D.5 GEOLOGY, SOILS, AND PALEONTOLOGY

Section D.5.1 provides a summary of existing geological, soil, and paleontological conditions and associated geologic and seismic hazards. Applicable regulations, plans, and standards are listed in *Section D.5.2*. Potential impacts and mitigation measures for the Proposed Project are presented in *Section D.5.3;* and alternatives are described and discussed in *Section D.5.4*. Mitigation monitoring, compliance, and reporting are discussed in *Section D.5.5.*

D.5.1 Environmental Setting for the Proposed Project

This section presents a discussion of the regional topography, geology, seismicity, soils, and mineral and paleontological resources in the project area. Baseline geologic information was collected from published and unpublished geologic, seismic, and geotechnical literature covering the Proposed Project alignment and the surrounding area. This was accomplished by conducting review of SDG&E's PEA (March 2004), SDG&E's Supplemental Application No. 2 (July 2004), the Potential Fault and Seismic Impacts Underground Transmission Line Report prepared for SDG&E by Ninyo & Moore, October 2004 as well as other supporting documents submitted by SDG&E for this Project. Review of SANDAG and City of San Diego geologic maps, and other relevant documents was also performed.

D.5.1.1 Regional Topographical and Geologic Setting

The project alignment is located in the southern part of the Peninsular Ranges Geomorphic Province of southern California. This province extends from south of the U.S. – Mexico border northward to the southern mountain front of the Transverse Ranges (just north of Los Angeles) (Norris and Webb, 1990). The province is bounded on the east by the Colorado Desert province. The landscape in the eastern and central part of the project area is defined by fault-block mountains separated by alluvium-filled valleys. Wide, sand- and boulder-filled river washes cut through the mountains and across the valleys in this part of the project area. The western portions of the province are characterized by the coastal plain which consists of numerous marine and non-marine terraces, which are dissected by stream valleys.

<u>Topography</u>

The project alignment traverses diverse topography ranging from rugged to steep slopes between the Sycamore Canyon Substation to Fanita Junction to virtually flat adjacent to San Diego Bay. As shown in *Table D.5-1,* elevations along the proposed alignment range from approximately 550 – 1,050 feet above mean sea level (msl) between the Sycamore Canyon Substation and Fanita Junction to approximately 10 - 30 feet msl adjacent to San Diego Bay.

TABLE D.5-1
ELEVATIONS ALONG THE OMPPA TRANSMISSION PROJECT
(feet above mean sea level)

Location / Elevation		Terrain/Elevation Ranges
Sycamore Canyon Substation	(400 ft)	Flat
Fanita Junction	(700 ft)	***Sycamore Canyon to Fanita Junction:*** rugged, steep (mile-post 0 to 4) elevation ranges 550 – 1,050 ft.
Miguel Substation	(500 ft)	Gentle northeast slope
South Bay Power Plant	(20 ft)	***Miguel to South Bay Power Plant:*** gentle slopes to flat coastal plain (mile-post 28 – 38) elevation ranges 50 – 600 ft
Sicard Street	(20 ft)	***South Bay Power Plant to Sweetwater River to Sicard Street:*** flat near shoreline (mile-post 38 – 45) elevation ranges 10 – 30 ft
Old Town Substation	(50 ft)	***Sicard Street to Old Town:*** gentle slope (mile-post 45 to 52) elevation ranges 20 -70 ft.

Geology

The geologic units anticipated to be encountered during construction of the Proposed Project are summarized in *Table D.5-2.*

TABLE D.5-2
GENERAL DESCRIPTIONS AND CHARACTERISTICS OF THE GEOLOGIC FORMATIONS

Symbol	Unit Name	Age	Description
Af	Artificial fill	Recent	Documented or undocumented soil of variable composition and compaction.
Qs	Shore deposits	Recent	Unconsolidated silt and clay deposits transported by currents within the bay.
Qa	Alluvium and slope wash	Recent	Silt, sand, and gravel deposited in active or abandoned stream channels and at the base of slopes.
Qt	Terrace deposits	Holocene	Thin layers of sand and gravel on elevated erosional surfaces.
Qbp	Bay Point Formation	Late Pleistocene	Marine poorly consolidated fine- to medium-grained fossiliferous sandstone interfingered with non-marine silts and sands. Deposited on lower erosional bench of The San Diego Formation. Abundant shells.
Ql	Linda Vista Formation	Early Pleistocene	Marine and non-marine moderate red-brown sandstone and conglomerate. Deposited on a 10-kilometer-wide bench on San Diego Formation. Some fossils.

