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**4.6 Geology and Soils**

Would the Project:	Potentially Significant Impact	Potentially Significant Unless APMs Incorporated	Less Than Significant Impact	No Impact
a. Expose people or structures to potential adverse effects, including the risk of loss, injury or death involving:				
i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
ii. Strong seismic ground shaking?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
iii. Seismic-related ground failure, including liquefaction?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
iv. Landslides?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
b. Result in substantial soil erosion or the loss of topsoil?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Would the Project:	Potentially Significant Impact	Potentially Significant Unless APMs Incorporated	Less Than Significant Impact	No Impact
c. Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
d. Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1997), creating substantial risks to life or property?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
e. Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

#### 4.6.1 Introduction

The analysis in this section is based on the Geotechnical Investigation: 69-kV Transmission Line TL 6965 Salt Creek Substation to Miguel Substation, prepared by Geosyntec Consultants, dated August 22, 2012 (Appendix 4.6-A); Geotechnical Investigation of the Proposed SDG&E Otay Ranch Substation, prepared by Kleinfelder, dated March 7, 2008 (Appendix 4.6-B); Geotechnical Investigation of TL 6910 Wood to Steel Improvements, prepared by GEOCON, dated July 15, 2011; and the Report of Earthwork Observation and Testing, prepared by URS Corporation, dated May 7, 2007. In addition, publicly available geologic maps and data were reviewed.

This section describes the geologic and soil conditions in the area for the proposed Salt Creek Substation, TL 6965, TL 6910 loop-in, and staging yards. The potential geologic and seismic impacts of the Proposed Project analyzed in this section include the exposure of people and structures to potential substantial adverse effects involving strong seismic ground shaking, fault rupture, liquefaction, unstable soils, landslides, expansive soil, or substantial soil erosion or loss of topsoil. The evaluation concludes that, with implementation of the design features identified in the geotechnical reports, construction of the Proposed Project would result in less-than-significant geologic impacts.

## 4.6.2 Methodology

This section was prepared based on the geotechnical investigations listed above, and data compiled from the U.S. Geological Survey (USGS), the California Geological Survey (CGS) (2012a, 2012b), and the General Plans of the County of San Diego (2011) and the City of Chula Vista (2005).

The proposed Salt Creek Substation, TL 6965, TL 6910 loop-in, and staging yards were considered in the following analysis, along with the Existing Substation. The proposed TL 6965 extends approximately 5 miles from its northwestern terminus at the Existing Substation to its southeastern terminus at the proposed Salt Creek Substation in the Otay Ranch area. Where existing conditions or potential impacts are identical for multiple components, these components are described together in the subsections that follow.

SDG&E would incorporate the design measures and findings of the Geotechnical Investigation reports prepared by Geosyntec Consultants, Kleinfelder, and the contractor's Geotechnical Engineer in the final design of all Proposed Project components. This approach would ensure that final design and construction techniques compensate for potential landslides, expansive soils, and slope instability. In addition, SDG&E would comply with all applicable codes and seismic standards, as appropriate, to minimize the potential for damage from a seismic event. Final design would be reviewed and approved, prior to commencement of construction, by a professional engineer registered in California.

## 4.6.3 Existing Conditions

### 4.6.3.1 Topography and Physiography

The Proposed Project area is located in the Peninsular Ranges Geomorphic Province, which encompasses an area that extends south approximately 900 miles, from the Transverse Ranges and the Los Angeles Basin to the southern tip of Baja California. The Peninsular Ranges vary in width from approximately 30 to 100 miles. The lower Peninsular Range Region in San Diego County is composed of foothills with elevations ranging from 600 feet above mean sea level (amsl) to 2,000 feet amsl (County of San Diego 2011). It is characterized by rolling to hilly uplands that contain frequent, narrow, winding valleys traversed by several rivers and intermittent drainages.

The land underlying proposed TL 6965 is generally characterized by sloping terrain varying from relatively flat to gentle slopes. The natural hillsides along the alignment are covered by moderate growth of scrub brush and low grasses. Elevations along the proposed power lines range from 487 feet amsl to 630 feet amsl. The majority of the land underlying proposed TL 6965 generally drains to the west or southwest toward San Diego Bay; however, the southern portion of the proposed TL 6965 near the proposed Salt Creek Substation site drains to the southeast toward Salt Creek and Lower Otay Lake.

The proposed Salt Creek Substation site is relatively undisturbed and consists of gentle to moderately sloping hillsides that descend to the west, south, and east toward a natural

drainage system below the site. The undeveloped portions of the site are covered with grasses and native scrub habitat.

**4.6.3.2 Soils**

Several soil types are present in the Proposed Project area, as shown in Figure 4.6-1. The majority of the Proposed Project area, including the Hunte Parkway staging yard, Eastlake Parkway staging yard, and the alternative staging yards at the Olympic Training Center, is composed of Diablo Clay, a very dark silty clay, present on uplands with slopes of 2 to 30%. The majority of the proposed Salt Creek Substation site is composed of Diablo-Olivenhain complex, a mix of clay and cobbly loam, which occurs on uplands at elevations of 100 to 600 feet. A portion of the Proposed Project area to the east of the Existing Substation is composed of soils from the San Miguel-Exchequer Rocky silt loams, present on mountainous uplands at elevations of 400 to 3,300 feet. A portion of the soils east of the southern terminus of the proposed power lines are composed of Linne clay loams, which are generally present on uplands, with slopes of 9 to 50%. The Olympic Training Center site is composed of Huerhuero loam, a moderately well-drained loam with clay subsoil that is present on uplands with slopes of 15 to 30%. Surficial materials encountered in the Proposed Project area are described below.

Table 4.6-1 shows the soil characteristics in the Proposed Project area. The erosion rate is characterized by the “T factor,” the soil loss tolerance expressed in tons per acre per year, with values ranging from 1 (low erosion potential) through 5 (high erosion potential).

**Table 4.6-1: Soil Characteristics in the Proposed Project Area**

<b>Soil Series</b>	<b>Description</b>	<b>Soil Type and Map Unit</b>	<b>Acreages in Project Area</b>	<b>Percent of Project Area</b>	<b>T Factor</b>
Diablo	Well-drained, moderately deep to deep clays derived from soft, calcareous sandstone and shale.	Diablo clay, 9 to 15% (DaD)	73.8	33.2%	3
		Diablo clay, 2 to 9% (DaC)	44.3	20.0%	3
		Diablo clay, 15 to 30% (DaE)	27.2	12.3%	3
		Diablo-Olivenhain complex, 9 to 30% slopes (DoE)	32.8	14.8%	3
		Diablo clay, 15 to 30% (DaE2)	0.8	0.4%	3
Olivenhain	Well-drained, slow-to-medium runoff and very slow permeability soils.	Olivenhain cobbly loam, 9 to 30% slopes (OhE)	12.4	5.6%	3
		Olivenhain cobbly loam, 2 to 9% slopes (OhC)	1.8	0.8%	3

Soil Series	Description	Soil Type and Map Unit	Acreages in Project Area	Percent of Project Area	T Factor
San Miguel-Exchequer	Well-drained, shallow to moderately deep silt loams that have clay subsoil.	San Miguel-Exchequer rocky silt loams, 9 to 70% slopes (SnG)	7.6	3.4%	2
Huerhuero	Moderately well-drained loams that have clay subsoil.	Huerhuero loam, 15 to 30% slopes (HrE2)	9.7	4.4%	2
		Huerhuero loam, 2 to 9% slopes (HrC)	1.0	0.5%	2
Riverwash	Occurs in intermittent stream channels and consists of sandy, gravelly, or cobbly material. It is excessively drained and rapidly permeable.	Riverwash (Rm)	6.9	3.1%	n/a
Linne	Well-drained, moderately deep clay loams derived from soft calcareous sandstone and shale.	Linne clay loam, 9 to 30% slopes (LsE)	1.5	0.7%	3
Salinas	Deep, well-drained soils that formed in alluvium weathered from sandstone and shale.	Salinas clay loam, 2 to 9% slopes (SbC)	1.2	0.5%	5
Terrace Escarpments	Steep to very steep escarpments on the nearly even fronts of terraces or alluvial fans.	Terrace escarpments (TeF)	1.0	0.5%	n/a

Source: NRCS 2012

***Topsoil/Colluvium***

Surficial deposits, including topsoil, alluvium, colluviums, slopewash, and residual soils, were encountered in portions of the proposed power lines within the natural drainages and mantling the sloping areas (Geosyntec 2012). The composition and strength of these materials are variable depending on the age, parent sources, and mode of deposition.

