurface conditions, identification of potential landslide hazards, and provide information for development of excavation plans and procedures. Where landslide hazard areas cannot be avoided, appropriate engineering design and construction measures shall be incorporated into the project designs to minimize potential for damage to project facilities. A report documenting these surveys and design measures to protect structures shall be submitted to the CPUC and BLM for review and approval at least 60 days before construction.

Operational Impacts

There are no known active faults crossing the proposed route segment in the Kofa NWR and the area is considered to have a low potential for seismic hazard. Therefore, there would not likely be any impacts along this segment related to fault rupture, liquefaction, strong groundshaking, or earthquake-induced landslides.

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along this segment of the proposed route have a high potential to corrode steel and a low to high potential to corrode concrete. Expansion potential for the soils along the segment is low to high. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

Impact G-4: Project structures could be damaged by landslides, earthflows, and/or debris flows (Class II)

Slope instability including landslides, earth flows, and debris flows has the potential to undermine foundations, cause distortion and distress to overlying structures, and displace or destroy project components.

The area where landslides would be most likely to occur is the slopes on the southern edge of the New Water Mountains where towers are fairly close to the base of the mountains from MP E60 to E61. SCE has proposed APMs G-6 and G-18 (see Table D.13-11) to reduce impacts related to landslide hazards during operations of the project. However, to ensure that potential landslide impacts to project structures would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-3a is required from MP E60 to E61 in addition to the APMs stated above.

D.13.6.3 Kofa National Wildlife Refuge to Colorado River

There would be no impacts related to mineral resources because there are no active mines identified within 1,000 feet of the segment.

Construction Impacts

Impact G-1: Construction could accelerate erosion (Class II)

Excavation and grading for tower foundations, work areas, access roads, and spur roads could loosen soil and accelerate erosion. In addition, some soils along this segment are typically covered by large areas of desert pavement. Therefore, Mitigation Measure G-1a (Protect desert pavement) is recommended to protect desert pavement. APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) would reduce impacts associated with erosion; however, implementation of Mitigation Measure G-1a (Protect desert pavement) at MPs E77.6–E85.8 and E92.6–E101.4 would ensure that impacts are less than significant (Class II).

Impact G-3: Excavation or grading during construction could cause slope instability (Class II)

Construction, consisting of grading and excavation, along the foothills at the eastern and western edges of Dome Mountains from MP E86 to E92 could cause slope instability. SCE has proposed APMs G-6, G-7, G-10, and G-18 (see Table D.13-11) to reduce impacts related to slope instability. However, to ensure that slope instability impacts would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-3a (Conduct geotechnical surveys for landslides) is required from MP E86 to E92 in addition to the APMs stated above.

Operational Impacts

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along this segment of the proposed route have a high potential to corrode steel and a low to high potential to corrode concrete. Expansion potential for the soils along the segment is low to moderate. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

Impact G-4: Project structures could be damaged by landslides, earthflows, and/or debris flows (Class II)

Slope instability could occur during the operation of the project where the proposed route segment crosses the Dome Rock Mountains from MP E86 to E92, which could undermine foundations, cause distortion and distress to overlying structures, and displace or destroy project components. SCE has proposed APMs G-6 and G-18 (see Table D.13-11) to reduce impacts related to landslide hazards during operations of the project. However, to ensure that potential landslide impacts to project structures would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-3a (Conduct geotechnical surveys for landslides) is required from MP E86 to E92 in addition to the APMs stated above.

Impact G-5: Project structures could be damaged by seismically included groundshaking and ground failure (Class II)

Seismically induced ground failure caused by groundshaking, which includes liquefaction and lateral spreading, could potentially cause damage to project facilities that would be located in the western part of this route segment. Liquefaction occurs in low-lying areas where saturated non-cohesive sediments are found, such as the area adjacent to the Colorado River (i.e., MP E100.0-E102.2). Lateral spreading occurs along waterfronts or canals where non-cohesive soils could move out along a free-face.

Some portions of the segment (e.g., near the Colorado River) are located in areas underlain by potentially liquefiable alluvial deposits and may be subject to liquefaction-related phenomena during a seismic event. SCE has proposed APMs G-4 and G-17 (see Table D.13-11) to reduce impacts related to seismically included groundshaking. However, to ensure that impacts associated with ground failure caused by groundshaking would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-5a is required from MP E100.0-E102.2 in addition to the APMs stated above.

Mitigation Measure for Impact G-5: Project structures could be damaged by seismically included groundshaking and ground failure.

G-5a **~~Protect~~ Design project facilities to avoid impact from ground failure.** Since seismically induced ground failure has the potential to damage or destroy project components, the Applicant shall complete design-level geotechnical investigations at tower locations in areas with potential liquefaction-related impacts. These studies shall specifically assess the potential for liquefaction and lateral spreading hazards to affect the approved project and all associated facilities. Where these hazards are found to exist, appropriate engineering design and construction measures shall be incorporated into the project designs. A report documenting results of the geotechnical surveys shall be submitted to the CPUC and BLM for review and approval at least 60 days before construction.

D.13.6.4 Palo Verde Valley (Colorado River to Midpoint Substation)

This segment of the proposed route is located on flat river floodplain in the valley and on gently sloping alluvial fans on the mesa. There would be no impacts associated with landslides (Impacts G-3 or G-4). There would be no impacts related to mineral resources because there are no active mines identified within 1,000 feet of the segment.

Construction Impacts

Impact G-1: Construction could accelerate erosion (Class III)

Excavation and grading for tower foundations, work areas, access roads, and spur roads could loosen soil and accelerate erosion. However, because the soil associations identified along the segment are not known to contain desert pavement, implementation of APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) is sufficient to ensure that potential impacts would be less than significant (Class III).

Operational Impacts

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along this segment of the proposed route have a high potential to corrode steel and a low to moderate potential to corrode concrete. Expansion potential for the soils along the segment is low to moderate. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

Impact G-5: Project structures could be damaged by seismically included groundshaking and ground failure (Class II)

Portions of the proposed route segment in the Palo Verde Valley are located in areas underlain by potentially liquefiable alluvial deposits from MP E102.2-E112.0 and may be subject to liquefaction-related phenomena during a seismic event. SCE has proposed APMs G-4 and G-17 (see Table D.13-11) to reduce impacts related to seismically included groundshaking. However, to ensure that impacts associated with ground failure caused by groundshaking would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-5a (~~Protect project facilities from ground failure~~Design project facilities to avoid impact from ground failure) is required from MP E102.2-E112.0 in addition to the APMs stated above.

D.13.6.5 Midpoint Substation

The proposed Midpoint Substation site is located on gently sloping to flat alluvial fan deposits on the Palo Verde Mesa. There would be no impacts associated with landslides (Impacts G-3 or G-4). There would be no impacts related to mineral resources because there are no active mines identified within 1,000 feet of the proposed substation site.

Construction Impacts

Impact G-1: Construction could accelerate erosion (Class III)

Grading activities that would be required to construct the substation equipment foundations and the access road to substation site could loosen soil and accelerate erosion. However, desert pavement is not known to occur in the soils along this route. Therefore, implementation of APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) is sufficient to ensure that potential impacts would be less than significant (Class III).

Operational Impacts

The peak horizontal acceleration expected for this area would not be expected to result in strong groundshaking. There would be no expected potential impacts associated with seismically induced ground failure or groundshaking (Impact G-5).

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils at the proposed substation site have a high potential to corrode steel and a low to moderate potential to corrode concrete. Expansion potential for the soils at the site is low to moderate. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

D.13.6.6 Midpoint Substation to Cactus City Rest Area

This segment of the route is located on flat to gently sloping alluvial fans, alluvial plains, and low-lying foothills that are not susceptible to landslides. There would be no impacts associated with landslides (Impacts G-3 or G-4). One mineral resource site (i.e., a gold mine on the Palo Verde Mesa) is within 1,000 feet of the proposed route segment. However, it is no longer in operation. There would be no impacts related to mineral resources along this route segment.

Construction Impacts

Impact G-1: Construction could accelerate erosion (Class II)

Excavation and grading for tower foundations, series capacitor banks, work areas, access roads, and spur roads could loosen soil and accelerate erosion. In addition, some of the soils along this segment are covered by local areas of desert pavement. Therefore, Mitigation Measure G-1a (Protect desert pavement) is recommended to protect desert pavement. APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) would reduce impacts associated with erosion; however, implementation of Mitigation Measure G-1a (Protect desert pavement) would ensure that impacts are less than significant (Class II).

Operational Impacts

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along this segment of the proposed route have a high potential to corrode steel and a low to moderate potential to corrode concrete. Expansion potential for the soils along the segment is low to high. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

Impact G-5: Project structures could be damaged by seismically included groundshaking and ground failure (Class III)

Moderate to strong groundshaking should be expected in the event of an earthquake on the faults near the western end of this segment. The segment would also be subject to groundshaking from a large earthquake on any of the major faults in the region. While the shaking would be less severe from an earthquake that originates farther from the route, the effects, particularly on the ridgelines and hills, could be damaging to project structures. It is likely that the transmission line towers would be subjected to at least one moderate or larger earthquake occurring close enough to produce groundshaking along this segment. However, implementation of proposed APMs G-4 and G-17 (see Table D.13-11) would ensure that impacts related to seismically included groundshaking are less than significant (Class III).

D.13.6.7 Cactus City Rest Area to Devers Substation

This segment of the route does not pass include topography with steep slopes that would be susceptible to landslides. There would be no impacts associated with landslides (Impacts G-3 or G-4).