TABLE D.5-2
GENERAL DESCRIPTIONS AND CHARACTERISTICS OF THE GEOLOGIC FORMATIONS

Symbol	Unit Name	Age	Description
Tsd	San Diego Formation	Pliocene	Generally yellow-brown, poorly consolidated sandstone and conglomerate with rare bentonite beds. Abundant fossils..
To	Otay Formation (Sweetwater Formation)	Oligocene to Miocene	Poorly cemented, massive, light colored sandstone, siltstone, and claystone with bentonite interbeds. Includes fossil-rich beds.
Tp	Pomerado Conglomerate	Eocene	Uppermost member of the Poway Group. Massive cobble conglomerate with occasional interbeds and lenses of sandstone. Fossiliferous lenses.
Tmv	Mission Valley Formation	Eocene	Friable marine sandstone: light olive gray. Often fossiliferous. Interbeds of sandstone.
Tst	Stadium Conglomerate	Eocene	Lowest member of Poway Group. Massive cobble conglomerate similar to the Pomerado Conglomerate. Lenses of cross-bedded fossiliferous sandstone.
Tf	Friars Formation	Eocene	Poorly indurated non-marine and near-shore claystone and sandstone with cobble conglomerate lenses. Source of numerous recent landslides. Includes layers with significant Eocene land-mammal fossils.
Kg	Granitic Rocks	Cretaceous	Mostly dark-colored, coarse-grained granodiorite, tonolite, and gabbro. Highly weathered at most exposures. Non-fossiliferous.
KJmv	Santiago Peak Formation	Jurassic to Cretaceous	Moderately altered volcanic and sedimentary rocks. Marine invertebrate fossils have been found in sedimentary beds north of the project area.

Sources: SDG&E 2004, Kennedy, 1975; Kennedy and Siang, 1977; California Geological Survey, 2003.

Soils

A variety of soil types occur in the large, diverse area of the project area. The soil types associated with granitic rock in the project area are highly susceptible to erosion due to the large, loose grains generated by the weathering of crystalline granite. Erodible soils generally correspond to those on the hillsides and mountains where granitic bedrock is close to or at the surface (SCS, 1973). Soils with a high potential for shrink-swell generally correspond to the areas where the younger flat-lying sediments occur where weathering of the parent rock material creates clay, such as in areas of metavolcanic rocks. Soils with high potential for shrink-swell occur where young sedimentary rocks exist along the proposed alignment. Soils with moderate potential for shrink-swell occur where the project alignment crosses metamorphic rocks. The areas with sandy soils over granitic rocks of the alignment have low shrink-swell potential.

Seismicity

Earthquake activity, also known as seismicity, is common throughout the southern California region. Most earthquakes in this region occur along active faults. Southern California is dominated by a major tectonic structure delineated as the San Andreas Fault. The San Andreas Fault trends along a roughly northwest/southeast alignment and is located 80 miles northeast of the study area. The San Andreas Fault Zone delineates the boundary between two global tectonic plates known as the North American Plate and Pacific Plate. The Pacific Plate occupies the area west of the San Andreas Fault. Other active faults in the region include the San Jacinto Fault (50 miles NE), the Elsinore Fault (30 miles NE), the Coronado Bank Fault Zone (20 miles SW, offshore) and the Rose Canyon Fault Zone which crosses the project alignment (see *Figure D.5-1*). An active fault, as defined by the CDMG, is a fault that has exhibited "surface displacement within Holocene time" (about the last 11,000 years). The state of California has established Alquist-Priolo Special Studies Zone (A-P Zone) along and parallel to traces of active faults for the purpose of prohibiting the location of structures on the traces of such faults. As shown on *Figure D.5-1*, the project alignment crosses an established Alquist-Priolo Earthquake Fault Zone associated with the Rose Canyon Fault in the vicinity of mile-post 46.

