C.7 Geology and Soils

Introduction

This section describes effects associated with Geology and Soils that would be caused by implementation of the VSSP. The following discussion addresses existing environmental conditions in the affected area, identifies and analyzes environmental impacts for the proposed Project, and recommends measures to reduce or avoid significant impacts anticipated from Project construction, operation, and maintenance. In addition, existing laws and regulations relevant to Geology and Soils are described. In some cases, compliance with these existing laws and regulations would serve to reduce or avoid certain impacts that might otherwise occur with the implementation of the proposed Project.

Baseline geologic, seismic, and soils information were collected from published and unpublished literature, geographic information systems (GIS) data, and online sources for the proposed Project and the surrounding area. Data sources included the following: reports and documents available from the applicant, geologic literature from the U.S. Geological Survey (USGS) and California Geological Survey (CGS), soils data from the U.S. Department of Agriculture (USDA), geologic and soils GIS data, available geotechnical reports for the area, and online reference materials. All the sources used for the purposes of characterizing baseline conditions and conducting the analysis for the proposed Project are referenced as appropriate. The literature and data review was supplemented by field reconnaissance. The literature review focused on the identification of specific geologic and seismic hazards with the Project site.

The study area was defined as the Project site and the area immediately adjacent to the proposed Project with the following exception: the study area related to seismically induced ground shaking issues includes significant regional active and potentially active faults within 50 miles of the proposed Project. The current condition and quality of these geology and soils resources was used as the baseline against which to compare potential impacts of the proposed Project.

Scoping Issues Addressed

During the scoping period for the EIR (May 5 through June 8, 2015), written comments were received from agencies, organizations, and the public. These comments identified various substantive issues and concerns relevant to the EIR analysis. No issues related to Geology and Soils were raised during scoping.

C.7.1 Environmental Setting

C.7.1.1 Geologic Setting

The VSSP is located within the Peninsular Ranges geomorphic province, which is a northwest-southeast oriented complex of blocks separated by similarly trending faults (Norris and Webb, 1976). The Peninsular Ranges geomorphic province is approximately 900 miles long, extending from the Transverse Ranges north of Los Angeles to the tip of Baja California, and ranges in width from 30 to 100 miles. The Peninsular Ranges is divided up into fault-bounded blocks, with the proposed Project located on the Perris Block. The Perris Block is a roughly rectangular area of relatively low relief that is bounded on the east by the San Jacinto fault zone and on the west by the Elsinore fault zone. The Perris block is underlain by lithologically diverse metasedimentary rocks that were intruded by Cretaceous plutons of the Peninsular Ranges Batholith (USGS, 2006). Erosion and deposition on the Perris block has led to extensive late Pleistocene and Holocene alluvial fans blanketing much of the metamorphic and granitic bedrock. Widespread, valley-filling, dissected, mid to late Pleistocene alluvial-fan deposits occur south of the Santa Ana River.

The proposed Project route generally traverses across alluvial valleys and bedrock hills. The proposed Project traverses portions of several valleys including: the southern end of Perris Valley, the eastern edge of Menifee Valley, the western end of Domenigoni Valley where it meets Paloma Valley, and across French and Auld Valleys. Bounding these valleys in the Project vicinity are a series of generally northeast-southwest trending low-lying bedrock hills, which the Project alignment crosses adjacent to and across. These hills are low-lying and gently sloping. Elevations along the proposed Project range from about 1,350 feet to 1,510 feet along Segment 1 and about 1,150 feet to 1,400 feet along Segment 2.

About 90 percent of the proposed Project route is underlain by Sedimentary units, ranging in age from Holocene to Pleistocene, with lesser amounts of Cretaceous and Triassic granitic and metamorphic rocks located throughout the alignment route. General descriptions of the geologic materials, listed chronologically, crossed by the proposed VSSP segments are summarized in Table C.7-1. Figure C.7-1 presents the regional geology along the proposed Project route.

C.7.1.2 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.

The proposed Project traverses across primarily flat to gently sloping alluvial valleys and along and across a few gently sloping hills with no known or mapped landslides. Therefore, the VSSP would not be subject to landslides or other slope stability issues.

C.7.1.3 Soils

The soils underlying the Project site reflect the underlying rock type, the extent of weathering of the rock, the degree of slope, and the degree of human modification. Potential hazards/impacts from soils include erosion, shrink-swell (expansive soils), and corrosion. Soil mapping by the USDA National Resource Conservation Service (NRCS), Soil Conservation Service, was reviewed for information about unsuitable characteristics of surface and near-surface soil materials. Soil mapping and GIS spatial and tabular data for the Western Riverside Area Soil Survey, California SSURGO soil survey (NRCS, 2014) were reviewed.