Topsoil/Colluvium was encountered in all borings and test pits on the proposed Salt Creek Substation site, with the exception of Boring B4, which was placed in the existing access road (Kleinfelder 2008). Topsoil/colluvium is related to natural soil development processes and movement downslope by precipitation and gravity. The topsoil/colluvium materials were generally encountered from the ground surface to depths of approximately 2 to 4 feet. However, colluviums depths of 6, 8, and 10 feet were observed in Test Pits 2, 4, and 7, which are located farther downslope than the other explorations and likely represent greater accumulations of colluviums. As encountered, the topsoil/colluvium consisted of light brown to dark brown, dry to moist, soft to firm, sandy silt, sandy clay, and clayey sand with some organics and pinhole porosity.

***Fill***

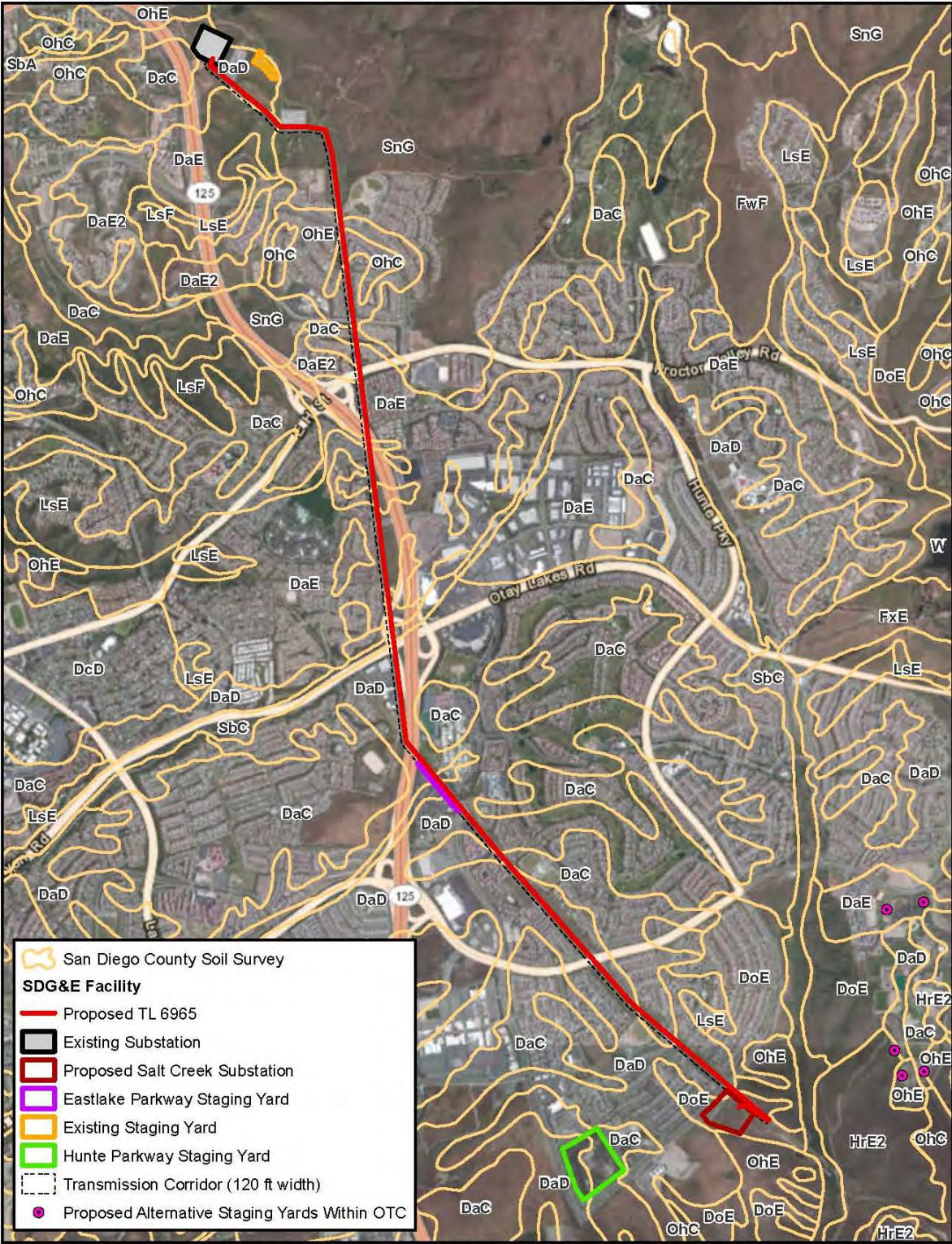
Undocumented fill was encountered during the geotechnical investigation (Kleinfelder 2008). The undocumented fill is generally loose, moist to wet, and consists of silty sand with cobbles and gravel. Fill materials present along portions of the access roads are primarily associated with construction of Hunte Parkway. This material consists of lean clay with some fat clay, which was not observed on the proposed Salt Creek Substation site.

**4.6.3.3 Geologic Units**

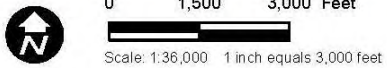
The Peninsular Ranges Geomorphic province is characterized by mountainous terrain on the east composed mostly of Mesozoic igneous and metamorphic rocks, and relatively low-lying coastal terraces to the west underlain by Quaternary, Tertiary, and late Cretaceous-age sedimentary rocks. Most of the coastal region of San Diego County occurs within this coastal terrace and is underlain by sedimentary rock. Specifically, the Proposed Project area in this portion of the province is underlain by Quaternary-age and Tertiary-age (Eocene) sediments. Figure 4.6-2 displays the local geologic area.



Figure 4.6-1: Soils in the Proposed Project Area



Note: The Transmission Corridor refers to the 120-foot SDG&E right-of-way for the proposed TL6965 and the existing TL643 on SDG&E property.  
 Source: GeomorphiS LLC, AECOM, SDG&E, 2013; Soils: NRCS, 2012; Esri/Basemaps, 2013



***Quaternary-Age Terrace Deposits***

Quaternary-age terrace deposits overlie portions of the Otay Formation in the vicinity of the Otay River basin. Sediments generally associated with this formation consist of cobble-gravel-sand mixtures, along with locally cemented zones and sandy to clayey siltstones. Granular portions of these terrace deposits typically exhibit adequate shear strength and low expansive potential in either an undisturbed or properly compacted condition.

***Mission Valley Formation***

The mid Tertiary-age Mission Valley Formation was encountered at the northern limits of the proposed power line during the geotechnical investigation (GEOCON 2011). This material consists of interbedding sandstone, claystone, and siltstone, with various degrees of cementation. The Mission Valley Formation in the area exhibits adequate shear strength. The clayey part of this formation may possess high expansion potential.