Construction Impacts

Impact G-1: Construction could accelerate erosion (Class II)

Excavation and grading for tower foundations, work areas, access roads, and spur roads could loosen soil and accelerate erosion. In addition, some of the soils along this segment are known to include desert pavement. Therefore, Mitigation Measure G-1a (Protect desert pavement) is recommended to protect desert pavement. APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) would reduce impacts associated with erosion; however, implementation of Mitigation Measure G-1a (Protect desert pavement) would ensure that impacts are less than significant (Class II).

Impact G-6: Construction activities would render known mineral resources inaccessible (Class II)

The Cactus City Rest Area to Devers Substation segment crosses an active sand and gravel quarry in the Indio Hills area called the Indio Pit operated by Granite Construction. The segment crosses the Indio Pit between MPs E205 and E206. The project route would pass through the site within an existing SCE ROW and would therefore not reduce accessibility to the sand and gravel resources. However, construction operations for the Proposed Project could potentially interfere with daily ongoing mining operations at the quarry. SCE recommended APMs L-8 and G-1 to reduce this impact. However, to ensure that this impact would be reduced to less than significant levels (Class II), Mitigation Measure G-6a is required.

Mitigation Measure for Impact G-6: Construction activities would render known mineral resources inaccessible

G-6a **Coordinate with quarry operations.** Operations and management personnel for the Indio Pit quarry shall be consulted regarding locations of active mining and for coordination of construction activities in and through those areas. A plan to avoid or minimize interference with mining operations shall be prepared in conjunction with mine/quarry operators prior to construction. SCE shall document compliance with this measure prior to the start of construction by submitting the plan to the CPUC and BLM for review at least 60 prior to the start of construction.

Operational Impacts

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along this segment of the proposed route have a moderate to high potential to corrode steel and a low to moderate potential to corrode concrete. Expansion potential for the soils along the segment is low to moderate. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

Impact G-5: Project structures could be damaged by seismically included groundshaking and ground failure (Class III)

Strong groundshaking should be expected in the event of an earthquake on the faults that are near and that cross this segment. The segment would also be subject to groundshaking from a large earthquake on any of the major faults in the region. It is likely that the transmission line towers would be subjected to at least one moderate or larger earthquake occurring close enough to produce groundshaking along this segment. However, implementation of proposed APMs G-4 and G-17 (see Table D.13-11) would ensure that impacts related to seismically included groundshaking are less than significant (Class III).

Impact G-7: Project structures could be damaged by surface fault rupture at crossings of active and potentially active faults (Class II)

Project facilities would be subject to hazards of surface fault rupture at crossings of the active Banning Fault, between approximately MPs E205 and E206 and at approximately MP E224.5. Hazards would not be as great where the proposed route crosses traces of potentially active faults, such as the Mecca Hills Fault. Fault crossings, where multiple feet of displacement are expected along active faults, are best crossed as overhead lines with towers placed well outside the fault zone to allow for the flex in the conductor lines to absorb offset. For aboveground installations such as substations near active faults and mapped Alquist-Priolo Earthquake Zones, SCE would follow standard design codes for facilities in seismic zones. In general, APMs G-2, G-3, and G-8 require that towers be sited so as not to straddle active fault traces and that the route alignment be designed to cross an active fault such that future rupture on the fault would not cause excessive stress on the line or the towers. In addition to these APMs, Mitigation Measure G-7a is required for fault crossings to minimize the length of transmission line within fault zones. Impacts associated with overhead active fault crossings would be reduced to less than significant levels (Class II) with implementation of Mitigation G-7a because conductor is able to distribute fault displacements over a comparatively long span.

The Devers Substation is not crossed by an active fault; it is located adjacent to two Alquist-Priolo zones. Although unlikely, the substation could potentially be damaged by rupture propagated along unmapped or new shear zones associated with these faults. This impact would be reduced to less than significant with implementation of Mitigation Measure G-7a (Class II).

Mitigation Measure for Impact G-7: Project structures could be damaged by surface fault rupture at crossings of active and potentially active faults.

G-7a **Minimize project structures within active fault zones.** SCE shall perform a geologic/geotechnical study to confirm the location of mapped traces of active and potentially faults crossed by the project route. For crossings of active faults, the towers shall be placed as far as feasible outside the area of mapped fault traces. Compliance with this measure shall be documented to the CPUC and BLM in a report submitted for review and approval at least 60 days prior to the start of construction.

D.13.7 Environmental Impacts and Mitigation Measures for the Proposed Project – West of Devers

This section presents discussion of impacts related to geologic, soil, and seismic conditions and mitigation measures for the portion of the DPV2 Project west of the Devers Substation. The discussion is divided into five geographic areas, three between Devers Substation and San Bernardino Junction, and the two segments west of San Bernardino Junction. Within each area, both construction impacts and operational impacts are addressed.

D.13.7.1 Devers Substation to East Border of Banning

Construction Impacts

Impact G-1: Construction could accelerate erosion (Class II)

Excavation and grading for tower foundations, work areas, access roads, and spur roads could loosen soil and accelerate erosion. In addition, some of the soils along this segment may have local areas of desert pavement. Therefore, Mitigation Measure G-1a (Protect desert pavement) is recommended to protect desert pavement. APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) would reduce impacts associated with erosion; however, implementation of Mitigation Measure G-1a (Protect desert pavement) would ensure that impacts are less than significant (Class II).

Impact G-3: Excavation or grading during construction could cause slope instability (Class II)

Construction consisting of grading and excavation along the foothills at the southern edges of San Bernardino Mountains from MP W9-W11 could cause slope instability. SCE has proposed APMs G-6, G-7, G-10, and G-18 (see Table D.13-11) to reduce impacts related to slope instability. However, to ensure that slope instability impacts would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-3a (Conduct geotechnical surveys for landslides) is required from MP W9 to W11 in addition to the APMs stated above.

Operational Impacts

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along this segment of the proposed route have a low to high potential to corrode steel or concrete. Expansion potential for the soils along the segment is low to moderate. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

Impact G-4: Project structures could be damaged by landslides, earthflows, and/or debris flows (Class II)

Slope instability could occur during the operation of the project along the foothills at the southern edges of San Bernardino Mountains from MP W9-W11 that could undermine foundations, cause distortion and distress to overlying structures, and displace or destroy project components. SCE has proposed APMs G-6 and G-18 (see Table D.13-11) to reduce impacts related to landslide hazards during operations of the project. However, to ensure that potential landslide impacts to project structures would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-3a (Conduct geotechnical surveys for landslides) is required from MP W9-W11 in addition to the APMs stated above.

Impact G-5: Project structures could be damaged by seismically included groundshaking and ground failure (Class III)

Strong groundshaking should be expected in the event of an earthquake on the faults that are near and that cross this segment. The segment would also be subject to groundshaking from a large earthquake on any of the major faults in the region. It is likely that the transmission line towers would be subjected to at least one moderate or larger earthquake occurring close enough to produce groundshaking along this segment. However, implementation of proposed APMs G-4 and G-17 (see Table D.13-11) would ensure that impacts related to seismically included groundshaking are less than significant (Class III).

Impact G-7: Project structures could be damaged by surface fault rupture at crossings of active and potentially active faults (Class II)

Project facilities would be subject to hazards of surface fault rupture at the numerous fault crossings; the segment crosses the Banning, Garnet Hill, and San Gorgonio Faults and their associated Alquist-Priolo zones. Fault crossings, where multiple feet of displacement are expected along active faults, are best crossed as overhead lines with towers placed well outside the fault zone to allow for the flex in the transmission lines to absorb offset. Implementation of APMs G-2, G-3, and G-8 would reduce potential impacts associated with surface fault rupture; however, Mitigation Measure G-7a (Minimize project structures within active fault zones) would ensure that impacts associated with fault crossings are reduced to less than significant levels (Class II).

D.13.7.2 Banning and Beaumont

Construction Impacts

Impact G-1: Construction could accelerate erosion (Class III)

Grading activities that would be required to construct the tower foundations and spur roads could loosen soil and accelerate erosion. However, desert pavement is not known to occur in the soils along this segment. Therefore, implementation of APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) is sufficient to ensure that potential impacts would be less than significant (Class III).

Impact G-3: Excavation or grading during construction could cause slope instability (Class II)

Construction consisting of grading and excavation along steeper parts of the proposed route, such as from MP W17-W21 where the route segment crosses several mesas cut by deep valleys, could cause slope instability. SCE has proposed APMs G-6, G-7, G-10, and G-18 (see Table D.13-11) to reduce impacts related to slope instability. However, to ensure that slope instability impacts would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-3a (Conduct geotechnical surveys for landslides) is required from MP W17-W21 in addition to the APMs stated above.

Impact G-6: Construction activities would render known mineral resources inaccessible

The Banning and Beaumont segment crosses an active sand and gravel quarry operated by Granite Construction at the northeastern edge of the City of Banning. The segment crosses the quarry between MPs W16.5 and W17.1. The project route would pass through the site within an existing SCE ROW and would therefore not reduce accessibility to the sand and gravel resources. However, construction operations for the Proposed Project could potentially interfere with daily ongoing mining operations at the quarry. SCE recommended APMs L-8 and G-1 to reduce this impact. However, to ensure that this impact would be reduced to less than significant levels (Class II), Mitigation Measure G-6a (Coordinate with quarry operations) is required.

Operational Impacts

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along this segment of the proposed route have a low to high potential to corrode steel and a low to moderate potential to corrode concrete. Expansion potential for the soils along the segment is low to high. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

Impact G-4: Project structures could be damaged by landslides, earthflows, and/or debris flows (Class II)

Slope instability could occur during the operation of the project along the steeper parts of the proposed route, such as from MP W17 to W21 where the route segment crosses several mesas cut by deep valleys. Slope instability could cause landslides that could undermine foundations, cause distortion and distress to overlying structures, and displace or destroy project components. SCE has proposed APMs G-6 and G-18 (see Table D.13-11) to reduce impacts related to landslide hazards during operations of the project. However, to ensure that potential landslide impacts to project structures would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-3a (Conduct geotechnical surveys for landslides) is required from MP W17 to W21 in addition to the APMs stated above.