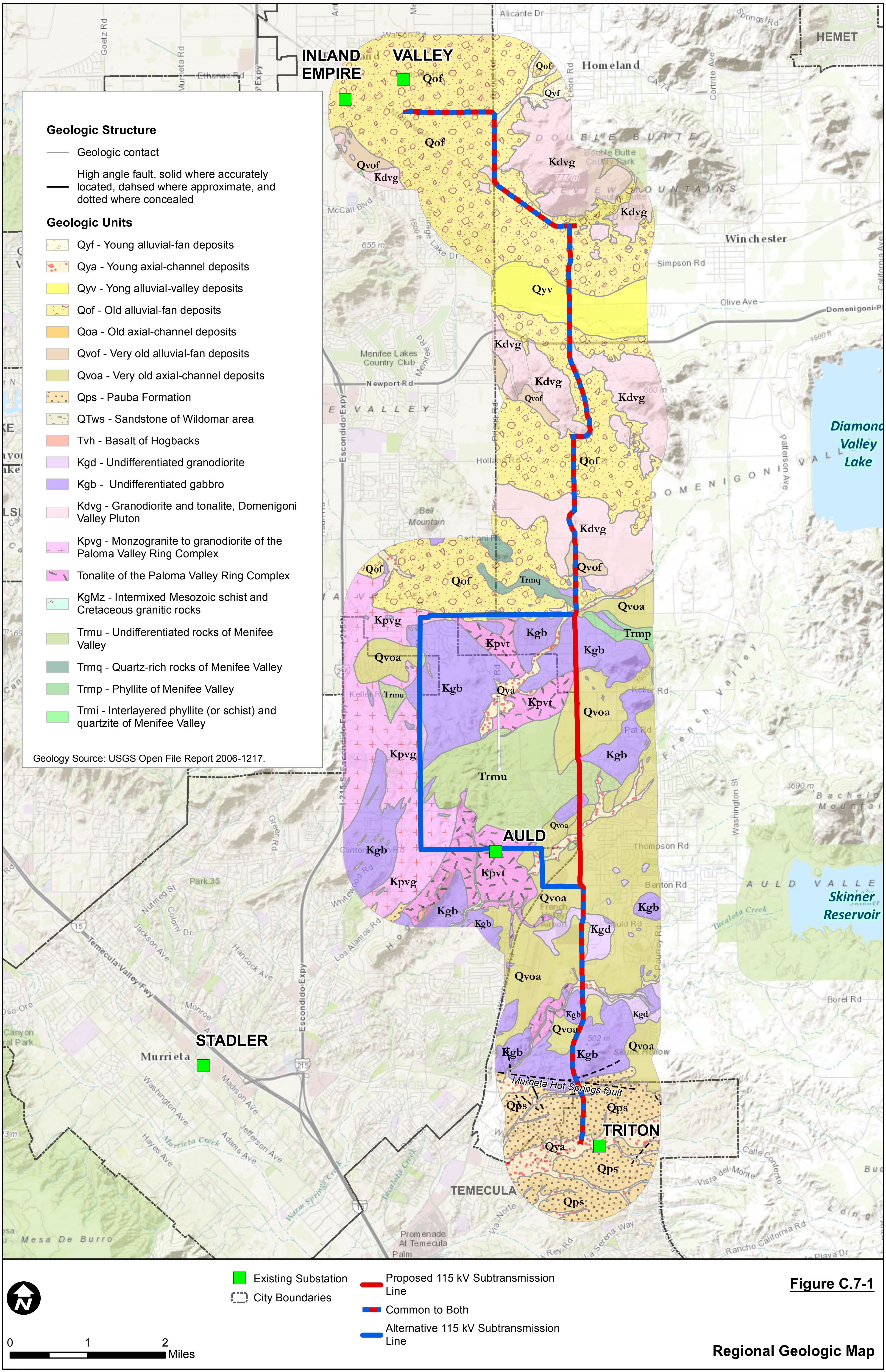

Figure C.7-1

Regional Geologic Map

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Table C.7-1. Geologic Units Along the proposed Project Alignment

Geologic Unit	Age	Project Segment Unit Underlies	Description/Comment	Excavation Characteristics[1]
Qyf – Young alluvial-fan deposits	Holocene and late Pleistocene	Segment 1	Unconsolidated to moderately consolidated silt, sand, pebbly cobbly sand, and boulder alluvial-fan deposits,	Easy to Moderate
Qya – Young axial-channel deposits	Holocene and late Pleistocene	Segment 1 and Segment 2	Slightly to moderately consolidated silt, sand, and gravel deposits.	Easy to Moderate
Qyv – Young alluvial valley deposits	Holocene and late Pleistocene	Segment 1	Fluvial deposits along valley floors consisting of unconsolidated sand, silt, and clay-bearing alluvium.	Easy to Moderate
Qof – Old alluvial-fan deposits	late to middle Pleistocene	Segment 1	Reddish-brown, moderately to well-consolidated silt, sand, and gravel with occasional boulders.	Moderate
Qvof – Very old alluvial-fan deposits	middle to early Pleistocene	Segment 1	Moderately to well consolidated silt, sand, gravel, and conglomerate. Typically well-dissected, orange brown sand and silt.	Easy to Moderate
Qvoa – Very old axial-channel deposits	middle to early Pleistocene	Segment 1 and Segment 2	Reddish brown alluvial deposits consisting dominantly of sand, with scattered gravel and pebble layers and silt and clay-bearing alluvium. Typically well consolidated to moderately to well-indurated.	Easy to Moderate
Qps – Pauba Formation	Pleistocene	Segment 2	Brown moderately well-indurated, cross bedded sandstone with sparse cobble to boulder conglomerate beds and grayish-brown, well-indurated, poorly sorted Fanglomerate and mudstone.	Easy to Moderate
Kdvg – Granodiorite and tonalite of Domenigoni Valley	Cretaceous	Segment 1	Main rock type of the Domenigoni Valley Pluton. Consists of relatively uniform, massive hornblende-biotite granodiorite grading into tonalite. Contains abundant to moderately abundant mafic inclusions.	Difficult
Kgd – Undifferentiated granodiorite	Cretaceous	Segment 2	Primarily massive, medium grained biotite and hornblende-biotite granodiorite.	Difficult
Kgb – Undifferentiated gabbro	Cretaceous	Segment 1 and Segment 2	Typically brown-weathering, medium to very coarse grained hornblende gabbro with common very large poikilitic hornblende crystals. Locally pegmatitic. Includes some noritic and dioritic rocks.	Difficult
Kpvt – Tonalite of the Pomona Valley Ring Complex	Cretaceous	Segment 1	Foliated biotite-hornblende tonalite, part of a composite ring dike intrusion. Eastern part of the tonalite grades to granodiorite.	Difficult
Trmu – Undifferentiated rocks of Menifee Valley	Triassic	Segment 1	Wide variety of low- to high-grade metamorphic rocks. May include biotite schist, greywacke, quartz-rich metasedimentary rocks, phyllite, schist, marble, interlayered quartzite and phyllite, manganese-bearing rocks, amphibolite, and gneiss.	Difficult
Trmq – Quart-rich rocks of the Rocks of the Menifee Valley	Triassic	Segment 1	Quartzite and quartz-rich metasandstone, locally conglomeritic.	Difficult

Sources: SCE, 2014 and USGS, 2006

Notes:

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. Actual excavation characteristics for each geological unit may vary widely, depending on site-specific subsurface conditions, which must be determined by site-specific geophysical surveys and geotechnical sampling, testing, and analysis.

Table C.7-2 presents a summary of the significant characteristics of the major soil associations traversed by the VSSP alignment, listed in alphabetical not geographic order, and the applicable project segment.

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

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. Soils with moderate to high shrink-swell potential would be classified as expansive soils. The expansive potential of the soils along the VSSP alignment ranges from low to high.

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. Corrosive potential of the soils along the VSSP alignment ranges from low to high for both corrosion to uncoated steel and corrosion to concrete.

C.7.1.4 Faults and Seismicity

The seismicity of southern California is dominated by the intersection of the north-northwest trending San Andreas Fault system and the east-west trending Transverse Ranges fault system. Both systems are responding to strain produced by the relative motions of the Pacific and North American Tectonic Plates. This strain is relieved by right-lateral strike-slip faulting on the San Andreas and related faults, left-lateral strike slip on the Garlock fault, and by vertical, reverse-slip or left-lateral strike-slip displacement on faults in the Transverse Ranges. The effects of this deformation include mountain building, basin development, deformation of Quaternary marine terraces, widespread regional uplift, and generation of earthquakes.