***Otay Formation***

The Otay Formation is the predominant geologic unit within the proposed power line (Geosyntec 2012). The Otay Formation consisted of dense to very dense, silty, fine to medium sandstone with occasional siltstone, claystone, and conglomerate interbeds (GEOCON 2011) along the proposed power lines.

The Otay Formation also underlies the proposed Salt Creek Substation site, and was encountered in the geotechnical explorations (Kleinfelder 2008). The Otay Formation typically consists of arkosic sandstone or claystone. For the proposed Salt Creek Substation site, the Otay Formation consisted of light brown and light gray, friable to weakly cemented, coarse-grained sandstone.

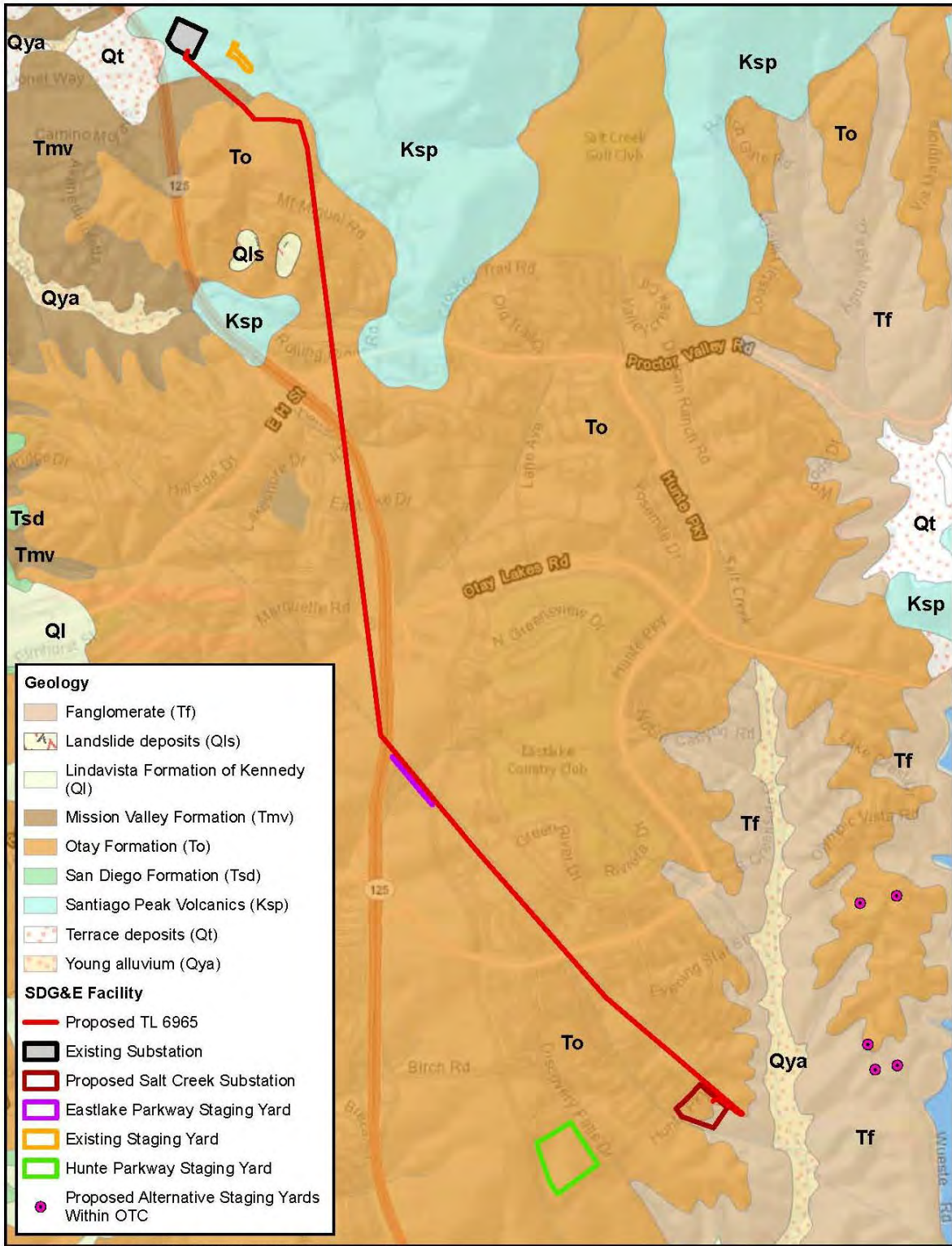
Due to low cementation, this material may also be classified as very dense sand. The proposed Salt Creek Substation site is underlain by the coarse “gritstone” granular facies of the lower Otay Formation. No significant clay beds were observed on the proposed Salt Creek Substation site during the geotechnical explorations (Kleinfelder 2008).

The fanglomerate facies of the Otay Formation was encountered within the southern portion of the proposed power lines during the geotechnical investigation (GEOCON 2011). This material consists of dense, moderately cemented, conglomeratic, clayey sandstones and sandy boulder conglomerates with clasts frequently exceeding 1 to 2 feet. The Otay Formation and fanglomerate facies possess relatively high shear strength parameters.

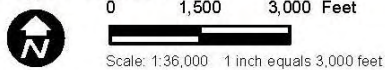
***Santiago Peak Volcanics***

Santiago Peak Volcanics were not encountered during any geotechnical explorations. Cretaceous/Jurassic-age Santiago Peak Volcanics consist of mildly metamorphosed volcanic and meta-sedimentary rock. These materials are generally moderately strong to strong, intensely to slightly weathered, and moderately to slightly jointed.

Figure 4.6-2: Local Geologic Area



Source: GeomorphIS LLC, AECOM, SDG&E, 2013; Esri Basemaps, 2013  
 Geology data: USGS, 2004



Note: SDG&E is providing this map with the understanding that the map is not survey grade.

**4.6.3.4 Faults and Seismicity**

**Faults**

Faults are fractures or lines of weakness in the Earth's crust. Rocks on one side of a fault are offset relative to the same rocks on the other side. Sudden movement along a fault generates an earthquake. Surface faults exhibiting horizontal movement are called strike-slip faults (e.g., Elsinore Fault).

The Proposed Project area is in a seismically active region. The Peninsular Ranges are traversed by a number of major active faults. The Whittier-Elsinore, San Jacinto, and San Andreas Faults are located northeast or east of the proposed Salt Creek Substation site, and the Rose Canyon, Newport-Inglewood, Coronado Bank, and San Diego Trough Faults are located to the west-southwest of the Proposed Project area.

**Seismicity**

The Proposed Project area is located in a seismically active region of Southern California that is subject to significant hazards from moderate to large earthquakes. Major tectonic activity associated with these faults is right-lateral strike-slip movement. The Proposed Project area does not lie within an active Alquist-Priolo Special Studies Zone and is not underlain by a known potentially active fault, as shown in Figure 4.6-3 (CGS 2012a).