Impact G-5: Project structures could be damaged by seismically included groundshaking and ground failure (Class III)

Strong to severe groundshaking should be expected in the event of an earthquake on the faults that are near and that cross this segment. The segment would also be subject to groundshaking from a large earthquake on any of the major faults in the region. It is likely that the transmission line towers would be subjected to at least one moderate or larger earthquake occurring close enough to produce groundshaking along this segment. However, implementation of proposed APMs G-4 and G-17 (see Table D.13-11) would ensure that impacts related to seismically included groundshaking are less than significant (Class III).

Impact G-7: Project structures could be damaged by surface fault rupture at crossings of active and potentially active faults (Class II)

Project facilities would be subject to hazards of surface fault rupture where the proposed route crosses the San Gorgonio Fault Zone and its associated Alquist-Priolo zone near MP W17.2. Fault crossings, where multiple feet of displacement are expected along active faults, are best crossed as overhead lines with towers placed well outside the fault zone to allow for the flex in the transmission lines to absorb offset. Implementation of APMs G-2, G-3, and G-8 would reduce potential impacts associated with surface fault rupture; however, Mitigation Measure G-7a (Minimize project structures within active fault zones) would ensure that impacts associated with fault crossings are reduced to less than significant levels (Class II).

D.13.7.3 Calimesa and San Timoteo Canyon

Mineral resources were not identified along this route segment. Therefore, there would be no impacts related to mineral resources along this segment.

Construction Impacts

Impact G-1: Construction could accelerate erosion (Class III)

Grading activities that would be required to construct the tower foundations and spur roads could loosen soil and accelerate erosion. However, desert pavement is not known to occur in the soils along this segment. Therefore, implementation of APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) is sufficient to ensure that potential impacts would be less than significant (Class III).

Impact G-3: Excavation or grading during construction could cause slope instability (Class II)

Construction consisting of grading and excavation along the ridges and hills of the San Timoteo Badlands from MP E27.0-E40.1 could cause slope instability. SCE has proposed APMs G-6, G-7, G-10, and G-18 (see Table D.13-11) to reduce impacts related to slope instability. However, to ensure that slope instability impacts would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-3a (Conduct geotechnical surveys for landslides) is required from MP E27.0-E40.1 in addition to the APMs stated above.

Operational Impacts

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along this segment of the proposed route have a moderate to high potential to corrode steel and a low to moderate potential to corrode concrete. Expansion potential for the soils along the segment is low to high. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

Impact G-4: Project structures could be damaged by landslides, earthflows, and/or debris flows (Class II)

Slope instability could occur during the operation of the project along the ridges and hills of the San Timoteo Badlands from MP E27.0-E40.1. Slope instability could cause landslides that could undermine foundations, cause distortion and distress to overlying structures, and displace or destroy project components. SCE has proposed APMs G-6 and G-18 (see Table D.13-11) to reduce impacts related to landslide hazards during operations of the project. However, to ensure that potential landslide impacts to project structures would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-3a (Conduct geotechnical surveys for landslides) is required from MP E27.0-E40.1 in addition to the APMs stated above.

Impact G-5: Project structures could be damaged by seismically included groundshaking and ground failure (Class III)

Strong to severe groundshaking should be expected in the event of an earthquake on the faults that are near and that cross this segment. The segment would also be subject to groundshaking from a large earthquake on any of the major faults in the region. It is likely that the transmission line towers would be subjected to at least one moderate or larger earthquake occurring close enough to produce groundshaking along this segment. However, implementation of proposed APMs G-4 and G-17 (see Table D.13-11) would ensure that impacts related to seismically included groundshaking are less than significant (Class III).

Impact G-7: Project structures could be damaged by surface fault rupture at crossings of active and potentially active faults (Class II)

Project facilities would be subject to hazards of surface fault rupture where the proposed route crosses the potentially active Loma Linda Fault near the San Bernardino Junction. Fault crossings, where multiple feet of displacement are expected along active faults, are best crossed as overhead lines with towers placed well outside the fault zone to allow for the flex in the transmission lines to absorb offset. Implementation of APMs G-2, G-3, and G-8 would reduce potential impacts associated with surface fault rupture; however, Mitigation Measure G-7a (Minimize project structures within active fault zones) would ensure that impacts associated with fault crossings are reduced to less than significant levels (Class II).

D.13.7.4 San Bernardino Junction to Vista Substation

No active mineral resources were identified along this route segment. Therefore, there would be no impacts related to mineral resources along this segment.

Construction Impacts

Impact G-1: Construction could accelerate erosion (Class III)

Grading activities that would be required to construct the tower foundations, foundations for the new equipment at the substation, and spur roads could loosen soil and accelerate erosion. However, desert pavement is not known to occur in the soils along this segment. Therefore, implementation of APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) is sufficient to ensure that potential impacts would be less than significant (Class III).

Impact G-3: Excavation or grading during construction could cause slope instability (Class II)

Construction consisting of grading and excavation along the ridges and hills of the San Timoteo Badlands from MP E40.1-V3.5 could cause slope instability. SCE has proposed APMs G-6, G-7, G-10, and G-18 (see Table D.13-11) to reduce impacts related to slope instability. However, to ensure that slope instability impacts would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-3a (Conduct geotechnical surveys for landslides) is required from MP E40.1-V3.5 in addition to the APMs stated above.

Operational Impacts

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along this segment of the proposed route have a low to high potential to corrode steel and a low to moderate potential to corrode concrete. Expansion potential for the soils along the segment is low to moderate. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

Impact G-4: Project structures could be damaged by landslides, earthflows, and/or debris flows (Class II)

Slope instability could occur during the operation of the project along the ridges and hills of the San Timoteo Badlands from MP E40.1-V3.5. Slope instability could cause landslides that could undermine foundations, cause distortion and distress to overlying structures, and displace or destroy project components. SCE has proposed APMs G-6 and G-18 (see Table D.13-11) to reduce impacts related to landslide hazards during operations of the project. However, to ensure that potential landslide impacts to project structures would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-3a (Conduct geotechnical surveys for landslides) is required from MP E40.1-V3.5 in addition to the APMs stated above.

Impact G-5: Project structures could be damaged by seismically included groundshaking and ground failure (Class III)

Strong to severe groundshaking should be expected in the event of an earthquake on the faults that are near and that cross this segment. The segment would also be subject to groundshaking from a large earthquake on any of the major faults in the region. It is likely that the transmission line towers would be subjected to at least one moderate or larger earthquake occurring close enough to produce groundshaking along this segment. However, implementation of proposed APMs G-4 and G-17 (see Table D.13-11) would ensure that impacts related to seismically included groundshaking are less than significant (Class III).

Impact G-7: Project structures could be damaged by surface fault rupture at crossings of active and potentially active faults (Class II)

Project facilities would be subject to hazards of surface fault rupture where the proposed route crosses the potentially active Loma Linda Fault (near San Bernardino Junction) and the active San Jacinto Fault and its associated Alquist-Priolo zone near MP V1.9. Fault crossings, where multiple feet of displacement are expected along active faults, are best crossed as overhead lines with towers placed well outside the fault zone to allow for the flex in the transmission lines to absorb offset. Implementation of APMs G-2, G-3, and G-8 would reduce potential impacts; however, implementation of Mitigation Measure G-7a (Minimize project structures within active fault zones) would ensure that impacts associated with fault crossings are reduced to less than significant levels (Class II).

D.13.7.5 San Bernardino Junction to San Bernardino Substation

Construction Impacts

Impact G-1: Construction could accelerate erosion (Class III)

Grading activities that would be required associated with preparing the foundations for the new equipment at the substation could loosen soil and accelerate erosion. However, desert pavement is not known to occur in the soils along this segment or at the San Bernardino Substation. Therefore, implementation of APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) is sufficient to ensure that potential impacts would be less than significant (Class III).

Operational Impacts

This segment of the proposed route is limited to reconductoring existing structures with no new towers to be constructed; therefore, there should be no operational impact to this project from geologic, soil, or seismic conditions. Operational impacts related to the new structures at the San Bernardino Substation are discussed below.

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils at the substation have a low to high potential to corrode steel and a low to moderate potential to corrode concrete. Expansion potential for the soils along the segment is low to moderate. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

Impact G-5: Project structures could be damaged by seismically included groundshaking and ground failure (Class III)

Strong to severe groundshaking should be expected at the San Bernardino Substation in the event of a large earthquake on the nearby and regional faults. It is likely that the Substation would be subjected to at least one moderate or larger earthquake occurring close enough to produce groundshaking. However, implementation of proposed APMs G-4 and G-17 (see Table D.13-11) would insure that impacts related to seismically included groundshaking are less than significant (Class III).

D.13.8 Alternatives for Devers-Harquahala

D.13.8.1 Harquahala-West Alternative

Environmental Setting

Geology. The Harquahala-West Alternative primarily traverses alluvial plains, alluvial fans, and pediments. This alternative crosses the Harquahala Plain and the northeastern edge of the Eagletail Mountains. Geologic units crossed by the alternative are undivided surficial deposits (Qs), younger sediments (QTs), and small outcrops of basalt (Qb) and andesitic, and rhyolitic dikes and plugs (Ki). Approximate locations of these units relative to the alternative mileposts are listed below.

- Qs: MPs 0–11.2 and 13–21
- QTs: MPs 11.2–13
- Qb and Ki: small outcrops between MPs 18.2 and 21.