Table C.7-2. Soil Units Along the Proposed Project Alignment

Map Unit/ID	Soil Name	Location	Expansion Potential (Shrink-Swell)	Risk of Corrosion		Erosion Class	
				Uncoated Steel	Concrete	Wind	Water
AtC2	Arlington and Greenfield fine sandy loams, 2 to 8% slopes, eroded	Segment 2	Low	Moderate to High	Low	Moderate to High	Moderate
AtD2	Arlington and Greenfield fine sandy loams, 8 to 15% slopes, eroded	Segment 2	Low	Moderate to High	Low	Moderate to High	Moderate
AuC	Auld clay, 2 to 8% slopes	Segment 1	Moderate to High	High	Low	Moderate	Moderate
AuD	Auld clay, 8 to 15% slopes	Segment 2	Moderate to High	High	Low	Moderate	Moderate to High
BfC	Bosanko clay, 2 to 8% slopes	Segment 2	High	High	Low	Moderate	Moderate
BkC2	Buchenau silt loam, 2 to 8% slopes, eroded	Segments 1 and 2	Low to Moderate	Moderate	Moderate	Low to Moderate	Moderate to High
BxC2	Buren loam, deep, 2 to 8% slopes, eroded	Segments 1 and 2	Low to Moderate	Moderate	Moderate	Low to Moderate	Moderate to High
CaC2	Cajalco fine sandy loam, 2 to 8% slopes, eroded	Segment 1	Low to Moderate	Moderate	Low	Moderate to High	Moderate to High
CaD2	Cajalco fine sandy loam, 8 to 15% slopes, eroded	Segments 1 and 2	Low to Moderate	Moderate	Low	Moderate to High	Moderate to High
CbF2	Cajalco rocky fine sandy loam, 15 to 50% slopes, eroded	Segment 2	Low to Moderate	Low	Low	Moderate to High	Moderate to High
Ce	Chino silt loam, drained	Segment 1	Low to Moderate	High	Moderate	Low to Moderate	High
Cf	Chino silt loam, drained, saline-alkali	Segments 1 and 2	Low to Moderate	High	High	Low to Moderate	High
ChC	Cieneba sandy loam, 5 to 8% slopes	Segment 1	Low	Low	Moderate	Moderate to High	Moderate
ChD2	Cieneba sandy loam, 8 to 15% slopes, eroded	Segment 1	Low	Low	Moderate	Moderate to High	Moderate
CkD2	Cieneba rocky sandy loam, 8 to 15% slopes, eroded	Segments 1 and 2	Low	Low	Moderate	Moderate to High	Moderate
CkF2	Cieneba rocky sandy loam, 15 to 50% slopes, eroded	Segment 1	Low	Low	Moderate	Moderate to High	Moderate
Ds2	Domino fine sandy loam, eroded	Segment 1	Low to Moderate	Moderate	Moderate	Moderate to High	High
Dt	Domino fine sandy loam, saline-alkali	Segment 1	Low to Moderate	High	High	Moderate to High	High
Du	Domino silt loam	Segment 1	Low to Moderate	Moderate	Moderate	Moderate	High
Dv	Domino silt loam, saline-alkali	Segment 1	Low to Moderate	High	High	Moderate	High

Table C.7-2. Soil Units Along the Proposed Project Alignment

Map Unit/ID	Soil Name	Location	Expansion Potential (Shrink-Swell)	Risk of Corrosion		Erosion Class	
				Uncoated Steel	Concrete	Wind	Water
Dw	Domino silt loam, strongly saline-alkali	Segment 1	Low to Moderate	High	High	Moderate	High
EnA	Exeter sandy loam, 0 to 2% slopes	Segment 1	Low to Moderate	High	Low	Moderate to High	Low to High
EnC2	Exeter sandy loam, 2 to 8% slopes, eroded	Segment 1	Low to Moderate	High	Low	Moderate to High	Moderate to High
EpA	Exeter sandy loam, deep, 0 to 2% slopes	Segment 1	Low to Moderate	High	Low	Moderate to High	Moderate to High
FaD2	Fallbrook sandy loam, 8 to 15% slopes, eroded	Segments 1 and 2	Low to Moderate	Low	Low	Moderate to High	Low to Moderate
FfC2	Fallbrook fine sandy loam, 2 to 8% slopes, eroded	Segment 1	Low to Moderate	Low	Low	Moderate to High	Moderate
FkD2	Fallbrook fine sandy loam, shallow, 8 to 15% slopes, eroded	Segments 1 and 2	Low to Moderate	Moderate	Low	Moderate to High	Moderate
FwE2	Friant fine sandy loam, 5 to 25% slopes, eroded	Segment 1	Low	Low	Moderate	Moderate to High	Moderate
GtA	Grangeville fine sandy loam, drained, 0 to 2% slopes	Segment 1	Low	High	Low	Moderate to High	Moderate
GyA	Greenfield sandy loam, 0 to 2% slopes	Segment 1	Low	High	Low	Moderate to High	Moderate
GyC2	Greenfield sandy loam, 2 to 8% slopes, eroded	Segment 1	Low	High	Low	Moderate to High	Moderate
HcA	Hanford coarse sandy loam, 0 to 2% slopes	Segment 1	Low	High	Low	Moderate to High	Low to Moderate
HcC	Hanford coarse sandy loam, 2 to 8% slopes	Segment 1	Low	High	Low	Moderate to High	Low to Moderate
HcD2	Hanford coarse sandy loam, 8 to 15% slopes, eroded	Segment 1	Low	High	Low	Moderate to High	Low to Moderate
HgA	Hanford fine sandy loam, 0 to 2% slopes	Segment 1	Low	High	Low	Moderate to High	Low to Moderate
LaC	Las Posas loam, 2 to 8% slopes	Segment 1	Moderate to High	Moderate	Low	Low to Moderate	Moderate
LaC2	Las Posas loam, 5 to 8% slopes, eroded	Segment 1	Moderate to High	Moderate	Low	Low to Moderate	Moderate
LaD2	Las Posas loam, 8 to 15% slopes, eroded	Segments 1 and 2	Moderate to High	Moderate	Low	Low to Moderate	Moderate
LaE3	Las Posas loam, 8 to 25% slopes, severely eroded	Segments 1 and 2	Moderate to High	Moderate	Low	Low to Moderate	Moderate

Table C.7-2. Soil Units Along the Proposed Project Alignment

Map Unit/ID	Soil Name	Location	Expansion Potential (Shrink-Swell)	Risk of Corrosion		Erosion Class	
				Uncoated Steel	Concrete	Wind	Water
LkF3	Las Posas rocky loam, 15 to 50% slopes, severely eroded	Segments 1 and 2	Moderate to High	Moderate	Moderate	Low	Moderate
MmB	Monserate sandy loam, 0 to 5% slopes	Segments 1 and 2	Low to Moderate	Low	Low	Moderate to High	Moderate
MmC2	Monserate sandy loam, 5 to 8% slopes, eroded	Segments 1 and 2	Low to Moderate	Low	Low	Moderate to High	Moderate
MnD2	Monserate sandy loam, shallow, 5 to 15% slopes, eroded	Segments 1 and 2	Low to Moderate	Low	Low	Moderate to High	Moderate
PaA	Pachappa fine sandy loam, 0 to 2% slopes	Segment 1	Low to Moderate	Moderate	Moderate	Moderate to High	Moderate
PoC	Porterville clay, 0 to 8% slopes	Segment 1	High	High	Low	Moderate	Moderate
PsC	Porterville clay, moderately deep, 2 to 8% slope s	Segment 1	High	High	Low	Moderate	Moderate
PtB	Porterville clay, moderately deep, slightly saline-alkali, 0 to 5% slopes	Segment 1	High	High	Low	Moderate	Moderate
PvD2	Porterville gravelly clay, moderately deep, 2 to 15% slopes, eroded	Segment 1	High	High	Low	Moderate	Low to Moderate
RaA	Ramona sandy loam, 0 to 2% slopes	Segment 1	Low	Low	Low	Moderate	Low to Moderate
RaB3	Ramona sandy loam, 0 to 5% slopes, severely eroded	Segment 1	Low	Low	Low	Moderate	Low to Moderate
ReC2	Ramona very fine sandy loam, 0 to 8% slopes, eroded	Segments 1 and 2	Low	Low	Low	Moderate	Moderate to High
RnE3	Ramona and Buren loams, 5 to 25% slopes, severely eroded	Segments 1 and 2	Low to Moderate	Low to Moderate	Low to Moderate	Low to Moderate	Moderate to High
RsC	Riverwash	Segments 1 and 2	Low	-	-	High	Low
RuF	Rough broken land	Segments 1 and 2	-	-	-	-	-
TeG	Terrace escarpments	Segments 1 and 2	-	-	-	-	-
VeD2	Vallecitos loam, thick solum variant, 8 to 15% slopes, eroded	Segment 1	Low to High	Moderate	Low	Low to Moderate	Moderate to High
VsC	Vista coarse sandy loam, 2 to 8% slopes	Segment 1	Low	Low	Moderate	Moderate to High	Moderate
VsD2	Vista coarse sandy loam, 8 to 15% slopes, eroded	Segment 1	Low	Low	Moderate	Moderate to High	Moderate
VtF2	Vista rocky coarse sandy loam, 2 to 35% slopes, eroded	Segment 1	Low	Low	Moderate	Moderate to High	Moderate
Wg	Willows silty clay, saline-alkali	Segment 1	High	High	High	Moderate	Moderate

Sources: Modified from SCE PEA Table 4.6-3 (SCE, 2014). NRCS SSURGO Soil Survey GIS Data Western Riverside Area, California, (NRCS,2014).