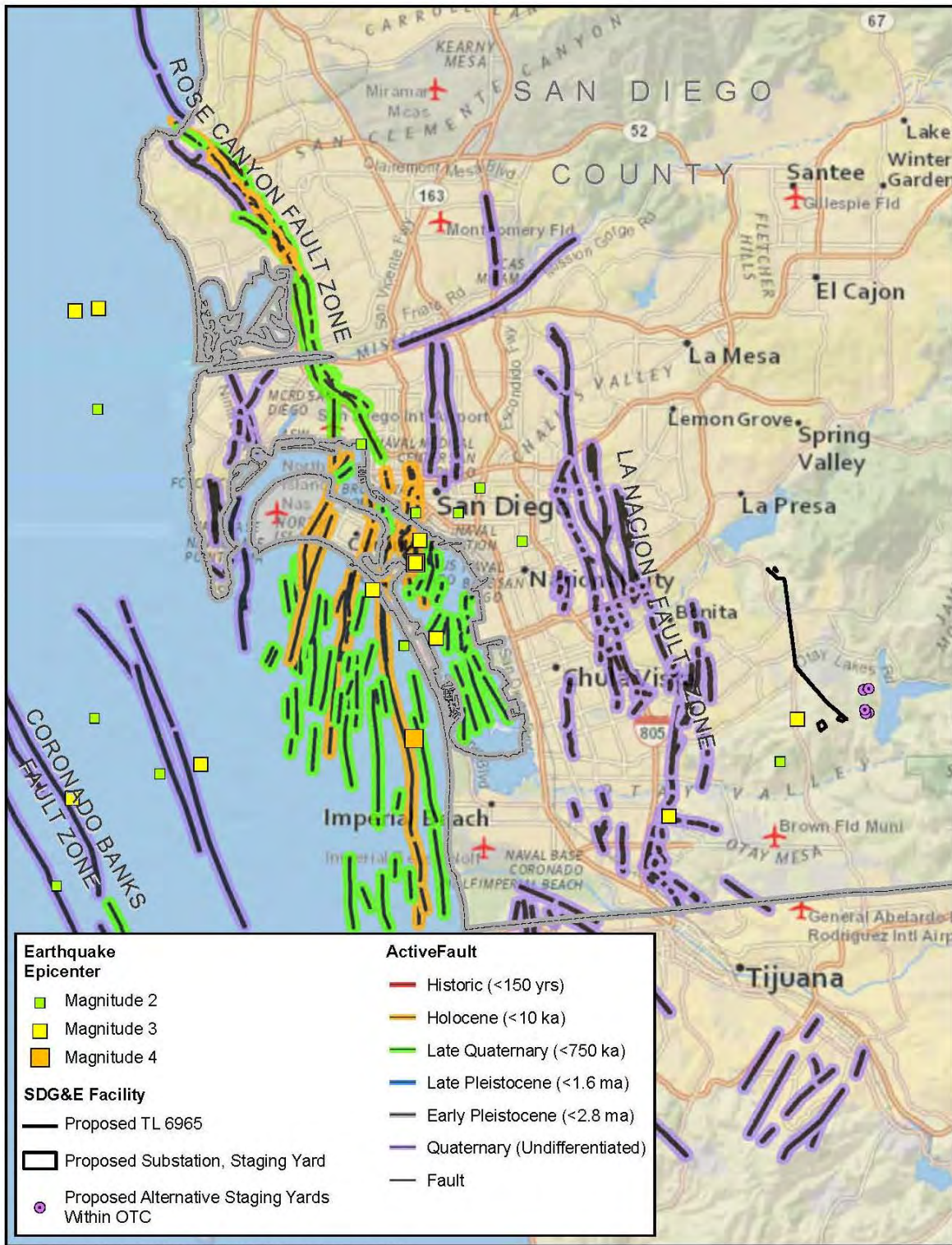
The Rose Canyon Fault zone is the closest mapped active fault zone, located approximately 10 miles west of the Proposed Project area. It is considered the dominant source of potential ground motion at the site.

The most recent major earthquake on the Rose Canyon Fault zone in San Diego occurred sometime between 1523 and 1769, with two additional earthquakes possibly occurring on the offshore segments of the Rose Canyon Fault zone in the 1800s.

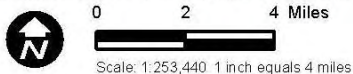
The Rose Canyon Fault zone consists of predominantly right-lateral strike-slip faults that extend south-southeast from La Jolla, bisecting the San Diego metropolitan area. The most significant seismic event likely to affect the Proposed Project area would be a maximum magnitude 7.2 earthquake resulting from the Rose Canyon Fault (Kleinfelder 2008).

A major strand of the La Nacion Fault zone is mapped approximately 3.8 miles west of the proposed Salt Creek Substation site and approximately 2.5 miles west of the proposed power lines. The La Nacion Fault zone is composed of several parallel to subparallel west-dipping normal faults that displace Tertiary and Quaternary deposits. CGS categorizes the La Nacion Fault zone as a potentially active fault zone.

Figure 4.6-3: Fault Zones and Earthquake Magnitudes in the Proposed Project Area



Source: GeomorphIS LLC, AECOM, SDG&E, 2013; Esri Basemaps, 2013  
 Earthquakes: USGS; Faults: California Geological Survey



Note: SDG&E is providing this map with the understanding that the map is not survey grade.

**4.6.3.5 Soil and Geologic Hazards**

***Erosion***

Erosion is the process by which rocks, soil, and other land materials are abraded or worn away from the Earth's surface over time. The erosion rate depends on many factors, including soil type, geologic parent material, slope, soil placement, vegetation, and human activity. As shown in Table 4.6-1, the majority of the Proposed Project area has a T factor that lies between 2 and 3, which is considered low to moderate (NRCS 2012). Less than 1% of the proposed power lines are composed of soils with a T factor of 5, which are highly erosive soils.

***Groundwater***

Groundwater was observed at one location within the alluvium in Boring B-5, located to the west of the proposed power lines near the Otay Lakes/SR-125 exit ramp, at a depth of approximately 11 feet below ground surface (bgs) (Geosyntec 2012). However, this depth of groundwater represents conditions observed at the time of drilling, and would not necessarily be indicative of stabilized water levels at this location. Perched groundwater in the filled drainage to the west of the proposed Salt Creek Substation site may be on the order of 225 to 230 feet in elevation (Kleinfelder 2008). With the exception of Boring B-5, regional groundwater was not encountered in the current or previous explorations performed within the Proposed Project alignment. Regional groundwater generally occurs at 40 feet bgs or greater (Geosyntec 2012; Kleinfelder 2008).

***Expansive and Collapsible Soils***

Expansive soils are characterized by their ability to undergo significant volume changes due to variations in moisture content. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors. Fluctuating moisture content may result in unacceptable settlement or heave of structures or concrete slabs supported on-grade. The majority of near-surface clayey materials are considered expansive and subject to desiccation cracking during cycles of wetting and drying.

In general, soils in the Proposed Project area are not expansive (NRCS 2012). During the geotechnical investigation of the proposed Salt Creek Substation site, a sample of topsoil was tested for expansion using the index Uniform Building Code (UBC) Standard 18-2 (Kleinfelder 2008). The test results indicated an expansion index (EI) of 46, which may be classified in the medium expansion range (less than 50 EI), with the potential for high expansion in some areas. The granular materials of the Otay Formation are present over the majority of the proposed Salt Creek Substation pad, and are considered to have very low to low expansion potential.

Collapsible soils occur as naturally relatively dry alluvial fans, colluviums, and wind-blow deposits. They are typically silt and sand size, with a small amount of clay (Geosyntec 2012). Collapsible soils are not anticipated to be present in significant quantities along the proposed power lines.

### **Fault Rupture**

Surface fault rupture occurs when movement along a fault trace causes displacement of surface deposits. This may result from a large earthquake or from “creep” along a fault without an associated earthquake. Ground rupture is considered more likely along active faults.

The Proposed Project area is not underlain by known active faults that exhibited evidence of ground displacement during the last 11,000 years (Geosyntec 2012). In addition, due to the distance from documented faults and small earthquake magnitudes in the Proposed Project area, as shown in Figure 4.6-3, the possibility of ground rupture in the Proposed Project area is considered low.