Table D.5-3 lists several aspects of active faults in the study region, including: maximum earthquake magnitude (M); associated maximum peak site acceleration (g); and Modified Mercalli site intensity (MM) which qualifies earthquake intensities in terms of potential effects on people and structures (see *Table D.5-4*). The maximum credible peak acceleration values are based on the attenuation relationships of Campbell and Bozorgnia (1994). A maximum credible event is considered the maximum magnitude capable for a fault given its specific size, configuration and tectonic framework.

TABLE D.5-3
ACTIVE FAULTS IN THE STUDY AREA

Fault Name	Distance from Fault to Project Alignment	Maximum Earthquake Magnitude (M)	Peak Horizontal Ground Acceleration (g)	Estimated Site Intensity Modified Mercalli (MM)
Elsinore – Julian Segment	30	7.1	0.41	X
San Jacinto – San Jacinto Valley	50	6.9	0.09	VII
Rose Canyon	0	6.9	0.08	VII
San Andreas – Southern	80	7.4	0.06	VI
Coronado Bank	20	7.4	0.06	VI

Source: USGS (1980); Greensfelder 1974; Seed and Idress 1982.

Figure D.5-1 Geologic Hazards Map

TABLE D.5-4
THE MODIFIED MERCALLI SCALE OF EARTHQUAKE INTENSITIES

If most of these effects are observed	*Then the intensity is*
Earthquake shaking not felt but people may observe marginal effects of large distance earthquakes without identifying these effects as earthquake-caused. Among them: trees, liquids, bodies of water sway slowly, or doors swing slowly.	I
Effect on people: Shaking felt by those at rest, especially if they are indoors, and by those on upper floors.	II
Effect on people: Felt by most people indoors. Some can estimate duration of shaking but many may not recognize shaking of building as caused by an earthquake; the shaking is like that caused by the passing of light trucks.	III
Other effects: Hanging objects swing. **Structural effects:** Windows or doors rattle. Wooden walls and frames creak.	IV
Effect on people: Felt by everyone indoors and by most people outdoors. Many now estimate not only the duration of shaking but also its direction and have no doubt as to its cause. Sleepers wakened. **Other effects:** Hanging objects swing. Standing autos rock. Crockery clashes, dishes rattle or glasses clink. **Structural effects:** Doors close, open or swing. Windows rattle.	V
Effect on people: Felt by everyone indoors and by most people outdoors. Many now estimate not only the duration of shaking but also its direction and have no doubt as to its cause. Sleepers wakened. **Other effects:** Hanging objects swing. Shutters or pictures move. Pendulum clocks stop, start, or change rate. Standing autos rock. Crockery clashes, dishes rattle or glasses clink. Liquids disturbed, some spilled. Small unstable objects displaced or upset. **Structural effects:** Weak plaster and Masonry D* crack. Windows break. Doors close, open, or swing.	VI
Effect on people: Felt by everyone. Many are frightened and run outdoors. People walk unsteadily. **Other effects:** Small church or school bells ring. Pictures thrown off walls, knicknacks and books off shelves. Dishes or glasses broken. Furniture moved or overturned. Trees, bushes shaken visibly, or heard to rustle. **Structural effects:** Masonry D* damaged; some cracks in Masonry C*. Weak chimneys break at roof line. Plaster, loose bricks, stones, tiles, cornices, unbraced parapets, and architectural ornaments fall. Concrete irrigation ditches damaged.	VII
Effect on people: Difficult to stand. Shaking noticed by auto drivers. **Other effects:** Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Furniture broken. Hanging objects quiver. **Structural effects:** Masonry D* heavily damaged; Masonry C* damaged, partially collapses in some cases; some damage to Masonry B*; none to Masonry A*. Stucco and some masonry walls fall. Chimneys, factory stacks, monuments, towers, elevated tanks twist or fall. Frame houses move don foundation if not bolted down; loose panel walls thrown out. Decayed piling broken off.	VIII