Both the Transverse Ranges and northern Los Angeles County area are 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; CGS, 2002):

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

Although it is difficult to quantify the probability that an earthquake will occur on a specific fault, this classification is based on the assumption that if a fault has moved during the Holocene epoch, it is likely to produce earthquakes in the future. 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. Blind thrust faults are seismogenic structures with no surface expression and thus the activity classification of these faults is predominantly based on geologic data from deep oil wells, geophysical profiles, historic earthquakes, and microseismic activity along the fault.

The proposed Project site is subject to ground shaking associated with earthquakes on faults of the San Andreas, Garlock, and Transverse Ranges fault systems. Active faults of the San Andreas system are predominantly strike-slip faults accommodating translational movement. Active reverse or thrust faults in the Transverse Ranges include the blind thrust faults responsible for the 1987 Whittier Narrows Earthquake and 1994 Northridge Earthquake, and the range-front faults responsible for uplift of the Santa Susana and San Gabriel Mountains. The Transverse Ranges fault system consists primarily of blind, reverse, and thrust faults accommodating tectonic compressional stresses in the region. Blind faults have no surface expression and have been located using subsurface geologic and geophysical methods. This combination of translational and compressional stresses gives rise to diffuse seismicity across the region.

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. 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 was extensive, from northwest of Parkfield in Monterey County extending southeastward for over 225 miles along the San Andreas Fault to the Cajon Pass northwest of San Bernardino (SCEDC, 2015).

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 ground shaking and fault rupture are of primary concern to safe operation of the VSSP. Table C.7-3 lists active faults that represent a significant seismic threat to the proposed Project Data presented in this table include estimated earthquake magnitudes, type of fault, and slip rates. Figure C.7-2 shows locations of significant active faults and historic earthquakes in the Project area and surrounding region.

Table C.7-3. Significant Regional Active and Potentially Active Faults

Name	Closest Distance to Project (miles)[1]	Estimated Maximum Earthquake Magnitude[2]	Fault Type and Dip Direction[1]
Elsinore fault zone – Temecula section, various rupture combinations of the Temecula alone and with the Glen Ivy, Julian, Coyote Mountain, and Whittier section	3.0	7.1-7.8[3]	Right Lateral Strike Slip, 90°
San Jacinto fault zone – Anza section: various rupture combinations of Anza section alone and with Clark, Coyote Creek, Borrego, and Superstition Mtn. sections	9.3	7.3-7.6[3]	Right Lateral Strike Slip, 90°
Elsinore fault zone – Glen Ivy section alone and with the Whittier section	10.2	6.9-7.3[3]	Right Lateral Strike Slip, 90°
San Jacinto fault zone– San Jacinto Valley section: various rupture combinations alone and with the San Bernardino Valley, Clark, Coyote Creek, Borrego, Anza, and Superstition Mtn. sections	10.5	7.0-7.8[3]	Right Lateral Strike Slip, 90°
Elsinore fault zone – Julian section alone and with the Coyote Mountain section	15.3	7.4-7.5[3]	Right Lateral Strike Slip, 90°
San Jacinto fault zone – San Bernardino Valley section alone	19.9	7.1	Right Lateral Strike Slip, 90°
South San Andreas fault zone – South San Bernardino section: rupturing alone and rupturing in various combinations with the North San Bernardino, Banning/Garnet Hill, South Mojave, North Mojave, Coachella, Carrizo Plain, Big Bend, Parkfield, and the Cholame sections	24.6	6.9-8.0[3]	Right Lateral Strike Slip, 90°
Chino fault	24.4	6.8	Right Lateral Strike Slip, 90°
Elsinore fault zone – Whittier section alone	25.8	7.0	Right Lateral Strike Slip, 90°
South San Andreas fault zone – North San Bernardino section: rupturing alone and rupturing in various combinations with the South Mojave, North Mojave, Carrizo Plain, Big Bend, Parkfield, and the Cholame sections	28.7	6.9-7.9[3]	Right Lateral Strike Slip, 90°
Newport-Inglewood fault zone – Offshore: rupture of Offshore alone or with onshore Newport-Inglewood fault	31.0	7.0-7.2[3]	Right Lateral Strike Slip, 90°
San Joaquin Hills blind thrust	31.4	7.1	Blind Thrust, 25°SW
Pinto Mountain fault zone	33.3	7.3	Right Lateral Strike Slip, 90°
Sierra Madre fault zone – Cucamonga section	34.7	6.7	Reverse/Thrust Dip-Slip, 45°N

Notes:

1. Fault distances and parameters obtained from USGS Earthquake Hazards Program, 2008 National Seismic Hazard Maps - Source Parameters website (USGS, 2015). http://geohazards.usgs.gov/cfusion/hazfaults_search/hf_search_main.cfm?hazmap=2007
2. Maximum Earthquake Magnitude – the maximum earthquake that appears capable of occurring under the presently known tectonic framework, magnitude listed is “Ellsworth-B” magnitude from USGS OF08-1128 (Documentation for the 2008 Update of the United States National Seismic Hazard Maps) unless otherwise noted.
3. Range of magnitudes represents varying rupture scenarios of one or more segments along a fault.

Faults that are the most significant potential seismic sources in the Project area are those associated with the San Andreas, San Jacinto, and Elsinore fault zones.

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. Historically, the San Andreas Fault has produced “great” earthquakes that have caused significant surface rupture in southern California; those closest to the Project area were the M6.3 1915, M6.9 1940, and M6.4 1979 Imperial Valley earthquakes. However, no significant historic earthquakes have occurred on the San Andreas segments closest to the proposed Project.