Soils. Three soil associations are mapped along the Harquahala-West Alternative: Momoli-Carrizo-Denure, Pahaka-Estrella-Antho, and Gunsight-Rillito-Chuckwalla. Description of these soils are provided in Table D.13-2. The Momoli-Carrizo-Denure (AZ008) association is present in the western portion of the alternative route from approximately alternative MPs 0–4.2. This soil association has low potential for expansion (shrink/swell) and corrosion to concrete; however, it has a high potential for corrosion to uncoated steel. The Pahaka-Estrella-Antho association (AZ028), which has a low to moderate potential for expansive soils, low potential for corrosion to concrete, and a high potential for corrosion to uncoated steel, are located at approximately alternative MPs 4.2–10.2. The third soil association, Gunsight-Rillito-Chuckwalla (AZ016), is located at approximately alternative MPs 10.2–21.0 and these soils have low potential for expansive soil characteristics, low to moderate potential for corrosion to concrete, and high potential for corrosion to uncoated steel. Momoli-Carrizo-Denure and Gunsight-Rillito-Chuckwalla soils are known to include areas of desert pavement.

Mineral Resources. No known mineral resources or active mines are identified within 1,000 feet of this alternative route.

Seismicity. There are no known active faults crossing the Harquahala-West Alternative. The area has been mapped by the AZGS as being in an area of low seismic hazard (AZGS, 2000) and is thus not likely to experience liquefaction, strong groundshaking, or earthquake-induced landslides.

Slope Stability. This alternative route is located in a relatively flat area that would not be susceptible to landslides.

Construction Impacts

No construction impacts related to project induced landslides (Impact G-3) or mineral resource (Impact G-6) would occur associated with this alternative.

Impact G-1: Construction could accelerate erosion (Class II)

Excavation and grading for tower foundations, work areas, access roads, and spur roads could loosen soil and accelerate erosion. In addition, some of the soils along this alternative route may have local areas of desert pavement. Therefore, Mitigation Measure G-1a (Protect desert pavement) is recommended to protect desert pavement. APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table

D.13-11) would reduce impacts associated with erosion; however, implementation of Mitigation Measure G-1a (Protect desert pavement) would ensure that impacts are less than significant (Class II).

Operational Impacts

There would be no impacts on project structures due to landslides (Impact G-4) or seismic hazards associated with this alternative (Impacts G-5 and G-7).

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along this alternative route have a high potential to corrode steel and a low to moderate potential to corrode concrete. Expansion potential for the soils along the route is low to moderate. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

D.13.8.2 SCE Palo Verde Alternative

Environmental Setting

Geology. The SCE Palo Verde Alternative primarily traverses alluvial plains, alluvial fans and pediments, and passes between and skirts the edges of Saddle Mountain and the Palo Verde Hills. Geologic units crossed by this alternative are undivided surficial deposits (Qs), younger sediments (QTs), and outcrops of basalt (Qb) and andesite (Ka). Approximate locations of these units relative to the alternative mileposts are listed below.

- QTs: MPs 0–8.2 and 14.0–~~14.5~~14.7
- Qs: MPs 8.2–14.0
- Ka: small outcrops at approximately MP 13.4
- Qb: small outcrops at approximately MPs 1.5, 3.3, and 5.0.

Soils. Three soil associations are mapped along the SCE Palo Verde Alternative: Momoli-Carrizo-Denure, Pahaka-Estrella-Antho, and Gunsight-Rillito-Chuckwalla. Descriptions of these soil units and approximate locations are included in Table D.13-13, below.

Table D.13-13. Major Soils along the SCE Palo Verde Alternative

Approximate Location (PV mileposts)	Unit ID	Soil Association	Description	Shrink/Swell (Expansive) Potential	Risk of Corrosion	
					Concrete	Uncoated Steel
11.8 to 12.2	AZ001	Carrizo-Brios-Antho	Very deep to deep soils formed in mixed alluvium on fans, terraces, and flood plains. Soil types include stony sand, gravelly coarse sand, sandy loam, and coarse sand.	Low	Low	High
0 to 1.5, 4.8 to 11.8, and 12.2 to ~~14.5~~14.7	AZ016	Gunsight-Rillito-Chuckwalla	Formed in mixed alluvium. Soils include calcareous gravelly loam, gravelly to gravelly sandy loam, and gravelly silt loam to silty clay loam. Local areas of desert pavement.	Low	Low to Moderate	High
1.5 to 4.8	AZ022	Quilotosa-Gachado-Hyder	Very shallow to shallow soils formed in material weathered from granitic and metamorphic rocks and in alluvium from various volcanic rocks. Soil types include gravelly coarse sandy loam, cobbly loam, sandy clay loam, and gravelly sandy loam.	Low to Moderate	Low	High

Sources: NRCS STASGO database; NRCS website, 2006.

Mineral Resources. No known mineral resources or active mines are identified within 1,000 feet of this alternative route.

Seismicity. There are no known active faults crossing the SCE Palo Verde Alternative. The area has been mapped by the AZGS as being in an area of low seismic hazard (AZGS, 2000) and is thus not likely to experience liquefaction, strong groundshaking, or earthquake-induced landslides.

Slope Stability. This alternative route is located in a relatively flat area that would not be susceptible to landslides.

Construction Impacts

No construction impacts related to project induced landslides (Impact G-3) or mineral resources (Impact G-6) would occur associated with this alternative.

Impact G-1: Construction could accelerate erosion (Class II)

Excavation and grading for tower foundations, work areas, access roads, and spur roads could loosen soil and accelerate erosion. In addition, some of the soils along this alternative route may have local areas of desert pavement. Therefore, Mitigation Measure G-1a (Protect desert pavement) is recommended to protect desert pavement. APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) would reduce impacts associated with erosion; however, implementation of Mitigation Measure G-1a (Protect desert pavement) would ensure that impacts are less than significant (Class II).

Operational Impacts

There would be no impacts on project structures due to landslides (Impact G-4) or seismic hazards associated with this alternative (Impacts G-5 and G-7).

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along this alternative route have a high potential to corrode steel and a low to moderate potential to corrode concrete. Expansion potential for the soils along the route is low to moderate. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

D.13.8.3 Harquahala Junction Switchyard Alternative

Environmental Setting

Geology. The Harquahala Junction Switchyard Alternative site is located in an area with alluvial fans and low-lying hills. The alluvial fan areas are underlain by younger sediments (QTs), while the low-lying hills are underlain by Precambrian schist that locally include diorite, greenstone, and rhyolite outcrops.

Soils. Only one soil association is mapped at the Harquahala Junction Switchyard Alternative site, the Gunsight-Rillito-Chuckwalla association (AZ016). A description of this soil is presented in Table D.13-2. This soil association has low potential for expansive soil characteristics, low to moderate potential for corrosion to concrete, and high potential for corrosion to uncoated steel. Gunsight-Rillito-Chuckwalla soils are known to include areas of desert pavement.

Mineral Resources. No known mineral resources or active mines are identified within 1,000 feet of this alternative switchyard site.

Seismicity. There are no known active faults crossing the Harquahala Junction Switchyard Alternative site. The area has been mapped by the AZGS as being in an area of low seismic hazard (AZGS, 2000) and is thus not likely to experience liquefaction, strong groundshaking, or earthquake-induced landslides.

Slope Stability. This alternative switchyard site is located in a relatively flat area that would not be susceptible to landslides.

Construction Impacts

No construction impacts related to project induced landslides (Impact G-3) or mineral resources (Impact G-6) would occur associated with this alternative.

Impact G-1: Construction could accelerate erosion (Class II)

Excavation and grading for switchyard foundations and the site access road could loosen soil and accelerate erosion. In addition, the soils at the site are known to include areas of desert pavement. Therefore, Mitigation Measure G-1a (Protect desert pavement) is recommended to protect desert pavement. APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) would reduce impacts associated with erosion; however, implementation of Mitigation Measure G-1a (Protect desert pavement) would ensure that impacts are less than significant (Class II).

Operational Impacts

There would be no impacts on project structures due to landslides (Impact G-4) or seismic hazards associated with this alternative (Impacts G-5 and G-7).

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils at the alternative switchyard site have a high potential to corrode steel and a low to moderate potential to corrode concrete. Expansion potential for the soils is low. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

D.13.8.4 Desert Southwest Transmission Project Alternative

The reroute portion of this alternative north of the Alligator Rock area, just south of I-10, for the Desert Southwest Transmission Project (DSWTP) follows the same path as the Alligator Rock–South of I-10 Frontage Alternative, which is discussed in sections D.13.8.7. Therefore, the reroute portion of this alternative around Alligator Rock is not further discussed in this section. The remainder of the DSWTP Alternative follows the route of the Proposed Project between Blythe and the Devers Substation, so all impacts identified in Sections D.13.6.5 through D.13.6.7 would also occur on this alternative.

Environmental Setting

Geology. The Keim and Desert Southwest Transmission Project (DSWTP) Midpoint Substation sites, and the transmission line route that would be between the two substations are located on the Palo Verde Mesa. Geologic material underlying the sites and route are as follows: nonmarine sedimentary deposits (Qc) at Keim; Recent dune sand (Qs) at Midpoint; and Qc, Qal, and Qs from east to west along the 8.8 mile transmission line route that would be between the two substation sites. Descriptions of these units are listed in Table D.13-1. The Dillon Road site associated with this alternative is located in the Coachella Valley, just east of the Indio Hills. The site is underlain by recent alluvium (Qal).