TABLE D.5-4
THE MODIFIED MERCALLI SCALE OF EARTHQUAKE INTENSITIES

If most of these effects are observed	*Then the intensity is*
Effect on people: General fright. People thrown to ground. **Other effects:** Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes. Steering of autos affected. Branches broken from trees. **Structural effects:** Masonry D* destroyed; Masonry C* heavily damaged, sometimes with complete collapse; Masonry B* is seriously damaged. General damage to foundations. Frame structures, if not bolted, shifted off foundations. Frames cracked. Reservoirs seriously damaged. Underground pipes broken.	IX
Effect on people: General panic. **Other effects:** Conspicuous cracks in ground. In areas of soft ground, sand is ejected through holes and piles up into a small crate, and, in muddy areas, water fountains are formed. **Structural effects:** Mast masonry and frame structures destroyed along with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, and embankments. Railroads bent slightly.	X
Effect on people: General panic. **Other effects:** Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. **Structural effects:** General destruction of buildings. Underground pipelines completely out of service. Railroads bent greatly.	XI
Effect on people: General panic. **Other effects:** Same as for Intensity X. **Structural effects:** Damage nearly total, the ultimate catastrophe. **Other effects:** Large rock masses displaced. Lines of sight and level distorted. Objects thrown into air.	XII
* Masonry A: Good workmanship and mortar, reinforced, designed to resist lateral forces. * Masonry B: Good workmanship and mortar, reinforced. * Masonry C: Good workmanship and mortar, unreinforced. * Masonry D: Poor workmanship and mortar and weak materials, like adobe.	

The Rose Canyon Fault Zone is the nearest significant seismic hazard to the project. The Rose Canyon Fault Zone is comprised predominantly of right lateral strike-slip faults that extend southeast, bisecting the San Diego metropolitan region. Portions of the Rose Canyon Fault Zone in downtown areas of San Diego have been designated by the State of California as an Alquist-Priolo Earthquake Fault Zone. The Rose Canyon Fault has been characterized by the State as capable of a magnitude (Mw) 6.9 earthquake. An earthquake associated with the Rose Canyon Fault Zone could result in a Modified Mercalli intensity of VII.

D.5.1.2 Geologic Hazards

Fault Rupture

Fault rupture refers to the physical displacement of surface deposits in direct response to movement along a fault. Ground surface displacement is perhaps the most important single factor to be considered in the seismic design of electric transmission lines and underground cables crossing active faults. Other secondary effects related to fault movement, such as ground shaking, liquefaction, and landslides, are discussed below. As discussed previously and shown in *Figure D.5-1,* the proposed alignment crosses three inferred buried traces of the Rose Canyon Fault along Sherman Street between Anna Street and Morena Boulevard. South of the San Diego River, the alignment is located roughly 400 feet to 1,000 feet west of inferred fault traces for a distance of approximately two miles. The alignment crosses inferred buried fault traces near Pacific Highway and Sutherland Street and along Harbor Drive near 1st Avenue and 2nd Avenue. The alignment crosses a State of California Earthquake Fault (Alquist-Priolo) Special Study Zone along Harbor Drive from approximately 1,000 feet southeast of 8th Avenue to approximately Crosby Street (Ninyo & Moore, 2004).

Because the alignment crosses potential fault traces, there is the potential for fault rupture to occur along the alignment. Based on published estimated slip rates and return intervals for the Rose Canyon Fault, the offset expected for individual segments of the Rose Canyon Fault in low potential liquefiable areas is estimated to be on the order of three to six feet. The portions of the alignment that cross mapped faults that are considered to be of low potential for liquefaction and would thus be potentially subject to fault rupture would be along Harbor Drive near 1st and 2nd Streets and along Harbor Drive from approximately 1,000 feet southeast of 8th avenue to approximately Crosby Street. Where the alignment crosses liquefiable areas, fault rupture would likely not extend to the ground surface, but would be absorbed by the relatively loose deposits or would cause the near surface soils to liquefy (Ninyo & Moore, 2004).