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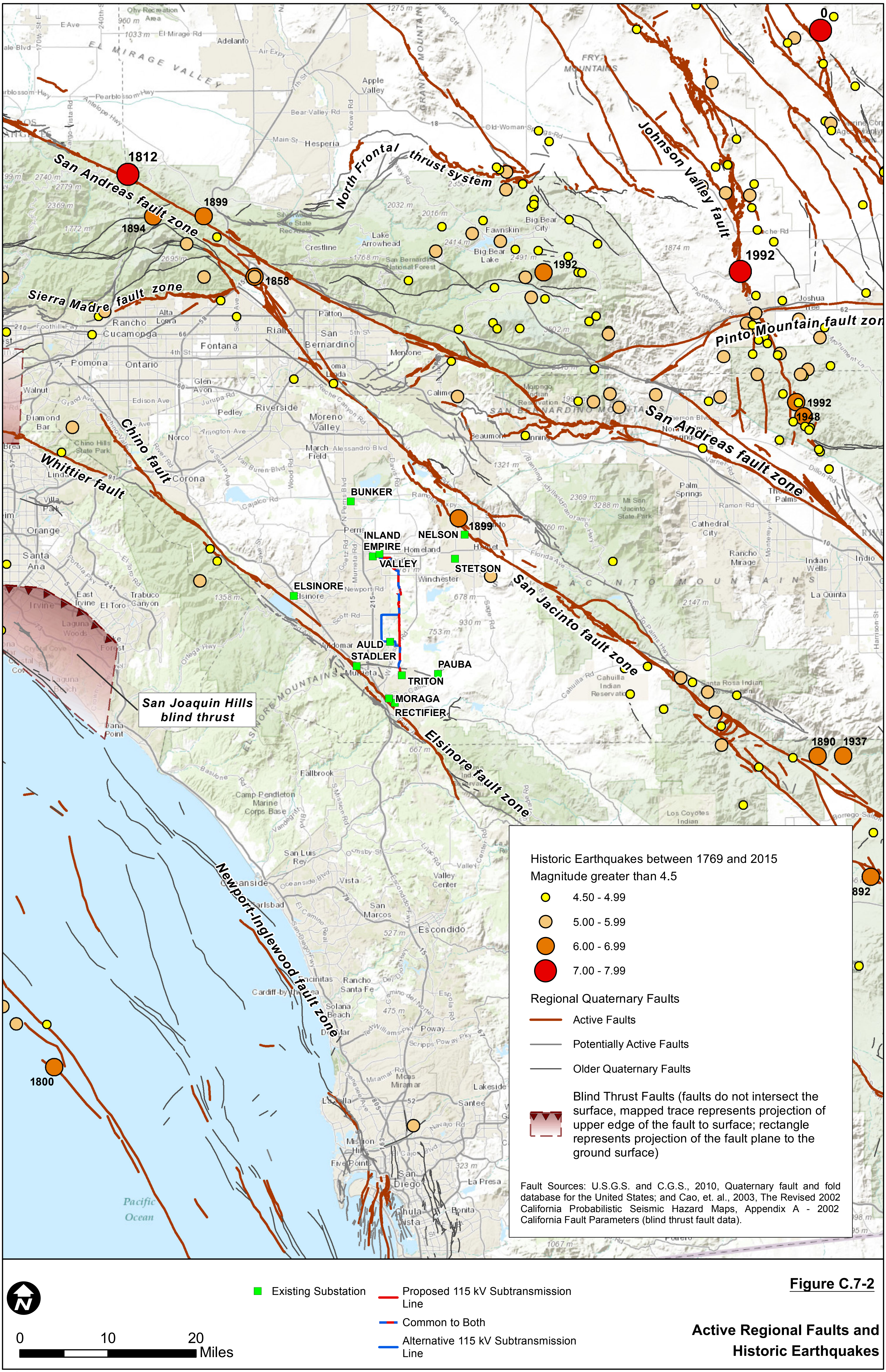

Fault Sources: U.S.G.S. and C.G.S., 2010, Quaternary fault and fold database for the United States; and Cao, et. al., 2003, The Revised 2002 California Probabilistic Seismic Hazard Maps, Appendix A - 2002 California Fault Parameters (blind thrust fault data).

Figure C.7-2

Active Regional Faults and Historic Earthquakes

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The San Jacinto Fault Zone is a major element of the San Andreas fault system in southern California, and is the most seismically active fault in southern California with significant historic earthquakes (if not ground rupture) associated with most of its sections. The seismically active San Jacinto fault zone is a complex system of strike-slip fault segments connected by releasing and restraining bends and stopovers that extends for approximately 150 miles from the San Andreas Fault near Cajon Pass southeastward through the Peninsular Ranges into the southwestern Imperial Valley. The San Jacinto fault zone has produced at least 8 earthquakes greater than M6.0 since 1890, including the M6.8 San Jacinto earthquake to the east of the Project area; and the M6.5 1968 Borrego Mountain and the 1987 M6.6 Superstition Hills and Elmore Ranch earthquakes southeast of the Project area near the Salton Sea.

The Elsinore Fault Zone extends over 155 miles southeastward from the Los Angeles Basin to the Mexico Border where it continues southeast as the Laguna Salada Fault. In historical times, the Elsinore fault has been one of the quietest in southern California, with the main trace of the Elsinore fault zone having only experienced one historical event greater than magnitude 5.2, an earthquake of about M 6.0 in 1910 near Temescal Valley (on the Glen Ivy segment) that produced no known surface rupture and did little damage. In the Project area, the fault zone is divided into two segments, the Temecula, and Glen Ivy segments, which cut diagonally across various Peninsular Range batholithic and pre-batholithic metamorphic terrain.

Fault Rupture

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

Segment 1 does not cross any known mapped faults. Segment 2 crosses the late Quaternary (greater than 130,000 year old) potentially active Murrieta Hot Springs Fault. The Murrieta Hot Springs Fault is a discontinuous zone of faulting trending generally east-west between Murrieta and Buck Mesa. The Murrieta Hot Springs fault zone intersects and is either cut off by the Wildomar fault of the Elsinore fault zone at Murrieta. No new or replacement structures are planned along Segment 2 at or near where the fault crosses it.

Strong Ground Shaking

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

The intensity of the seismic shaking, or strong ground motion, during an earthquake is dependent on the distance between the Project area and the epicenter of the earthquake, the magnitude of the earthquake, and the geologic conditions underlying and surrounding the Project area. Earthquakes occurring on faults closest to the Project area would most likely generate the largest ground motion.

The intensity of earthquake-induced ground motions can be described using peak site accelerations, represented as a fraction of the acceleration of gravity (g). GIS data based on the USGS Probabilistic Seismic Hazard Assessment (PSHA) Maps was used to estimate peak ground accelerations (PGAs) along the Project alignment. PSHA Maps depict peak ground accelerations with a 2 percent probability of exceedance in 50 years, which corresponds to a return interval of 2,475 years for a maximum considered earthquake (USGS, 2014). Peak ground acceleration is the maximum acceleration experienced by a particle on the Earth's surface during the course of an earthquake, and the units of acceleration are most commonly measured in terms of fractions of g, the acceleration due to gravity (980 cm/sec2). Peak ground accelerations along the VSSP alignment ranges from 0.5 to 0.6 g, which corresponds to strong ground shaking.

Liquefaction

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

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

Liquefaction susceptibility mapping by Riverside County (County of Riverside, 2015) indicates low to very low liquefaction susceptibility for most of the proposed Project alignment, with the exception of the valley and creek sediments along Salt Creek and within the sediment along the creeks that cross the alignment within Domenigoni, and French Valleys, and along Santa Gertudis Creek. In areas mapped as having low liquefaction susceptibility within the proposed Project area it is unlikely that the Project components would be subject to liquefaction related phenomena. However, there is still a slight potential for liquefaction if seasonal perched groundwater were present during an earthquake. Areas underlain by consolidated sedimentary, granitic, and metamorphic bedrock are not susceptible to liquefaction.