Soils. The Keim Substation site is underlain by Aco-Rositas-Carrizo (CA654) association soils. Corrosion potential for these soils is high for uncoated steel and ranges from low to moderate for concrete. Expansion potential for these soils ranges from low to moderate. The DSWTP Midpoint site is underlain by Rositas-Carsitas-Dune Land (CA921) soils. Corrosion potential to uncoated steel for these soils is high, and low to moderate for concrete. Expansion potential of this soil association is highly variable ranging from low to high potential. The alternative transmission line route between these sites is underlain by both of these soil associations, with Aco-Rositas-Carrizo soils to the east and Rositas-Carsitas-Dune Land soils on the western portion. The Dillon Road Substation site is underlain by Carsitas-Myoma-Carrizo association (CA 601), which is primarily formed in alluvial fans. These soils have high potential for corrosion to uncoated steel and low potential for corrosion to concrete and expansive (shrink/swell) characteristics. These soils include areas of desert pavement. Additional descriptions of these soils are presented in Table D.13-2.

Mineral Resources. No mineral resource sites were identified within 1,000 feet of the alternative route and sites, and no other known mineral resources are identified in the area near the sites.

Seismicity – Fault Rupture. There are no known active faults crossing the alternative Keim or Midpoint Substation sites, or the connecting transmission line. The Dillon Road Substation site is located within the Alquist-Priolo zone for a set of short late Quaternary faults that are most likely shear faults splaying off the San Andreas Fault in a northerly direction formed by the transfer of displacement to the active faults to the north (Homestead Valley Fault Zone). These short faults most likely only sustain surface rupture from large earthquake events on the nearby San Andreas Fault Zone.

Seismicity – Groundshaking. The peak horizontal acceleration for the area surrounding the alternative Keim, Midpoint, and connecting transmission line is only 0.1 to 0.2g, and thus is not expected to undergo strong groundshaking. The San Andreas Fault Zone is in relatively close proximity to the Dillon Road Substation site. Strong groundshaking caused by an earthquake on any of the faults in the vicinity of this site should be expected. The peak horizontal acceleration for this segment ranges from 0.5g to 0.8g. Severe groundshaking is likely in the event of an earthquake on the nearby segment of the San Andreas Fault.

Seismicity – Liquefaction. The sites located on the Palo Verde Mesa have a low potential for liquefaction due to anticipated groundwater depths of greater than 100 feet and lack of strong groundshaking potential. Although located in an area of potential strong groundshaking, the Dillon Road site also has a low potential for liquefaction due to anticipated groundwater depths of greater than 100 feet.

Seismicity – Earthquake-Induced Landslides. All of these project components are located on flat to gently sloping alluvial fans and alluvial plains that are not susceptible to landslides.

Construction Impacts

No construction impacts related to project induced landslides (Impact G-3) or mineral resource (Impact G-6) would occur associated with this alternative.

Impact G-1: Construction could accelerate erosion (Class II)

Excavation and grading for equipment foundations at the substation sites, tower foundations, and access and spur roads could loosen soil and accelerate erosion. In addition, the soils at the site are known to include areas of desert pavement. Therefore, Mitigation Measure G-1a (Protect desert pavement) is recommended to protect desert pavement. APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) would reduce impacts associated with erosion; however, implementation of Mitigation Measure G-1a (Protect desert pavement) would ensure that impacts are less than significant (Class II).

Operational Impacts

There would be no impacts on project structures due to landslides (Impact G-4).

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along the alternative route and substation sites have a high potential to corrode steel and a low to moderate potential to corrode concrete. Expansion potential for the soils is low to high. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

Impact G-5: Project structures could be damaged by seismically included groundshaking and ground failure (Class III)

Strong to severe groundshaking should be expected in the event of an earthquake on the faults that are near and that cross this alternative route. The route would also be subject to groundshaking from a large earthquake on any of the major faults in the region. It is likely that the transmission line towers would be subjected to at least one moderate or larger earthquake occurring close enough to produce groundshaking along this segment. However, implementation of proposed APMs G-4 and G-17 (see Table D.13-11) would ensure that impacts related to seismically included groundshaking are less than significant (Class III).

Impact G-7: Project structures could be damaged by surface fault rupture at crossings of active and potentially active faults (Class II)

Although the Dillon Road Substation site is not crossed by an active fault, it is located within an Alquist-Priolo zone for several nearby unnamed short Quaternary fault segments. This indicates that structures (substation equipment and towers) at and immediately adjacent to the site would potentially be vulnerable to surface fault rupture hazards. Implementation of APMs G-2, G-3, and G-8 would reduce potential impacts; however, implementation of Mitigation Measure G-7a (Minimize project structures within active fault zones) would ensure that impacts associated with fault crossings are reduced to less than significant levels (Class II).

D.13.8.5 Alligator Rock–North of Desert Center Alternative

Environmental Setting

Geology. The Alligator Rock–North of Desert Center Alternative is located near the southwestern edge of the Chuckwalla Valley near the Chuckwalla Mountains to the south. Geologic units crossed by this alternative route are recent dune sand (Qs), recent alluvium (Qal), and nonmarine sedimentary deposits (Qc and Qco). Descriptions of these units are listed in Table D.13-1. The alternative route is primarily underlain by young alluvium with interfingering pockets of older fan deposits (Qc and Qco). Dune sand deposits are located from approximately alternative MP 8.3 to 9.4.

Soils. This alternative crosses two soil associations: the Cherioni-Hyder-Cipriano (CA928) and the Gunsight-Rillito-Chuckwalla (CA927). Descriptions of these soils are presented in Table D.13-2. Cherioni-Hyder-Cipriano soils are the primary soil association along this alternative route, located from approximately MP 0.4 to the end of the alternative route. The first 0.4 miles are underlain by Gunsight-Rillito-Chuckwalla soils, which have local areas of desert pavement. Cherioni-Hyder-Cipriano soils have low potential for corrosion to concrete and for expansive soils. Gunsight-Rillito-Chuckwalla soils have low potential for expansive soils and low to moderate potential for corrosion to concrete. Corrosion potential to uncoated steel for both of these soils is high.

Mineral Resources. One mineral resource site was identified within 1,000 feet of the alternative route, a talc-soapstone surface mining operation at approximately MP 4.8 that is no longer in operation. No other mineral resources are identified in the area. Therefore, no impacts from construction or operation of this alternative to mineral resources are anticipated.

Seismicity. The Alligator Rock–North of Desert Center Alternative is located in an area of low seismic activity. No active faults cross the alignment or are located in the vicinity. The estimated peak horizontal acceleration for this alternative route is less than 0.2 g; therefore, this area should not experience strong groundshaking. The lack of strong groundshaking and deep groundwater elevations preclude liquefaction-related phenomena. This alternative is located on flat to gently sloping alluvial fans and alluvial plains that are not susceptible to landslides.

Construction Impacts

No construction impacts related to project induced landslides (Impact G-3) or mineral resources (Impact G-6) would occur associated with this alternative.

Impact G-1: Construction could accelerate erosion (Class II)

Excavation and grading for tower foundations and access and spur roads could loosen soil and accelerate erosion. In addition, some of the soils along the route are known to include areas of desert pavement. Therefore, Mitigation Measure G-1a (Protect desert pavement) is recommended to protect desert pavement. APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) would reduce impacts associated with erosion; however, implementation of Mitigation Measure G-1a (Protect desert pavement) would ensure that impacts are less than significant (Class II).

Operational Impacts

There would be no impacts on project structures due to landslides (Impact G-4) or seismic hazards associated with this alternative (Impacts G-5 and G-7).

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along the alternative route have a high potential to corrode steel and a low potential to corrode concrete. Expansion potential for the soils is low. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

D.13.8.6 Alligator Rock–Blythe Energy Transmission Alternative

Environmental Setting

Geology. The Alligator Rock–Blythe Energy Transmission Alternative is located near the southwestern edge of the Chuckwalla Valley near the northern edge of the Chuckwalla Mountains. Geologic units crossed by this alternative are recent alluvium (Qal) and nonmarine sedimentary deposits (Qc and Qco), descriptions of these units are listed in Table D.13-1. The alternative route is underlain by interfingering young alluvium (Qal) and older fan deposits (Qc and Qco).

Soils. This alternative is underlain by one soil association, the Cherioni-Hyder-Cipriano (CA928). A description of these soils is presented in Table D.13-2. These soils have low potential for corrosion to concrete and for expansive soils, and corrosion potential to uncoated steel for these soils is high.

Mineral Resources. No mineral resource sites were identified within 1,000 feet of the alternative route and no other mineral resources are identified in the area.

Seismicity. The Alligator Rock–Blythe Energy Transmission Alternative is located in an area of low seismic activity. No active faults cross the alternative route or are located in the vicinity. The estimated peak horizontal acceleration for this route is less than 0.2 g; therefore, this area should not experience strong groundshaking. The lack of strong groundshaking and deep groundwater elevations preclude liquefaction-related phenomena.

Slope Stability. This alternative is located on flat to gently sloping alluvial fans and alluvial plains that are not susceptible to landslides.

Construction Impacts

No construction impacts related to project induced landslides (Impact G-3) or mineral resources (Impact G-6) would occur associated with this alternative.

Impact G-1: Construction could accelerate erosion (Class III)

Excavation and grading for tower foundations and access and spur roads could loosen soil and accelerate erosion. The soils along the route are not known to include areas of desert pavement. Therefore, implementation of APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) would result in less than significant impacts (Class III).

Operational Impacts

There would be no impacts on project structures due to landslides (Impact G-4) or seismic hazards associated with this alternative (Impacts G-5 and G-7).

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along the alternative route have a high potential to corrode steel and a low potential to corrode concrete. Expansion potential for the soils is low. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

D.13.8.7 Alligator Rock–South of I-10 Frontage Alternative

Environmental Setting

Geology. The Alligator Rock–South of I-10 Frontage Alternative is located near the southwestern edge of the Chuckwalla Valley near the northern edge of the Chuckwalla Mountains. Geologic units crossed by this segment of the alternative are recent dune sand (Qs), recent alluvium (Qal), and nonmarine sedimentary deposits (Qc and Qco), descriptions of these units are listed in Table D.13-1. The route is underlain by interfingering young alluvium (Qal) and older fan deposits (Qc and Qco). Dune sand deposits are located from approximately alternative MP 6.1 to 7.4.