Liquefaction

Liquefaction is a phenomenon in which loose, saturated, granular soil deposits lose shear strength and mobilize as a result of increased pore water pressure induced by strong ground shaking during an earthquake. Structures founded on or above potentially liquefiable soil may experience settling (both total and differential) and loss of foundation support. The factors known to influence liquefaction potential include soil type, grain size, relative density, confining pressure, depth to ground water and the intensity and duration of ground shaking. Soils most susceptible to liquefaction are saturated, loose, sandy soils and some silts. Liquefaction generally occurs in areas of high groundwater (depths of 50 feet or less). As shown in *Figure D.5-1,* such conditions occur in the project area along Anna Street, Sherman Street, and Napa Street north of the San Diego River and for the majority of the alignment within Pacific Highway north of Market Street, and along the San Diego Bay between project alignment mile-posts 38 and 51. The potential for liquefaction and seismically induced settlement along the proposed alignment between mile-posts 38 and 51 based on the design earthquake is considered moderate to high.

Subsidence/Differential Settlement

Land subsidence due to mechanisms such as removal of groundwater, oil or gas, compaction of unconsolidated sediments, or tectonic lowering, is not documented as occurring along the project alignment. Unconsolidated or weakened geologic units along the project may be subject to differential settlement. These include areas underlain by alluvium, recent shoreline deposits, existing landslides, and highly weathered rock.

Slope Instability

Slope instability has the potential to undermine foundations and cause distortion and distress to overlying structures. Slope failures include landslides, slumps, mudflows, debris flows, block failures and rock falls. Gravitational and erosional forces that can cause a variety of modes of slope failure act continuously upon slopes. Potential hazards associated with slope instability, mudflows, debris flows and rock falls generally increase with steeper slopes and are considered to be potential hazards in the study area, particularly in areas consisting of the Friars Formation. The proposed alignment crosses steep slopes underlain by the Friars Formation between mile-posts 0 and 4.

D.5.1.3 Mineral Resources

Sand and gravel deposits occur in the vicinity of mile-posts 0 to 4 where the alignment crosses several washes. No other mineral resources occur within the proposed alignment.

D.5.1.4 Paleontology

Determination of the "significance" of a fossil can only occur after a fossil has been found and identified by a qualified paleontologist. Until then, the actual significance is unknown. The most useful designation for paleontological resources in an EIR document is the "sensitivity" of a particular geologic unit. Sensitivity refers to the likelihood of finding significant fossils within a geologic unit. In California, fossils of land-dwelling vertebrates are considered significant.

The following levels of sensitivity recognize the important relationship between fossils and the geologic formations within which they are preserved.

- **High Sensitivity.** High sensitivity is assigned to geologic formations known to contain paleontological localities with rare, well-preserved, an/or critical fossil materials for stratigraphic or paleo-environmental interpretation, and fossils providing important information about the paleobiology and evolutionary history (phylogeny) of animal and plant groups. Generally speaking, highly sensitive formations are known to produce or have the potential to produce vertebrate fossil remains.

- **Moderate Sensitivity.** Moderate sensitivity is assigned to geologic formations known to contain paleontological localities with moderately preserved, common elsewhere, or stratigraphically long-ranging fossil material. The moderate sensitivity category is also applied to geologic formations that are judged to have a strong, but unproven potential for producing important fossil remains (e.g., pre-Holocene sedimentary rock units representing low to moderate energy, of marine to non-marine depositional settings).

- **Low Sensitivity.** Low sensitivity is assigned to geologic formations that, based on their relative youthful age and/or high energy depositional history, are judged unlikely to produce important fossil remains. Typically, low sensitivity formations may produce invertebrate fossil remains in low abundance.

- **Marginal Sensitivity.** Marginal sensitivity is assigned to geologic formations that are composed either of pyroclastic volcanic rocks or metasedimentary rocks, but which nevertheless have a limited probability for producing fossil remains from certain sedimentary lithologies at localized outcrops.

- **Zero Sensitivity.** Zero sensitivity is assigned to geologic formations that are entirely plutonic (volcanic rocks formed beneath the earth's surface) in origin and therefore have no potential for producing fossil remains.

High to moderate paleontologically sensitive geologic units along the proposed project alignment occur between mile-posts 0 and 4 in the Stadium Conglomerate and Friars Formation, along mile-posts 28 to 38 in the Otay Formation, Mission Valley Formation, and San Diego Formation and between mile-posts 45 and 52 in the Bay Point Formation, shore deposits and alluvium and slope wash.