Seismic Slope Instability

Other forms of seismically-induced ground failures that may affect the Project area include ground cracking, and seismically-induced landslides. Landslides triggered by earthquakes have been a significant cause of earthquake damage; in Southern California large earthquakes such as the 1971 San Fernando and 1994 Northridge earthquakes triggered landslides that were responsible for destroying or damaging numerous structures, blocking major transportation corridors, and damaging life-line infrastructure. Areas that are most susceptible to earthquake-induced landslides are steep slopes in poorly cemented or highly fractured rocks, areas underlain by loose, weak soils, and areas on or adjacent to existing landslide deposits.

As discussed above, the proposed Project crosses flat to gently sloping alluvial fans and valleys and gently sloping hills and no landslides are mapped along or near to the proposed Project. Therefore the proposed Project would not be subject to seismically-induced landslides or other slope failures.

C.7.2 Regulatory Framework

C.7.2.1 Federal

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

International Building Code. The International Building Code (IBC) is published by the International Code Council (ICC). The scope of this code covers major aspects of construction and design of structures and buildings, except for three-story one- and two-family dwellings and town homes. The IBC has replaced the Uniform Building Code (UBC) as the basis for the California Building Code (CBC) and contains provisions for structural engineering design. The 2015 IBC addresses the design and installation of structures and building systems through requirements that emphasize performance. The IBC includes codes governing structural as well as fire- and life-safety provisions covering seismic, wind, accessibility, egress, occupancy, and roofs.

C.7.2.2 State

California Building Code. The CBC, Title 24, Part 2 provides building codes and standards for design and construction of structures in California. The 2013 CBC is based on the 2012 IBC 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.

CPUC General Order 95 (GO95) and General Order 128 (GO128). California Public Utilities GO95 and GO128 contain the State of California rules formulated to provide uniform requirements for overhead electrical line construction (GO95) and underground electrical supply and communication systems (GO 128) to ensure adequate service and secure safety to persons engaged in the construction, maintenance, operation or use of overhead electrical lines and underground electrical supply and communication systems and to the public. GO95 and GO128 are not intended as complete construction specifications, but to embody requirements that are most important from the standpoint of safety and service. Construction shall be according to accepted good practice for the given local conditions in all particulars not specified in the rules.

GO95 applies to all overhead electrical supply and communication facilities within the jurisdiction of the CPUC, located outside of buildings, including facilities that belong to non-electric utilities, as follows: Construction and Reconstruction of Lines, Maintenance of Lines, Lines Constructed Prior to This Order, Reconstruction or Alteration, Emergency Installation, and Third Party Nonconformance.

GO128 applies to (a) all underground electrical supply systems used in connection with public utility service; when located in buildings, the vaults, conduit, pull boxes or other enclosures for such systems shall also meet the requirements of any statutes, regulations or local ordinances applicable to such enclosures in buildings; and (b) all underground communication systems used in connection with public utility service located outside of buildings. GO128 applies to the following activities related to underground electrical supply and communication systems: Construction and Reconstruction of Lines, Maintenance, Systems Constructed Prior to These Rules, Reconstruction or Alteration, and Third Party Nonconformance.

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

Seismic Hazard Mapping Act. The Seismic Hazards Mapping Act (the Act) of 1990 (PRC, Chapter7.8, Division 2, Sections 2690–2699.) directs the California Department of Conservation, Division of Mines and Geology [now called California Geological Survey (CGS)] to delineate Seismic Hazard Zones. The purpose of the Act is to reduce the threat to public health and safety and to minimize the loss of life and property by identifying and mitigating seismic hazards. Cities, counties, and State agencies are directed to use seismic hazard zone maps developed by CGS in their land-use planning and permitting processes. The Act requires that site-specific geotechnical investigations be performed prior to permitting most urban development projects within seismic hazard zones.

C.7.2.3 Local

The CPUC regulates and authorizes the construction of investor-owned public utility facilities, and therefore the CPUC has jurisdiction over the siting and design of the proposed Project. Investor-owned public utility projects, such as the VSSP, are exempt from local land use and zoning regulations and permitting in accordance with General Order No. 131-D. This exemption is applicable to all components of the proposed Project. However, Section XIV.B requires “public utilities shall consult with local agencies regarding land-use matters.” The following information presents goals and policies from local agency land use plans that address geology and soils for the Project area.

Riverside County

The Riverside County General Plan Safety Element (County of Riverside, 2008) presents a summary of geologic and other hazards in the County and facilitates the identification and mitigation of hazards for new development that strengthens existing codes, project review, and permitting processes, and presents policies directed at identifying and reducing hazards in existing development. The County has prepared a Safety Element Technical Background Report that is an assessment of natural and man-made hazards in the County, including, but not limited to: earthquakes, landslides, subsidence/settlement, floods, inundation, and wildland fire. The report serves as the foundation for the Safety Element and includes detailed GIS hazard mapping and analyses.

City of Menifee General Plan

The Safety Element of the City of Menifee’s General Plan contains the following policies that would be relevant to the proposed Project:

- S-1.3: Encourage the city's utility service providers to identify sections of their distribution networks that are old and/or in areas susceptible to earthquake-induced ground deformation, and to repair, replace, or strengthen the sections as necessary.

- S-2.3: Minimize grading and modifications to the natural topography to prevent the potential for man-induced slope failures.

City of Temecula General Plan

The Public Safety Element of the City of Temecula's General Plan contains the following policy that is relevant to the proposed Project:

- Policy 1.1: Identify and mitigate potential adverse impacts of ground surface rupture, liquefaction, and landslides at the project level.

C.7.3 Applicant-Proposed Measures

In its PEA, SCE has listed a number of Applicant Proposed Measures (APMs) that are designed to reduce impacts from the proposed Project. None of the APMs are specifically applicable to Geology and Soils. However, the impact discussion in Section C.7.4 (below) identifies mitigation measures, where appropriate, to reduce significant adverse impacts that could result from construction and operation of the VSSP.

C.7.4 Environmental Impacts and Mitigation Measures

This section describes effects on and from geologic and soils resources and conditions that would be caused by the implementation of the proposed Project. Geologic, soil, and seismic conditions were evaluated with respect to adverse effects implementation of the proposed Project may have on local geology and soils, as well as the impact that specific geologic hazards may have upon components of the VSSP. A wide range of potential impacts, including unsuitable soils, slope instability, and seismic hazards of surface fault rupture, strong ground shaking, liquefaction, and seismically induced landslides, were considered in this analysis. Geologic formations, slope conditions, and soil types have been characterized by their potential to contribute to hazardous conditions. Areas prone to risk for potential adverse impacts due to existing geologic, topographic, or soils conditions were identified and their relationship to proposed Project components analyzed. Where existing conditions suggest a potential risk or impact, mitigation measures were identified to reduce the risk or impact.

C.7.4.1 Criteria for Determining Significance

The proposed Project would result in significant impacts to Geology and Soils if it would:

- Criterion GEO1: Results in triggering or acceleration of geologic processes, such as landslides or substantial soil erosion.
- Criterion GEO2: Expose people or structures to potential risk of loss or injury where there is high potential for earthquake-related ground rupture in the vicinity of major fault crossings.
- Criterion GEO3: Expose people or structures to potential risk of loss or injury where there is high potential for seismically induced ground shaking, landslides, liquefaction, settlement, lateral spreading, and/or surface cracking.
- Criterion GEO4: Expose people or structures to potential risk of loss or injury where expansive soils or other unsuitable soils are present.