Soils. This alternative is underlain by one soil association, the Cherioni-Hyder-Cipriano (CA928) soil association. A description of these soils is presented in Table D.13-2. These soils have low potential for corrosion to concrete and for expansive soils, and corrosion potential to uncoated steel for these soils is high.

Mineral Resources. No mineral resource sites were identified within 1,000 feet of the alternative route and no other mineral resources are identified in the area.

Seismicity. The Alligator Rock–South of I-10 Frontage Alternative is located in an area of low seismic activity. No active faults cross the alternative route or are located in the vicinity. The estimated peak horizontal acceleration for this route on the CGS PSHA maps is less than 0.2 g; therefore, this area should not experience strong groundshaking. The lack of strong groundshaking and deep groundwater elevations preclude liquefaction-related phenomena.

Slope Stability. This alternative is located on flat to gently sloping alluvial fans and alluvial plains that are not susceptible to landslides.

Construction Impacts

No construction impacts related to project induced landslides (Impact G-3) or mineral resources (Impact G-6) would occur associated with this alternative.

Impact G-1: Construction could accelerate erosion (Class III)

Excavation and grading for tower foundations and access and spur roads could loosen soil and accelerate erosion. The soils along the route are not known to include areas of desert pavement. Therefore, implementation of APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) would result in less than significant impacts (Class III).

Operational Impacts

There would be no impacts on project structures due to landslides (Impact G-4) or seismic hazards associated with this alternative (Impacts G-5 and G-7).

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along the alternative route have a high potential to corrode steel and a low potential to corrode concrete. Expansion potential for the soils is low. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

D.13.9 Alternatives for West of Devers

D.13.9.1 Devers-Valley Alternative

Geology. The Devers-Valley Alternative starts in the eastern end of the Coachella Valley, traverses the northern end of the San Jacinto Mountains and southern edge of the San Gorgonio Pass area, before turning southwest and crossing the San Jacinto Valley and the Lakeview Mountains. The alternative route generally traverses alluvial fans and pediments, alluvial basins, mountains, and hills. The Devers-Valley Alternative route is underlain by a mix of sedimentary units ranging in age from Holocene to Pliocene, Mesozoic granitic rocks, and pre-Cretaceous metamorphic and granitic rocks. General descriptions of the geologic materials that are crossed by the route are summarized in chronological order in Table D.13-14.

The table includes the approximate locations of the geologic units along the alternative route, formation name and age, general unit descriptions, and anticipated excavation characteristics of each unit.

Table D.13-14. Summary of Geologic Units along the Devers-Valley Alternative

Approximate Location Along Route (DV Mileposts)	Formation	Age	Description/Comment	Excavation Characteristics[1]
0–2.9, 3.9–7.8, 11.7–15.9, 17.9–20.7, 30–32.6, and 40.4–41.3	Qal – Recent Alluvium	Holocene	Unconsolidated alluvial fan, river channel, and stream deposits consisting of silt, sand, clay, and gravel.	Easy
20.7–22.7 and 23.7–24.3	Qc – Nonmarine Sedimentary Deposits	Pleistocene	Older alluvium and fanglomerate, dissected with well-developed desert pavement and desert varnish in some areas. Consists mostly of clay, siltstone, sand, and gravel.	Easy
2.9–3.9	Qco – Nonmarine Sedimentary Deposits	Pleistocene	Older folded or uplifted fan deposits, very dissected. Locally extensively folded and faulted. Consists of conglomerate, sand-stone, and clay; boulder conglomerate in some areas along margins of the Coachella Valley.	Easy
22.7–23.7, 24.3–29.2, and 29.8–30	Pc – San Timoteo Formation	Pleistocene/ Pliocene	Nonmarine sandstone, siltstone, conglom-erate, and shale.	Easy to Moderate
7.8–11.7, and misc. outcrops between 23–29	gr – Granitic Rocks	Mesozoic	Granitic rock of several types and may include granite, quartz monzonite, diorite, and granodiorite.	Difficult
32.6–35 and 35.9–40.4	gr^t –Lakeview Mountain Tonalite	Mesozoic	Light colored, coarse grained tonalite.	Difficult
29.2–29.8	ms – Metasedimentary Rocks	pre-Cretaceous	Predominantly gneiss and schist, with some calc-silicate rocks, marble, phyllite, and amphibolite.	Difficult
15.9–17.9	gr-m – Granitic and Metamorphic Rocks	pre-Cenozoic	Mixed rocks consisting foliated migmatitic gneiss and quartz diorite, marble, phyllite, and amphibolite. Locally intruded by gabbro, granodiorite, quartz monzonite, and other granitic rocks.	Difficult

Source: CGS, 1966.

Slope Stability. Most of the alternative route does not cross any areas identified as existing landslide. However, unmapped landslides and areas of localized slope instability may be encountered in the mountains and hills traversed by the Devers-Valley Alternative.

Soils. A summary of the significant characteristics of the major soil associations traversed by the Devers-Valley Alternative route, listed in numerical not geographic order, is presented in Table D.13-15.

Mineral Resources. Five mineral resource sites were identified within 1,000 feet of this alternative route: a feldspar prospect, beryllium and limestone occurrences, and silica and magnesite occurrences. Only the magnesite location located at approximately MP 14.2, listed as Metropolitan Rock Stockpile, is identified as an active site. All of these sites are at least 100 feet or greater from the alternative route. Construction of a transmission line within the existing ROW should not impact access to mineral resources near the route.

Table D.13-15. Major Soils along the Proposed Devers-Valley Alternative

Approximate Location along Route (DV Mileposts)	Unit ID	Soil Association	Description	Shrink/Swell (expansive) Potential	Risk of Corrosion	
					Concrete	Uncoated Steel
0–2.9 and 3.9–7.8	CA601	Carsitas-Myoma-Carrizo	Formed in alluvial fans and sand blown from alluvial deposits. May include some areas of desert pavement and desert varnish[1]. Soil types include gravelly and gravely coarse sand, very gravelly sand, stony sand, and fine to very fine sand.	Low	Low	High
2.9–3.9	CA605	Badland-Beeline-Rillito	These soils are formed in alluvium and vary from shallow gravelly sandy and sandy loam[2] to deep gravelly sandy loam and gravelly loam.	Low	Low to Moderate	Moderate to High
21–24.3	CA609	Ramona-Greenfield-Linne	Formed in alluvium weathered from granitic rocks and in material weathered from sandstone and shale. Soil types include fine sandy to sandy loam, sandy clay loam, and sandy clay to clay loam.	Low to High	Low to Moderate	Moderate to High
11.7–16, 18–19.7, 20.2–21, 35–35.9, and 40.4–41.3	CA614	Greenfield-Hanford-Gorgonio	Soil formed in alluvium and alluvial fans and consists of fine sandy loam, sandy loam, and gravelly loamy fine sand.	Low to Moderate	Low to Moderate	Low to High
29.7–32.7	CA616	Domino-Traver-Willows	Medium depth to very deep soils formed on alluvial fans and in basins in coarse to fine grained alluvium of varying composition. Domino series soils have hardpan at 20 to 40 inches depth. Soil types include silt loam, silty clay loam, fine sandy loam, and clay.	Low to High	Low to Moderate	Moderate to High
32.7–35 and 35.9–40.4	CA620	Cieneba–Rock Outcrop–Sesame	Includes outcrops of bare rock. Shallow to moderately deep soils formed in material weathered from granitic rocks. Soil types include fine gravelly loam, gravelly loam, and sandy to sandy clay loam.	Low to Moderate	Low to Moderate	Low to High
16–18 and 19.7–20.2	CA624	Friant–San Miguel–Exchequer	Shallow soils formed in material weathered from metamorphic bedrock. Depth to bedrock ranges from 6 to 34 inches. Soils types include fine sandy loam, silt loam, clay, and gravelly clay.	Low, minor areas of Moderate to High	Moderate to High	Moderate to High
7.8–11.7	CA632	Rock Outcrop–Lithic Torriorthents–Omstott	Includes areas of bare rock outcrop, and very shallow poorly developed soils over bedrock. Omstott soils are shallow soils formed in material weathered from granodiorite, mica schist, and gneiss and consist primarily of fine sandy loam.	Low	Low	Moderate
24.3–29.7	CA648	Badland–San Timoteo–Xerorthents	Formed in material weathered from shale, sandstone, and calcified granite. Soil types include loam, sandy loam, and silt loam.	Low to Moderate	Low to Moderate	Moderate to High

Source: NRCS STATSGO California GIS data, 1994; NRCS website, 2006.

1 A desert pavement is a desert surface that is covered with closely packed, interlocking angular or rounded rock fragments of pebble and cobble size. Desert varnish is the thin red to black coating found on exposed rock surfaces in arid regions. Varnish is composed of clay minerals, oxides and hydroxides of manganese and/or iron. Both desert pavement and desert varnish take thousands of years to form.

2 Loam soil composed of sand, silt, clay, and organic matter in evenly mixed particles of various sizes.

Faults and Seismicity. Active and potentially active faults that intersect the Devers Valley Alternative are listed in Table D.13-16. Data presented in this table include fault length, maximum estimated earthquake, type of fault, and slip rates. Table D.13-16 shows locations of significant active faults and historic earthquakes in the Devers-Valley area.