### **Ground Motion**

Ground shaking is the seismic effect that causes most structural damage. Several factors control how ground motion interacts with structures. As a result, impact hazards associated with ground shaking are difficult to predict. Seismic waves propagating through the Earth’s crust are responsible for the ground vibrations typically felt during an earthquake. Seismic waves can vibrate in any direction and at different frequencies, depending on the frequency content of the earthquake, its rupture mechanism, the distance from the seismic epicenter, and the path and material through which the waves are propagating.

Active faults are classified as Type A, Type B, or Type C. Type A faults are capable of producing large-magnitude ( $M$ ) events ( $M \geq 7.0$ ) and have a high rate of seismic activity. Type C faults are not capable of producing large-magnitude events ( $M \geq 7.0$ ) and have a relatively low rate of seismic activity. Type B faults are all other faults (not Type A or C). The San Andreas Fault and segments of the San Jacinto and Elsinore Fault zones are Type A. Type B faults are the majority of the rest of the seismic faults in the San Diego area, including the Rose Canyon Fault zone.

Relative to the Proposed Project area, the Rose Canyon Fault zone is the closest active or potentially active fault. Due to its proximity, it is more dominant for ground motion evaluation than the nearest Type A fault zone.

Approximate ground-motion parameters were estimated for both endpoints of the Proposed Project area. These ground-motion parameters are for environmental review purposes and should not be used for engineering design. The parameters are at the northern terminus of the proposed TL 6965 at the Existing Substation and at the proposed Salt Creek Substation site (Table 4.6-2 and Figure 4.6-4) (CGS 2012b).

The ground-motion values presented in Table 4.6-2 represent a 10% probability of being exceeded during a 50-year period. They are expressed as a fraction of the acceleration due to gravity ( $g$ ). Three ground-motion values are shown: peak ground acceleration (PGA), short-period (0.2-second) spectral acceleration ( $S_a$ ), and moderately long period (1.0-second)  $S_a$ . Each ground-motion value is shown for three site conditions: firm rock, soft rock, and alluvium. The Proposed Project area is underlain primarily by soft rock and firm rock at different depths, and possibly some alluvium at the surface.

**Table 4.6-2: Estimated Ground Motion Parameters in the Proposed Project Area**

Ground Motion	Firm Rock (g)	Soft Rock (g)	Alluvium (g)
<b><i>Northern Terminus of TL 6965 – Existing Substation</i></b>			
Peak ground acceleration (PGA)	0.216	0.236	0.276
Spectral acceleration ( $S_a$ ) (0.2-second)	0.509	0.555	0.662
$S_a$ (1.0-second)	0.195	0.247	0.330
<b><i>Salt Creek Substation Site</i></b>			
PGA	0.213	0.232	0.274
$S_a$ (0.2-second)	0.501	0.547	0.654
$S_a$ (1.0-second)	0.191	0.242	0.324

g=acceleration of gravity  
Source: CGS 2012b

### ***Liquefaction***

Liquefaction is a phenomenon in which water-saturated cohesionless sediments, such as sand and silt, temporarily lose their strength and liquefy. This occurs when saturated sediments are subjected to dynamic forces, such as intense and prolonged ground shaking during an earthquake. The factors known to influence liquefaction potential include soil type, relative density, and grain size; confining pressure; depth to groundwater; and the intensity and duration of the seismic ground shaking. Cohesionless soils most susceptible to liquefaction are loose, saturated sands and some silts.

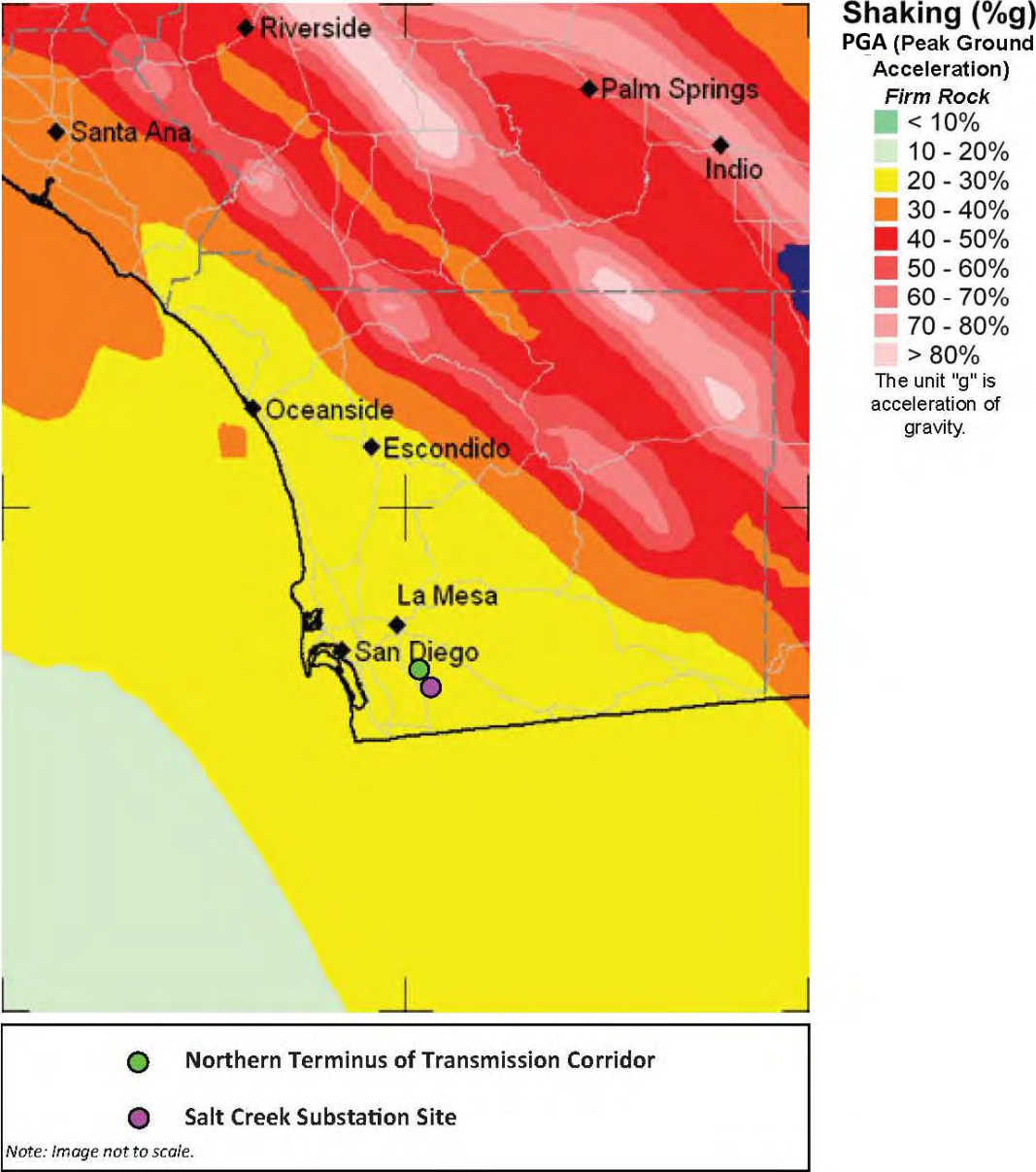
Liquefaction typically occurs when groundwater is shallow (i.e., less than 50 feet bgs) and soils are predominantly granular and unconsolidated. Structures located on or above potentially liquefiable soils may experience vertical settlement due to the temporary loss of foundation support or bearing capacity failures. Liquefaction may also cause lateral spreading and damage to structures.