The following thresholds from the CEQA Appendix G Environmental Checklist are not relevant to the proposed Project. As the project would not include the construction of any restroom facilities or other components requiring wastewater disposal, this CEQA threshold would not be applicable to the proposed

Project. In addition, the proposed Project traverses across flat to gently sloping alluvial fans and valleys and is adjacent to and along the edge of gently sloping low-lying hills. No landslides or known unstable slopes exist in the immediate Project area. The proposed Project would not be subject to impacts from future slope failures. Therefore, the following two criteria are not discussed further in this section.

- Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.
- Results in damage to Project structures where there is potential for future slope failures on existing unstable slopes.

C.7.4.2 Impact Analysis – Direct and Indirect Effects

This section describes the direct and indirect impacts of the proposed Project. Cumulative impacts are discussed separately in Section C.7.4.3.

Impact GEO-1 (Criterion GEO1): Project construction could trigger soil erosion. (Class III)

The proposed Project is located on flat to gently sloping alluvial fans and valley floors and adjacent to and on gently sloping hills within and between these valleys. Therefore there would be no impact related to construction triggered landslides or other slope instability (No Impact).

Excavation and grading for underground conduits and vaults, new and replacement poles, work areas, and other Project components could loosen soil and trigger or accelerate erosion. The soils in the Project area generally contain high percentages of sand and may be susceptible to wind and water erosion. Soils containing high percentages of fine sands and silt and that are low in density, are generally the most erodible. As the clay and organic matter content of soils increases, the potential for erosion decreases. Clays act as a binder to soil particles, thus reducing the potential for erosion. Erosion potential of the soils throughout the Project area due to wind ranges from low to high and erosion potential from water (sheet and rill erosion) also ranges from low to high.

Current regulations would require that the proposed Project obtain under the CWA regulations a NPDES General Permit for Storm Water Discharges Associated with Construction Activity as construction would disturb a surface area greater than one acre. Additionally, compliance with the NPDES would require that SCE submit a SWPPP. The SWPPP would require development and implementation of best management practices (BMPs) to identify and control erosion, which would reduce the potential for construction triggered erosion to less than significant (Class III).

Operation of the proposed Project would not require any significant ground disturbance other than what may be required for repairs. Therefore, significant soil erosion would not be triggered or accelerated due to Project operation.

Impact GEO-2 (Criterion GEO2): The Project could expose people or structures to potential risk of loss or injury where there is high potential for earthquake-related ground rupture in the vicinity of major fault crossings. (Class III)

No known faults cross Segment 1, therefore there is no potential for earthquake-related ground rupture along this portion of the proposed Project. A potentially active fault, the Murrieta Hot Springs fault, crosses Segment 2; however, construction on this segment consists predominantly of reconductoring and no new structures are planned in the area where the fault crosses the Segment 2 alignment. The existing poles along the current alignment of Segment 2 cross this fault and these existing poles have been designed to a wind loading standard that generally also exceeds seismic loading criteria, thus, reducing the risk of a pole failing during a seismic event. It is not expected that the reconductoring of the existing poles would alter the existing baseline conditions or add substantial instability to the existing overhead structures. Therefore, the impact would be less than significant related to fault rupture along the proposed Project (Class III).

Impact GEO-3 (Criterion GEO3): Project structures could be damaged by seismically-induced ground shaking. (Class III)

The proposed Project would be subject to ground shaking from a large earthquake on any of the major faults in the region. Strong ground shaking should be expected in the event of an earthquake on the faults near the proposed Project, with estimated PGAs of 0.5 to 0.6 for a 2 percent probability of exceedance in 50 years. While the shaking would be less severe from an earthquake that originates farther from the Project site, the effects from nearby or regional earthquakes could be damaging to Project structures. It is likely that Project components would be subjected to at least one moderate or larger earthquake occurring close enough to produce ground shaking at the Project site. However, the new poles and new underground conduit and vaults would be designed as required by CPUC GO95 and GO128 (overhead electrical line construction requirements and underground electrical supply and communication systems requirements, respectively). Above-ground poles would be designed to meet wind loading criteria, which generally exceed seismic loading criteria; reducing and/or eliminating the risk of poles or towers failing due to ground shaking. Design of these new structures to the above referenced guidelines and standards would reduce any potential damage from ground shaking to these features to negligible resulting in a less-than-significant impact (Class III).

Impact GEO-4 (Criterion GEO3): Project structures could be damaged by seismically-induced ground failures. (Class II)

The proposed Project is located on flat to gently sloping alluvial fan and alluvial valley floors and adjacent to and along the edges of gently sloping hills, and would not be subject to seismically-induced slope failures.

Portions of the proposed Project have been mapped as having moderate to very high liquefaction susceptibility by County of Riverside. These areas are located within unconsolidated alluvial valley and creek sediments. There is a potential that these unconsolidated sediments may be subject to liquefaction in the event of strong ground shaking due to the potential for shallow groundwater in these areas. New project structures with foundations, such as tubular steel poles (TSPs), along Segment 1 that are located in areas with potentially liquefiable alluvial sediment could potentially suffer liquefaction related damage in a large earthquake. As required by CPUC GO95 and GO128, these structures would be designed to withstand seismic loading. However, to reduce impacts associated with seismically induced ground failures or liquefaction for proposed Project structures with foundations, Mitigation Measure GEO-1 (Investigations for Liquefaction) shall be implemented prior to final Project design. This measure would ensure that people or structures would not be exposed to hazards associated with earthquake-induced liquefaction. This would result in a less-than-significant impact wit mitigation (Class II). The potential for liquefaction related damage to the existing poles along Segment 2 would not change from the current conditions with the proposed reconductoring, resulting in a less-than-significant impact for this portion of the proposed Project (Class III).

Mitigation Measure for Impact GEO-3

GEO-1 **Investigations for Liquefaction.** Because seismically induced liquefaction-related ground failure has the potential to damage or destroy Project components, the design-level geotechnical investigations to be performed by Southern California Edison shall include investigations designed to assess the potential for liquefaction to affect new Project structures with foundations (such as Tubular Steel Poles) in areas with potential liquefaction-related impacts. Where these hazards are found to exist, appropriate engineering design and construction measures shall be incorporated into the Project designs as deemed appropriate by the Project engineer. Design measures that would mitigate liquefaction-related impacts could include ground improvement of liquefiable zones, installation of flexible bus connections, and incorporation of slack in cables to allow ground deformations without damage to structures. Study results and proposed solutions to mitigate liquefaction shall be provided to the California Public Utilities Commission for review and approval at least 60 days before final Project design.

Impact GEO-5 (Criterion GEO4): Project structures could be damaged by unsuitable soils. (Class II)

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 along the Project may have moderate to high clay contents and many have moderate to high shrink-swell potential. Expansion potential for the soils along the proposed Project alignment ranges from low to high, as presented in Table C.7-2, with most of the Project underlain by soils with low and low to moderate expansion potential. There are a few soil units along the alignment with moderate to high and high potential for expansion. Expansive soils may cause differential and cyclical movements of new TSP foundations and other new buried structures that can cause damage and/or distress to structures and equipment.