Table D.13-16. Significant Active Faults in the Devers-Valley Alternative Vicinity

Fault	Fault Length (miles)	Maximum Estimated Earthquake Magnitude	Type of Fault and Dip Direction	Slip Rate (mm/yr)
Cucamonga	17	6.9	reverse, 45°N	5.0
Cleghorn	16	6.5	left lateral strike slip, 90	3.0
San Andreas: Mojave Segment	64	7.0	right lateral strike slip, 90°	30.0
San Jose	12	6.4	left lateral right oblique, 75°NW	0.5
Whittier	24	6.8	right lateral strike slip, 90°	2.5
Elsinore: Glen Ivy Segment	22	6.8	right lateral strike slip, 90°	5.0
Burnt Mountain	13	6.5	right lateral strike slip, 90°	0.6
Eureka Peak	12	6.4	right lateral strike slip, 90°	0.6
Helendale-South Lockhart	60	7.3	right lateral strike slip, 90°	0.6
Landers	52	7.3	right lateral strike slip, 90°	0.6
Lenwood-Lockhart–Old Woman Springs	90	7.5	right lateral strike slip, 90°	0.6
North Frontal Fault Zone - East	17	6.7	reverse, 45°S	0.5
North Frontal Fault Zone - West	32	7.2	reverse, 45°S	1.0
Pinto Mountain	46	7.2	left lateral strike slip, 90°	2.5
Pisgah–Bullion Mountain–Mesquite Lake	55	7.3	right lateral strike slip, 90°	0.6
San Andreas: Coachella Segment	60	7.2	right lateral strike slip, 90°	25.0
San Andreas: San Bernardino Segment	64	7.5	right lateral strike slip, 90°	24.0
San Jacinto: Anza Segment	57	7.2	right lateral strike slip, 90°	12.0
San Jacinto: San Jacinto Valley Segment	27	6.9	right lateral strike slip, 90°	12.0
South Emerson–Copper Mountain	34	7.0	right lateral strike slip, 90°	0.6

Sources: CGS, 2002.

Fault Rupture. This eastern end of the alternative route crosses the active trace of the Banning Fault just west of the Devers Substation at an oblique angle near MP 0.6, and crosses the Alquist-Priolo zone for this fault from approximately MP 0.4 to 1.0. Potential fault offset along this active trace could be as much as 15 feet of right-lateral displacement. The route crosses a strand of the Garnet Hill Fault at an oblique angle near approximately MP 3.7 with an associated Alquist-Priolo zone from MP 3.6 to 3.8.

The western end of the alternative route crosses several strands of the San Jacinto Fault Zone and associated Alquist-Priolo zones between MPs 30 and 31. The alternative route then crosses the Casa Loma Fault, a segment of the San Jacinto Fault Zone, and its associated Alquist-Priolo zone at approximately MP 32.

Strong Groundshaking. The projected peak ground accelerations for the Devers-Valley Alternative are presented in Table D.13-17. A review of historic earthquake activity from 1800 to 2005 indicates that many earthquakes of M6.0 or greater have occurred within 50 miles of the alternative route (CGS, 2005). A summary of significant M6.0 or greater earthquake events is presented in Table D.13-18.

Based on the information presented in this section, it is likely that the Devers-Valley route would experience strong to severe ground-shaking from an earthquake on any of the faults in the vicinity of the route should be expected.

Table D.13-17. Approximate Peak Ground Accelerations

Approximate Transmission Line Milepost	Total Length of Segments (miles)	Peak Ground Acceleration
30.2–35	4.8	> 0.8 g
0–2, 27.8–30.2, and 35–35.6	5.6	0.7–0.8g
2.6–6.9, 26–27.8, and 35.6–37	6.5	0.6–0.7g
6.9–26 and 37–39.6	21.7	0.5–0.6g
39.6–41.3	1.6	0.4–0.5g

Source: CGS, 2006.

Table D.13-18. Significant Historic Earthquakes Affecting the Devers-Valley Vicinity

Date	Earthquake Name or General Location	Fault Involved, if Known	Magnitude[1]	Approximate Closest Distance to Rout[1]
October 16, 1999	Hector Mine Earthquake	Lavic Lake and Bullion	7.15	49 miles northeast
June 28, 1992	Landers Earthquake	Johnson Valley, Landers, Homestead Valley, Emerson, Camp Rock, and others	7.3	20 miles northeast
June 28, 1992	Big Bear Earthquake – aftershock of the Landers Earthquake	Unnamed fault	6.5	18 miles north
April 23, 1992	Joshua Tree	Eureka Peak	6.2	15 miles east
July 8, 1986	North Palms Springs Earthquake	Banning or Garnet Hill	5.9	4.5 miles northwest
December 4, 1948	Desert Hot Springs Earthquake	Banning or So San Andreas	6.0	11 miles east
March 11, 1933	Long Beach Earthquake	Newport-Inglewood	6.4	49 miles west
July 22, 1923	North San Jacinto Fault Earthquake	San Jacinto	6.3	16 miles northwest
April 21, 1918	San Jacinto Earthquake	San Jacinto	6.8	7 miles southeast
May 15, 1910	Elsinore Earthquake	Elsinore	6.0	14 miles west
December 25, 1899	San Jacinto Fault Earthquake, located southeast of San Jacinto	San Jacinto	6.5	4.5 miles southeast
July 22, 1899	Cajon Pass Earthquake	Uncertain	6.4	40 miles northwest
February 2, 1890	San Jacinto or Elsinore Fault region	Uncertain	Estimated 6.5 to 6.8	41 miles southeast
December 8, 1812	Wrightwood Earthquake	San Andreas	7.5	49 miles northwest

Source: CGS EQ database, 2005; SCEC Website, 2006.
1 Earthquake magnitudes and locations before 1932 are estimated by Toppozada and others (1978, 1981, and 1982) based on reports of damage and felt effects.

Liquefaction. Due to the generally deep water table in the eastern portion of the Devers-Valley alternative route, liquefaction is not considered a potential hazard. Potential for liquefaction in this area is low due to groundwater depths of greater than 50 feet. However, during storms or a wet season, the water table may rise and sections of the alternative route that lie near the San Gorgonio River Wash and unconsolidated sediments in that area may be moderately susceptible to liquefaction if a strong earthquake were to occur while the valley floor sediments are saturated. Alluvial sediments in the San Jacinto Valley from MP DV13–DV15 and DV30.0 to DV32.5 may be susceptible to liquefaction.

Earthquake-Induced Landslides. Portions of the alternative route that cross moderate to steep slopes of the San Jacinto Mountains (i.e., from MPs DV7.5–DV12.0, DV16–DV18, DV23–DV30, and DV32.5–DV35.0) could be damaged by landslides, rock avalanches, and rockfalls originating on the slopes of the proposed alignment.

Construction Impacts

Construction of a transmission line within the existing ROW should not impact access to mineral resources near the route.

Impact G-1: Construction could accelerate erosion (Class II)

Excavation and grading for tower foundations and access and spur roads could loosen soil and accelerate erosion. In addition, some of the soils along the route are known to include areas of desert pavement. Therefore, Mitigation Measure G-1a (Protect desert pavement) is recommended to protect desert pavement. APMs W-3, W-7 through W-9, W-11, G-10 through G-14, and G-19 (see Table D.13-11) would reduce impacts associated with erosion; however, implementation of Mitigation Measure G-1a (Protect desert pavement) would ensure that impacts are less than significant (Class II).

Impact G-3: Excavation or grading during construction could cause slope instability (Class II)

Construction consisting of grading and excavation along the ridges and hills of the San Jacinto Mountains could cause slope instability from MPs DV7.5–DV12.0, DV16–DV18, DV23–DV30, and DV32.5–DV35.0. SCE has proposed APMs G-6, G-7, G-10, and G-18 (see Table D.13-11) to reduce impacts related to slope instability. However, to ensure that slope instability impacts would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-3a (Conduct geotechnical surveys for landslides) is required from MPs DV7.5–DV12.0, DV16–DV18, DV23–DV30, and DV32.5–DV35.0 in addition to the APMs stated above.

Operational Impacts

Impact G-2: Project structures could be damaged by problematic soils (Class II)

Soils along this segment of the proposed route have a low to high potential to corrode steel and concrete. Expansion potential for the soils along the segment is low to high. Application of standard design and construction practices and implementation of APMs G-9 and G-15 (see Table D.13-11) would reduce the adverse affects of problematic soils. However, implementation of Mitigation Measure G-2a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) would ensure that potential impacts associated with problematic soils are reduced to less than significant levels (Class II).

Impact G-4: Project structures could be damaged by landslides, earthflows, and/or debris flows (Class II)

Slope instability could occur during the operation of the project along the ridges and hills of the San Jacinto Mountains from MPs DV7.5–DV12.0, DV16–DV18, DV23–DV30, and DV32.5–DV35.0. Slope instability could cause landslides that could undermine foundations, cause distortion and distress to overlying structures, and displace or destroy project components. SCE has proposed APMs G-6 and G-18 (see Table D.13-11) to reduce impacts related to landslide hazards during operations of the project. However, to ensure that potential landslide impacts to project structures would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-3a (Conduct geotechnical surveys for landslides) is required from MPs DV7.5–DV12.0, DV16–DV18, DV23–DV30, and DV32.5–DV35.0 in addition to the APMs stated above.

Impact G-5: Project structures could be damaged by seismically included groundshaking and ground failure (Class II)

Seismically induced ground failure, including liquefaction and lateral spreading, could potentially cause damage to project structures. Some portions of the alternative route (i.e., from MP DV13–DV15 and DV30.0 to DV32.5) are located in areas underlain by potentially liquefiable alluvial deposits and may be subject to liquefaction-related phenomena during a seismic event. SCE has proposed APMs G-4 and G-17 (see Table D.13-11) to reduce impacts related to seismically included groundshaking. However, to ensure that impacts associated with ground failure caused by groundshaking would be mitigated to less than significant levels (Class II), implementation of Mitigation Measure G-5a (Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design) is required from MP DV13–DV15 and DV30.0 to DV32.5 in addition to the APMs stated above.