Due to the relatively dense nature of shallow geologic units, weathered bedrock underlying the proposed power line, and the lack of permanent shallow groundwater, the probability of liquefaction for the Proposed Project is considered low. According to the City of Chula Vista’s General Plan, the Proposed Project area is not located in an area susceptible to liquefaction (City of Chula Vista 2005).

The proposed Salt Creek Substation site is generally underlain by weakly to moderately cemented sandstones or compacted fill. Based on the dense nature of these deposits and the absence of shallow groundwater, liquefaction potential and seismic-related settlement across the proposed Salt Creek Substation site is considered low.



Figure 4.6-4: Ground Motion Parameters



Note: SDG&E is providing this map with the understanding that the map is not survey grade.

***Landslides***

A landslide is defined as the slipping down or flowing of a land mass (rock, soil, and debris) from a mountain or hill. Landslide potential is high in steeply sloped areas underlain by alluvial soils, thinly bedded shale, or clay bedrock formations where the bedding planes are oriented in an out-of-slope direction (bedding plane angles that are greater than horizontal, but less than the slope face), and/or in areas with fracture planes. Major landslides are deep-seated ground failures that occur tens to hundreds of feet deep, in which a large section of a slope detaches and slides downhill.

Landslides can cause damage to structures above and below the slide mass. Several formations within the San Diego region, including the Otay Formation, are particularly prone to landslides. These formations generally have high clay content and mobilize when they are saturated with water. Portions of the Existing Substation were previously identified as being underlain by landslide deposits or possible landslides. In addition, other nearby landslides were previously mapped to the west of the proposed power lines. However, based on review of the available geologic maps and aerial photographs, there are no landslides that have been identified beneath the proposed sites (Geosyntec 2012).

The City of Chula Vista’s General Plan indicates that the Proposed Project area is not located in an area susceptible to landslides (City of Chula Vista 2005). In addition, the Proposed Project area was absent of deep-seated (several tens to hundreds of feet deep) landslides and other landslide factors. Landslide potential is considered low.

***Subsidence***

Subsidence is a deep-seated settlement due to the withdrawal of fluid (oil, natural gas, or water). When fluid is withdrawn, pressure in the drained sediments increases. Compressible sediments are then compacted due to overlying pressures no longer being compensated by hydrostatic pressure from below. The underlying geologic formations in San Diego County are mostly granitic, which has a very low potential for subsidence (County of San Diego 2011).

***Tsunamis and Seiches***

Tsunamis are seismically induced waves generated by sudden movements of the ocean bottom during earthquakes, landslides, or volcanic activity. Seiches are wind- or earthquake-induced “standing waves” within enclosed water bodies, such as bays, lakes, or reservoirs. Based on the inland location of the Proposed Project area and site elevation, potential for tsunami damage is considered very low (Geosyntec 2012). Since the nearest lakes to the Proposed Project area are Lower Otay Lake, approximately 1 mile east of the proposed Salt Creek Substation site, and the Sweetwater Reservoir, approximately 0.85 mile northwest of the Existing Substation, the potential for damage due to a seiche is considered very low (Geosyntec 2012).

#### 4.6.3.6 Regulatory Setting

##### **Federal**

There are no federal regulations applicable to the Proposed Project related to geology, soils, or seismic hazards.

##### **State**

###### *Alquist-Priolo Earthquake Fault Zoning Act*

The 1972 Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) provided for the delineations of rupture zones along active faults in California. The purpose of the Alquist-Priolo Act is to regulate development on or near active fault traces to reduce the hazard of fault rupture and to prohibit the location of structures for human occupancy across active fault traces. Cities and counties must regulate certain development projects within Alquist-Priolo hazard zones, which may include withholding permits until geologic investigations demonstrate that development sites are not threatened by future surface displacement.

###### *Seismic Hazards Mapping Act*

The California Seismic Hazards Mapping Act of 1991 was enacted to protect the public from the effects of strong seismic ground shaking, liquefaction, landslides, or other ground failure, and from other hazards caused by earthquakes. The Seismic Hazards Mapping Act mandates that the state geologist delineate various seismic hazard zones, and requires cities, counties, and other local permitting agencies to regulate certain development projects within these zones.

###### *California Building Code*

The California Building Code (CBC) is a modified version of the UBC, published in the United States by the International Conference of Building Officials. Standards and text were amended to reflect California earthquake conditions. Oversight of the CBC is assigned to the California Building Standards Commission, which, by law, is responsible for coordinating building standards.

##### **Local**

###### *County of San Diego*

The County of San Diego General Plan includes the following applicable policies related to soils and seismic hazards:

**Policy S-7.1:** Locate development in areas where the risk to people or resources is minimized. In accordance with the California Department of Conservation Special Publication 42, require development be located a minimum of 50 feet from active or potentially active faults, unless an alternative setback distance is approved based on geologic analysis and feasible engineering design measures adequate to demonstrate that the fault rupture hazard would be avoided.

**Policy S-7.2:** Require all development to include engineering measures to reduce risk in accordance with the CBC, UBC, and other seismic and geologic hazard safety standards,

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including design and construction standards that regulate land use in areas known to have or potentially have significant seismic and/or other geologic hazards.

**Policy S-7.3:** Prohibit high occupancy uses, essential public facilities, and uses that permit significant amounts of hazardous materials within Alquist-Priolo and county special studies zones.

**Policy S-7.4:** Require the retrofitting of unreinforced masonry structures to minimize damage in the event of seismic or geologic hazards.

**Policy S-7.5:** Seismically retrofit essential facilities to minimize damage in the event of seismic or geologic hazards.

**Policy S-8.1:** Direct development away from areas with high landslide, mudslide, or rock fall potential when engineering solutions have been determined by the county to be infeasible.

**Policy S-8.2:** Prohibit development from causing or contributing to slope instability.

### *City of Chula Vista*

The City of Chula Vista's General Plan includes the following applicable policies related to seismic hazards:

**Policy E-14.1:** To the maximum extent practicable, protect against injury, loss of life, and major property damage through engineering analyses of potential seismic hazards, appropriate engineering design, and the stringent enforcement of all applicable regulations and standards.

**Policy E-14.2:** Prohibit the subdivision, grading, or development of lands subject to potential geologic hazards in the absence of adequate evidence demonstrating that such development would not be adversely affected by such hazards and would not adversely affect surrounding properties.

**Policy E-14.3:** Require site-specific geotechnical investigations for proposals within areas subject to potential geologic hazards, and ensure implementation of all measures deemed necessary by the City Engineer and/or Building Official to avoid or adequately mitigate such hazards.

**Policy E-14.4:** Promote programs to identify un-reinforced masonry buildings and other buildings and structures that would be at risk during seismic events, and promote strengthening of these buildings and structures, where appropriate.

**Policy E-14.5:** Wherever feasible, land uses, buildings, and other structures determined to be unsafe from geologic hazards shall be discontinued, removed, or relocated.

### **4.6.4 Impacts**

#### **4.6.4.1 Significance Criteria**

Standards of significance were derived from Appendix G of the CEQA Guidelines.

Impacts to geology and soils would be considered significant if the Proposed Project:

- exposes people or structures to potential substantial adverse effects involving fault rupture, strong seismic ground shaking, liquefaction, or landslides;
- results in substantial soil erosion or the loss of topsoil;
- is located on a geologic unit or soil that is unstable, or that will become unstable as a result of the Proposed Project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;
- is located on expansive soil, as defined in Table 18-1-B of the UBC (ICBO 1997), creating substantial risks to life or property; and/or
- is located on soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater.