Soils along the proposed Project have the potential to corrode both steel and concrete ranging from low to high, as presented in Table C.7-2. In areas where corrosive subsurface soils exist along the proposed Project route, the 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. Of most concern along the proposed Project is the potential for corrosion of concrete foundations for the TSPs and of the potential for corrosion of the direct buried light weight steel poles. Soils with moderate and high potential to corrode concrete and moderate, moderate to high, and high potential to corrode uncoated steel are mapped as intermittently underlying both Segments 1 and 2. Implementation of Mitigation Measure GEO-2 would reduce impacts to less than significant (Class II).

Mitigation Measures for Impact GEO-4

GEO-2 **Assess Soil Characteristics.** The design-level geotechnical studies to be performed for the proposed Project shall include soils analyses to identify the presence, if any, of potentially detrimental soil chemicals, such as chlorides and sulfates, detrimental soil pH at Tubular Steel Pole (TSP) and Light Weight Steel Pole locations and testing for soils with moderate to high shrink/swell or expansion potential at TSP locations. If corrosive soils are identified, 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. If expansive soils are identified, the Project design shall be modified to include appropriate design features such as excavation of potentially expansive soils during construction and replacement with engineered backfill, ground-treatment processes, and redirection of surface water and drainage away from expansive foundation soils. Study results and proposed solutions to mitigate expansive or corrosive soils conditions shall be provided to the California Public Utilities Commission for review and approval at least 60 days before final Project design.

C.7.4.3 Cumulative Impacts

Geographic Extent/Context

The geographic extent of cumulative analysis for geology and soils resources is limited to the Project alignment and other Project facilities including substations. This area is considered sufficient to capture potential cumulative effects to mineral resources because primary impacts from geologic conditions, geologic hazards, and soils occur at specific locales and are unaffected by activities not acting on them directly and any impacts of the proposed Project would be site-specific.

Existing Cumulative Conditions

Past and ongoing development throughout the proposed Project area has resulted in alterations to the natural landscape. Past, existing, and future projects could contribute to the cumulative effects of geology and soils resources, creating the following condition: triggering or acceleration of erosion. These conditions would be limited to the areas within and adjacent to the boundaries of individual projects. In order to be cumulatively considerable, such conditions would have to occur at the same time and in the same location as the same or similar conditions of the proposed Project. Seismic impacts (ground shaking, earthquake-induced ground failure, and fault rupture) from the numerous local and regional faults comprise an impact of the geologic environment on individual projects and would not introduce cumulatively considerable impacts. Impacts from unsuitable soils (expansive or corrosive soils) would also represent an impact of the environment on individual projects and would not be cumulatively considerable.

Cumulative Impact Analysis

The potential for geology and soils impacts of the proposed Project (described in Section C.7.4.2) to combine with the effects of other proposed, planned, and reasonably foreseeable future projects, as listed in Table C.1-1, that are within the geographic extent of the cumulative analysis are described below for each significance criterion.

Criterion GEO1: Results in triggering or acceleration of geologic processes, such as landslides or substantial soil erosion.

Potential erosion related to excavation and grading for the proposed Project would be limited to areas of ground disturbance for this Project that are underlain by soils with moderate to high erosion potential and compliance with the project NPDES and SWPPP reduces the potential to trigger or accelerate erosion **(Impact GEO-1)** to less than significant (Class III). The potential for this impact to combine with similar effects of other projects would only occur if other projects were implemented in the same area at the same time as the proposed Project. However, construction of the proposed Project would preclude other projects from being implemented concurrently in the same location. Therefore proposed Project impacts would not have the potential to combine with similar effects from other projects and would not be cumulatively considerable.

Criterion GEO2: Expose people or structures to potential risk of loss or injury where there is high potential for earthquake-related ground rupture in the vicinity of major fault crossings.

There is no potential impact from fault rupture on the proposed Project (Impact GEO-2). Fault rupture impacts are an impact of the seismic environment on a project and would therefore be project specific and not be cumulatively considerable.

Criterion GEO3: Expose people or structures to potential risk of loss or injury where there is high potential for seismically induced ground shaking, landslides, liquefaction, settlement, lateral spreading, and/or surface cracking.

Large earthquakes on regional faults could result in strong seismically induced ground shaking (Impact GEO-3) and liquefaction (Impact GEO-4) in the general project area. However, as noted above, seismic impacts such as seismically-induced ground shaking and liquefaction related phenomena would be impacts of the environment on each specific project and would not be cumulatively considerable.

Criterion GEO4: Expose people or structures to potential risk of loss or injury where expansive soils or other unsuitable soils are present. Unsuitable soils such as expansive and corrosive soils occur within the Project area (Impact GEO-5), however the Project's impacts from unsuitable soils would be less than significant with implementation of Mitigation Measure GEO-2 (*Assess Soil Characteristics*). As noted above, impacts related to unsuitable soils are an impact of the environment on each project and would therefore not be cumulatively considerable.

C.7.4.4 Impact and Mitigation Summary

This section summarizes the conclusions of the impact analysis and associated mitigation measures presented in Section C.7.4.2 for the proposed Project. Table C.7-4 lists each impact identified for the proposed Project, along with the significance of each impact.

Table C.7-4. Impact and Mitigation Summary – Geology and Soils

Impact	Significance Conclusion	Reason for Conclusion
GEO-1: Project construction could trigger soil erosion.	Class III	Compliance with NPDES and SWPPP would reduce potential for Project related ground disturbance to trigger or accelerate soil erosion.
GEO-2: Project could expose people or structures to potential risk of loss or injury where there is high potential for earthquake-related ground rupture in the vicinity of major fault crossings.	Class III	No faults cross Segment 1 of the proposed Project. A potentially active fault crosses Segment 2, however only reconductoring would be completed on this segment. The reconductoring is not expected to alter existing conditions or add substantial instability to existing overhead structures.
GEO-3: Project structures could be damaged by seismically-induced ground shaking.	Class III	Project design would comply with CPUC GO 95 and GO 128, reducing and/or eliminating the risk of poles or towers failing due to ground shaking.
GEO-4: Project structures could be damaged by seismically-induced ground failures.	Class II	Implementation of **Mitigation Measure GEO-1** (*Investigations for Liquefaction*) and compliance with CPUC GO 95 and GO 128 during Project design would reduce the potential for damage to Project components with foundations from liquefaction.
GEO-5: Project structures could be damaged by unsuitable soils.	Class II	Implementation of **Mitigation Measure GEO-2** (*Assess Soil Characteristics*) prior to final Project design would allow for identification of unsuitable soils and design of appropriate counter measures to prevent damage to buried concrete and steel components at TSP and LSW pole locations.

Class I: Significant impact; cannot be mitigated to a level that is not significant. A Class I impact is a significant adverse effect that cannot be mitigated below a level of significance through the application of feasible mitigation measures. Class I impacts are significant and unavoidable.

Class II: Significant impact; can be mitigated to a level that is not significant. A Class II impact is a significant adverse effect that can be reduced to a less than significant level through the application of feasible mitigation measures presented in this EIR.

Class III: Adverse; less than significant. A Class III impact is a minor change or effect on the environment that does not meet or exceed the criteria established to gauge significance.

Class IV: Beneficial impact. A Class IV impact represents a beneficial effect that would result from project implementation.