Impact G-7: Project structures could be damaged by surface fault rupture at crossings of active and potentially active faults (Class II)

Project facilities would be subject to hazards of surface fault rupture where the proposed route crosses the Banning, Garnet Hill, San Jacinto, and Casa Loma Faults and their associated Alquist-Priolo zones. Fault crossings, where multiple feet of displacement are expected along active faults, are best crossed as overhead lines with towers placed well outside the fault zone to allow for the flex in the transmission lines to absorb offset. Implementation of APMs G-2, G-3, and G-8 would reduce potential impacts; however, implementation of Mitigation Measure G-7a (Minimize project structures within active fault zones) would ensure that impacts associated with fault crossings are reduced to less than significant levels (Class II).

D.13.10 No Project/No Action Alternative

Under the No Project Alternative, the proposed transmission line would not be constructed; therefore, no direct or cumulative construction-related or operational impacts associated with geology, soils, or mineral resources would occur. The No Project Alternative scenario could result in construction of additional power plants or transmission lines, resulting in potential impacts to geology, soils, and/or mineral resources. Specific potential impacts would have to be assessed at the time other projects were proposed.

D.13.11 Mitigation Monitoring, Compliance, and Reporting Table

Table D.13-19 presents the mitigation monitoring table for Geology, Mineral Resources, and Soils.

Table D.13-19. Mitigation Monitoring Program – Geology, Mineral Resources, and Soils

IMPACT G-1	Construction could accelerate erosion (Class II)
MITIGATION MEASURE	**G-1a: Protect desert pavement.** Grading for new access roads or work areas in areas covered by desert pavement shall be avoided if possible. If avoidance of these areas is not possible, the desert pavement surface shall be protected from damage or disturbance from construction vehicles by use of temporary mats on the surface, or by other suitable means. A plan for identification and avoidance or protection of sensitive desert pavement shall be prepared and submitted to the CPUC ~~and~~ , BLM, and USFWS for review and approval at least 60 days prior to start of construction.
Location	All locations were desert pavement may be present, including the following proposed route segments: Harquahala to Kofa NWR; Kofa NWR; Kofa NWR to Colorado River; Midpoint Substation to Cactus City Rest Area; Cactus City Rest Area to Devers Substation; Devers Substation to East Border of Banning; and the following alternative routes: SCE Harquahala-West; SCE Palo Verde Alternative; Harquahala Junction Switchyard; the reroute associated with the Desert Southwest Transmission Project; Alligator Rock–North of Desert Center, Devers-Valley No. 2.
Monitoring / Reporting Action	Review plan and ensure that it is implemented in the field.
Effectiveness Criteria	Construction activities do not damage desert pavement.
Responsible Agency	CPUC, BLM, USFWS
Timing	Prior to and during construction.
IMPACT G-2	Project structures could be damaged by problematic soils (Class II)
MITIGATION MEASURE	**G-2a: Conduct geotechnical studies for ~~problematic~~ soils to assess characteristics and aid in appropriate foundation design.** Design-level geotechnical studies shall be performed by the Applicant to identify the presence, if any, of potentially detrimental soil chemicals, such as chlorides and sulfates. Appropriate design measures for protection of reinforcement, concrete, and metal-structural components against corrosion shall be utilized, such as use of corrosion-resistant materials and coatings, increased thickness of project components exposed to potentially corrosive conditions, and use of passive and/or active cathodic protection systems. The geotechnical studies shall also identify areas with potentially expansive or collapsible soils and include appropriate design features, including excavation of potentially expansive or collapsible soils during construction and replacement with engineered backfill, ground-treatment processes, and redirection of surface water and drainage away from expansive foundation soils. Study results and proposed solutions shall be provided to the CPUC and BLM, as appropriate, for review and approval at least 60 days before construction.
Location	All project locations where permanent project structures will be installed.
Monitoring / Reporting Action	Review study results and proposed solutions. Ensure that study recommendations are implemented during construction.
Effectiveness Criteria	Project structures are not damaged by problematic soils.
Responsible Agency	CPUC, BLM
Timing	Prior to and during construction.

Table D.13-19. Mitigation Monitoring Program – Geology, Mineral Resources, and Soils

IMPACT G-3	Excavation or grading during construction could cause slope instability (Class II)
MITIGATION MEASURE	**G-3a: Conduct geotechnical surveys for landslides.** The Applicant shall perform design-level geotechnical surveys in areas crossing and adjacent to hills and mountains. These surveys will acquire data that will allow identification of specific areas with the potential for unstable slopes, landslides, earth flows, and debris flows along the approved transmission line route and in other areas of ground disturbance, such as grading for access and spur roads. The investigations shall include an evaluation of subsurface conditions, identification of potential landslide hazards, and provide information for development of excavation plans and procedures. Where landslide hazard areas cannot be avoided, appropriate engineering design and construction measures shall be incorporated into the project designs to minimize potential for damage to project facilities. A report documenting these surveys and design measures to protect structures shall be submitted to the CPUC and BLM for review and approval at least 60 days before construction.
Location	Proposed Project route MPs E60-E61, E86-E92, W9-W11, W17-W20.5, W27-W40.1, and W40.1-V3.5 and Devers-Valley Alternative MPs DV7.5–DV12.0, DV16–DV18, DV23–DV30, and DV32.5–DV35.0.
Monitoring / Reporting Action	Review study results. Ensure that study recommendations are implemented during construction.
Effectiveness Criteria	The project does not cause landslides.
Responsible Agency	CPUC, BLM
Timing	Prior to and during construction.
IMPACT G-4	Project structures could be damaged by landslides, earthflows, and/or debris flows (Class II)
MITIGATION MEASURE	G-3a: Conduct geotechnical surveys for landslides (see above)
Location	Proposed Project route MPs E60-E61, E86-E92, W9-W11, W17-W20.5, W27-W40.1, and W40.1-V3.5 and Devers-Valley Alternative MPs DV7.5–DV12.0, DV16–DV18, DV23–DV30, and DV32.5–DV35.0.
Monitoring / Reporting Action	Review study results. Ensure that study recommendations are implemented during construction.
Effectiveness Criteria	Project structures are not damaged by landslides.
Responsible Agency	CPUC, BLM
Timing	Prior to and during construction.
IMPACT G-5	Project structures could be damaged by seismically included groundshaking and ground failure (Class II)
MITIGATION MEASURE	**G-5a: ~~Protect~~ Design project facilities to avoid impact from ground failure.** Since seismically induced ground failure has the potential to damage or destroy project components, the Applicant shall complete design-level geotechnical investigations at tower locations in areas with potential liquefaction-related impacts. These studies shall specifically assess the potential for liquefaction and lateral spreading hazards to affect the approved project and all associated facilities. Where these hazards are found to exist, appropriate engineering design and construction measures shall be incorporated into the project designs. A report documenting results of the geotechnical surveys shall be submitted to the CPUC and BLM for review and approval at least 60 days before construction.
Location	Proposed Project route MPs E100-E112 and Devers-Valley Alternative MPs DV13–DV15 and DV30.0–DV32.5.
Monitoring / Reporting Action	Review study results. Ensure that study recommendations are implemented during construction.
Effectiveness Criteria	Project structures are not damaged by liquefaction or lateral spreading.

Table D.13-19. Mitigation Monitoring Program – Geology, Mineral Resources, and Soils

Responsible Agency	CPUC, BLM
Timing	Prior to and during construction.
IMPACT G-6	Construction activities would render known mineral resources inaccessible (Class II)
MITIGATION MEASURE	G-6a: Coordinate with quarry operations. Operations and management personnel for the Indio Pit quarry shall be consulted regarding locations of active mining and for coordination of construction activities in and through those areas. A plan to avoid or minimize interference with mining operations shall be prepared in conjunction with mine/quarry operators prior to construction. SCE shall document compliance with this measure prior to the start of construction by submitting the plan to the CPUC and BLM for review at least 60 prior to the start of construction.
Location	Between Proposed Project MPs E205 and E206 and between W16.5 and W17.1
Monitoring / Reporting Action	Review plan. Ensure that that the plan is implemented during construction.
Effectiveness Criteria	Project does not render known mineral resource inaccessible.
Responsible Agency	CPUC, BLM
Timing	Prior to and during construction.
IMPACT G-7	Project structures could be damaged by surface fault rupture at crossings of active and potentially active faults (Class II)
MITIGATION MEASURE	G-7a: Minimize project structures within active fault zones. SCE shall perform a geologic/geotechnical study to confirm the location of mapped traces of active and potentially faults crossed by the project route. For crossings of active faults, the towers shall be placed as far as feasible outside the area of mapped fault traces. Compliance with this measure shall be documented to the CPUC and BLM in a report submitted for review and approval at least 60 days prior to the start of construction.
Location	Between Proposed Route MPs E205 and E206 and at MP E224.5, Devers Substation to East Border of Banning Segment, Banning and Beaumont segment at MP W17.2, Loma Linda Fault near the San Bernardino Junction, and the San Jacinto Fault at MP V1.9. Also, at the Dillon Road Substation site associated with the DSW Alternative and the Banning, Garnet Hill, San Jacinto, and Casa Loma Fault crossings that would be associated with the DV Alternative.
Monitoring / Reporting Action	Review report. Ensure that that the recommendations of the report are implemented during construction.
Effectiveness Criteria	Project structures are not damaged by surface fault rupture.
Responsible Agency	CPUC, BLM
Timing	Prior to and during construction.

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