#### **4.6.4.2 Impact Analysis**

##### ***Question 4.6(a)(i) Rupture of a Known Earthquake Fault***

###### **Construction – Less-than-Significant Impact**

Since potential impacts are identical for the multiple Proposed Project components, these components were analyzed together. The Proposed Project would be located in Southern California, an area considered seismically active. However, no known active faults or mapped Alquist-Priolo Earthquake Fault Zones traverse or are in the immediate vicinity of the Proposed Project area. A major strand of the potentially active La Nacion Fault zone is mapped approximately 3.8 miles west of the proposed Salt Creek Substation site and approximately 2.8 miles west of the proposed power lines. The Rose Canyon Fault zone is the closest mapped active fault zone and is located approximately 10 miles west of the Proposed Project area. Therefore, fault rupture hazard is considered very low and impacts would be less than significant.

###### **Operation and Maintenance – Less-than-Significant Impact**

The Proposed Project would be unattended, with operation crews visiting the proposed Salt Creek Substation site for routine maintenance approximately six times per year. Therefore, the potential for personnel to be exposed to fault rupture is minimal and impacts would be less than significant.

##### ***Question 4.6(a)(ii) Strong Seismic Ground Shaking***

###### **Construction – Less-than-Significant Impact**

Since potential impacts are identical for the multiple components of the Proposed Project, these components were analyzed together. The Proposed Project would be located in a seismically active region. Severe ground shaking has the potential to cause harm to structures or human injury; however, due to the short duration of construction (18 to 24 months) and the low probability of a seismic event occurring during this time, the potential for structures and

construction personnel to be exposed to strong seismic ground shaking is minimal. Impacts would be less than significant.

**Operation and Maintenance – Less-than-Significant Impact**

Strong seismic ground shaking could occur during the operational lifetime of the Proposed Project as a result of a moderate or greater earthquake. The Proposed Project, including the proposed Salt Creek Substation structures and foundations, would be designed to withstand strong seismic accelerations in accordance with SDG&E standard design and engineering practices to reduce the potential for damage to occur to the proposed facilities in the event of a major seismic event. The Institute of Electrical and Electronics Engineers’ (IEEE) 693 Recommended Practices for Seismic Design of Substations includes specific requirements to reduce or avoid substation equipment damage. SDG&E follows these requirements. When these recommendations are followed, minimal structural damage from horizontal ground accelerations is anticipated. Incorporation of these standard engineering practices and recommendations would address hazards associated with strong seismic ground shaking. As such, impacts would be less than significant.

Routine maintenance crews would be working on the proposed TL 6965 and TL 6910 loop-in or at the proposed Salt Creek Substation site only periodically throughout the year and for limited periods of time, minimizing the potential for exposure to strong seismic ground shaking during a seismic event if one occurred. Therefore, impacts would be less than significant.

**Question 4.6(a)(iii) Seismic-Related Ground Failure (Including Liquefaction)**

**Construction – Less-than-Significant Impact**

*Salt Creek Substation*

The proposed Salt Creek Substation site is underlain by weakly to moderately cemented sandstones or by compacted fill. Based on the dense nature of these on-site deposits, as well as the absence of a shallow groundwater in those areas, liquefaction potential and seismic-related settlement across the proposed Salt Creek Substation site is low. According to the City of Chula Vista’s General Plan, the proposed Salt Creek Substation site is not located in an area susceptible to liquefaction (City of Chula Vista 2005). Due to the short duration of construction (18 to 24 months) and the low probability of a seismic event occurring during this time, the potential for construction personnel to be exposed to seismic-related ground failure is minimal. As such, impacts would be less than significant.

*TL 6965 and TL 6910 Loop-In*

Due to the relatively dense nature of the geologic units, weathered bedrock underlying the proposed TL 6965 and TL 6910 loop-in, and the lack of permanent groundwater, liquefaction probability is considered low (Geosyntec 2012). According to the City of Chula Vista’s General Plan, the proposed power line would not be located in an area susceptible to liquefaction (City of Chula Vista 2005). Therefore, impacts would be less than significant.

*Existing Substation Modifications*

The Existing Substation is underlain by weakly to moderately cemented sandstones or by compacted fill. According to the City of Chula Vista's General Plan, the Existing Substation is not located in an area susceptible to liquefaction (City of Chula Vista 2005). Therefore, impacts would be less than significant.

*Staging Yards*

According to the City of Chula Vista's General Plan, the staging yards are not located in an area susceptible to liquefaction (City of Chula Vista 2005). Therefore, impacts would be less than significant.

**Operation and Maintenance – Less-than-Significant Impact**

Although unlikely, seismic-induced ground failure could occur during the operational lifetime of the Proposed Project as a result of a moderate or greater earthquake. However, the proposed Salt Creek Substation site is not located in an area susceptible to liquefaction, and all Proposed Project structures would be designed and constructed in accordance with the latest version of the CBC, the UBC, and all other applicable federal, state, and local codes relative to seismic criteria. With adherence to all applicable building codes and design requirements, impacts would be less than significant.

Routine maintenance crews would be working on the proposed TL 6965 and TL 6910 loop-in or proposed Salt Creek Substation site only periodically throughout the year and for limited periods of time, minimizing the potential for exposure to liquefaction or seismic-related ground failure during a seismic event if one occurred. Therefore, impacts would be less than significant.

**Question 4.6(a)(iv) Landslides**

**Construction – Less-than-Significant Impact**

*Salt Creek Substation*

Several formations within the San Diego region are particularly prone to landslides. These formations generally have high clay content and mobilize when they are saturated with water. According to the City of Chula Vista's General Plan, the Proposed Project area is not located in an area susceptible to landslides (City of Chula Vista 2005). In addition, the proposed Salt Creek Substation site lacks deep-seated (several tens to hundreds of feet deep) landslides and other landslides factors. As such, impacts would be less than significant.

The proposed Salt Creek Substation would include construction of retaining walls to widen the existing sewer access road. To ensure that the proposed Salt Creek Substation is designed to minimize the risk from geological hazards, including landslides, the Proposed Project would implement the design features presented in the geotechnical reports. The engineering geotechnical reports provide geotechnical and structural design specifications that meet existing building code requirements and incorporate design measures that address site-specific geological conditions. As such, impacts would be less than significant.

### *TL 6965 and TL 6910 Loop-In*

Nearby landslides were previously mapped to the west of the proposed power lines. However, based on review of the available geologic maps and aerial photographs, no landslides were identified under the proposed power lines (Geosyntec 2012). In addition, the Proposed Project would adhere to the design features stated in the geotechnical reports; therefore, impacts would be less than significant.

### *Existing Substation Modifications*

Portions of the Existing Substation were previously identified as being underlain by landslide deposits or possible landslides (Geosyntec 2012). However, the Proposed Project would adhere to the design features stated in the geotechnical reports. Therefore, impacts would be less than significant.

### *Staging Yards*

The City of Chula Vista's General Plan indicates that the Proposed Project area is not located in an area susceptible to landslides (City of Chula Vista 2005). In addition, the staging areas lacked deep-seated (several tens to hundreds of feet deep) landslides and other landslide factors. As such, impacts would be less than significant.

### **Operation and Maintenance – Less-than-Significant Impact**

Activities associated with operation and maintenance of the Proposed Project would not expose people or equipment to additional hazards related to landslides. Impacts from landslides would be less than significant.

### ***Question 4.6(b) Substantial Soil Erosion or the Loss of Topsoil***

#### **Construction – Less-than-Significant Impact**

##### *Salt Creek Substation*

The Proposed Project would not result in substantial soil erosion or loss of topsoil. As shown in Table 4.6-1, the proposed Salt Creek Substation site has a T factor of 3, which is considered moderate (NRCS 2012). The Proposed Project would require significant grading, as discussed in Section 3.6. During construction, grading would expose soils for a limited time, allowing for possible erosion, although the temporary nature of the soil exposure would not be expected to cause substantial erosion. Rain and wind may further contribute to the erosion of disturbed soils, which may be transported to off-site locations or off-site water bodies. However, the Proposed Project would implement the design measures included in the SWPPP and SDG&E's Water Quality Construction BMP Manual. Therefore, impacts would be less than significant.

##### *TL 6965 and TL 6910 Loop-In*

As shown in Table 4.6-1, the majority of the proposed power lines have a T factor between 2 and 3, which is considered low to moderate (NRCS 2012). Approximately 0.5% of the proposed power lines are composed of soils with a T factor of 5, which have a high potential for erosion. During construction, grading would expose soils for a limited time, allowing for possible



erosion, although the temporary nature of the soil exposure would not be expected to cause substantial erosion. Rain and wind may further contribute to the erosion of disturbed soils, which may be transported to off-site locations or off-site water bodies; however, with the implementation of design measures included in the SWPPP and SDG&E's Water Quality Construction BMP Manual, the potential for erosion or loss of topsoil would be less than significant.

#### *Existing Substation Modifications*

As shown in Table 4.6-1, the majority of the Existing Substation has a T factor between 2 and 3, which is considered low to moderate (NRCS 2012). With implementation of the design measures included in the SWPPP and SDG&E's Water Quality Construction BMP Manual, the potential for erosion or loss of topsoil would be less than significant.

#### *Staging Yards*

The majority of the Hunte Parkway staging yard, Eastlake Parkway staging yard, Existing Substation staging yard, and potential staging sites at the Olympic Training Center have a T factor between 2 and 3, which is considered low to moderate (NRCS 2012). With implementation of the design measures included in the SWPPP and SDG&E's Water Quality Construction BMP Manual, the potential for erosion or loss of topsoil would be less than significant.

### **Operation and Maintenance – Less-than-Significant Impact**

Long-term operation and maintenance of the proposed Salt Creek Substation would generally not involve ground-disturbing activities or grading. If additional grading were required for maintenance, SDG&E would implement the measures provided in SDG&E's BMP Manual, including installation of silt fences, fiber rolls, and gravel bags, in addition to landscaping. To minimize further ground disturbance and potential resultant soil erosion or loss of topsoil, maintenance vehicles would use access roads and would not disturb undeveloped lands. No large areas of exposed soils subject to erosion would be created or affected by operation of the Proposed Project. As such, impacts would be less than significant.

#### ***Question 4.6(c) Geologic Unit Instability***

### **Construction – Less-than-Significant Impact**

#### *Salt Creek Substation*

The majority of the existing and proposed site slopes are considered stable due to their planned inclinations, strength of subsurface materials, and lack of adverse bedding. The proposed Salt Creek Substation site, along with all of Southern California, is subject to seismic shaking due to earthquakes; however, implementation of required engineering design features would ensure that all structures and proposed Salt Creek Substation components are engineered to withstand strong ground movement. The proposed Salt Creek Substation site is not at risk for impacts related to landslides or liquefaction. The proposed Salt Creek Substation site is not located in an area likely to be subject to subsidence because construction and/or operation and maintenance

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activities would not involve withdrawal of substantial amounts of groundwater that could result in subsidence. The proposed Salt Creek Substation would be located on relatively flat terrain, and Proposed Project design includes construction of a retaining wall for the existing sewer access road improvements to reduce the potential for on-site slope failure, which is considered to be low. As a result, impacts would be less than significant.

### *TL 6965 and TL 6910 Loop-In*

The majority of the existing and proposed site slopes are considered stable due to their planned inclinations, strength of subsurface materials, and lack of adverse bedding. No impacts would occur.

### *Existing Substation Modifications*

The majority of the existing and proposed site slopes are considered stable due to their planned inclinations, strength of subsurface materials, and lack of adverse bedding. The Existing Substation, along with all of Southern California, is subject to seismic shaking due to earthquakes; however, implementation of required engineering design features would ensure that all structures and Proposed Project components are engineered to withstand strong ground movement. Impacts would be less than significant.

### *Staging Yards*

The majority of the existing and proposed site slopes are considered stable due to their planned inclinations, strength of subsurface materials, and lack of adverse bedding. The staging yards, along with all of Southern California, are subject to seismic shaking due to earthquakes; however, no construction would occur within the staging yards, which would be used for the storage of construction materials and equipment during construction of all of the Proposed Project components. Therefore, impacts would be less than significant.

### **Operation and Maintenance – Less-than-Significant Impact**

Site conditions and potential hazards related to landslides, liquefaction, lateral spreading, and subsidence would not change as a result of operation and maintenance activities of the Proposed Project; therefore, impacts would be less than significant.

### **Question 4.6(d) Expansive Soils**

#### **Construction – No Impact**

The potential for encountering expansive or collapsible soils within the Proposed Project area is relatively low. However, a sample of topsoil near the proposed Salt Creek Substation site tested for expansion indicated an EI of 46, which may be classified in the medium expansion range (less than 50 EI), with the potential for high expansion in some areas. The geotechnical investigation prepared for the Proposed Project recommends that existing potentially compressible soils within the limits of site grading be removed to native formation prior to the placement of engineered fill materials (Kleinfelder 2008). Expansive soils with an EI greater than 50 may be blended with other granular soils and used as embankment fill. Expansive soils may also be used as deeper compacted fill in non-structural areas, but they may not be placed in the

outer portion of fill slopes, which is defined as the outer 15 feet from the slope or the height of the slope, whichever is less. SDG&E would comply with the geotechnical recommendations. Therefore, no impacts from expansive soils would occur during construction.

**Operation and Maintenance – No Impact**

Improved site conditions and the removal of expansive soils during construction, as noted above, would not change as a result of operation and maintenance activities of the Proposed Project; therefore, no impacts would occur.

**Question 4.6(e) Septic Tanks or Alternative Wastewater Disposal Systems**

**Construction – No Impact**

The proposed Salt Creek Substation would not include toilet facilities or result in new or increased demand for the use of septic tanks or alternative wastewater disposal systems. Self-contained portable toilet facilities would be provided during construction. Therefore, no impact would occur.

**Operation and Maintenance – No Impact**

The Proposed Project would be unattended. No septic tanks or alternative wastewater disposal systems (e.g., leach fields) are part of the Proposed Project. As such, the proposed Salt Creek Substation would not include toilet facilities or result in new or increased demand for the use of septic tanks or alternative wastewater disposal systems; therefore, no impact would occur.

**4.6.5 Project Design Features and Ordinary Construction/Operations Restrictions**

With implementation of the ordinary construction restrictions as outlined within Section 3.8, Project Design Features and Ordinary Construction/Operations Restrictions; Proposed Project design features; and applicable engineering standard transmission line practices and guideline recommendations as identified in the geotechnical reports (GEOCON 2011; Geosyntec 2012; Kleinfelder 2008; URS 2007), potential impacts to geology and soils would be less than significant.

**4.6.6 Applicant-Proposed Measures**

The Proposed Project’s impacts on geology and soils would be less than significant; therefore, no APMs are required or proposed.

**4.6.7 Detailed Discussion of Significant Impacts**

Based on the above analyses, no significant impacts have been identified for the Proposed Project, and no APMs are required or proposed.

**4.6.8 References**

- California Geologic Survey (CGS). 2012a. Alquist-Priolo Earth Quake Fault Zones. Available at [http://www.consrv.ca.gov/CGS/rghm/ap/Map\\_index/F4F.htm](http://www.consrv.ca.gov/CGS/rghm/ap/Map_index/F4F.htm). Accessed September 18, 2012.
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