D.5.2 Applicable Regulations, Plans and Standards

Geologic resources and geotechnical hazards are governed primarily by local jurisdictions. The conservation elements and seismic safety elements of city and county general plans contain policies for the protection of geologic features and avoidance of hazards, but do not specifically address transmission line construction projects. For the segment that may be placed underground, local grading ordinances establish detailed procedures for underground utility construction, including trench backfill, compaction, and testing. Relevant and potentially relevant statutes, regulations and policies are discussed below.

D.5.2.1 State Statutes

California Environmental Quality Act (CEQA) (Pub. Resource Code sections 21000-21177.1). CEQA was adopted in 1970 and applies to most public agency decisions to carry out, authorize, or approve projects that may have adverse environmental impacts. CEQA requires that agencies inform themselves about the environmental effects of their proposed actions, consider all relevant information, provide the public an opportunity to comment on the environmental issues, and avoid or reduce potential environmental harm whenever feasible. Relevant CEQA sections include those for protection of geological and mineral resources, protection of soil from erosion, and for the protection of paleontological resources (certain fossils found in sedimentary rocks).

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

The **California Building Code** (CBC, 2001) is based on the 1997 Uniform Building Code (UBC), 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. Because the Proposed Project route lies within UBC Seismic Zone 3, provisions for design should follow the requirements of Chapter 16. Chapter 33 of the CBC contains requirements relevant to the construction of underground transmission lines. California Code of Regulations Title 24, Section 3301.2 and 3301.3 *et. seq.* contain the provisions requiring protection of adjacent properties during excavations and requires ten days written notice and access to the excavation be given to the adjacent property owners.

D.5.2.2 Local

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

D.5.3 Environmental Impacts and Mitigation Measures for the Proposed Project

D.5.3.1 Definition and Use of Significance Criteria

Geologic and soil conditions, and paleontological resources were evaluated with respect to the impacts the project may have on the local geology, as well as the impact specific geologic hazards may have upon the OMPPA Transmission Project. The significance of these impacts was determined on the basis of CEQA statutes, guidelines and appendices: thresholds of significance developed by local agencies; government codes and ordinances; and requirements stipulated by California Alquist-Priolo statutes. Significance criteria and methods of analysis were also based on standards set or expected by agencies for the evaluation of geologic hazards.

Impacts of the project on the geologic environment would be considered significant if:

- Unique geologic features or geologic features of unusual scientific value (including significant fossils) for study or interpretation would be disturbed or otherwise adversely affected by the proposed new transmission line towers and the associated construction activities.

- Known mineral and/or energy resources would be rendered inaccessible by transmission line construction.

- Geologic processes, such as landslides or erosion, could be triggered or accelerated by construction or disturbance of landforms.

- Substantial alteration of topography would be required or could occur beyond that which would result from natural erosion and deposition.

Impacts of geologic hazards on the project would also be considered significant if the following conditions existed:

- High potential for earthquake-induced groundshaking to cause liquefaction, settlement, lateral spreading and/or surface cracking along the route and probable attendant damage to the transmission line or other project structures.
- Potential for failure of construction excavations or underground borings due to the presence of loose saturated sand or soft clay.
- Presence of corrosive soils, which would damage the underground portions of the transmission line, the transmission line support structures, or foundations at the substations.

D.5.3.2 Application Proposed Measures

Table D.5-5 presents the APMs proposed SDG&E to reduce project impacts related to geology, soils, and paleontology.

TABLE D.5-5
APPLICANT PROPOSED MEASURES – GEOLOGY, SOILS, AND PALEONTOLOGY

APM No.	Description
3	Project construction activities shall be designed and implemented to avoid or minimize new disturbance, erosion on manufactured slopes, and off-site degradation from accelerated sedimentation, and to reduce maintenance and repair costs. Maintenance of cut and fill slopes created by project construction activities would consist primarily of erosion repair. In situations where revegetation would improve the success of erosion control, planting or seeding with native hydroseed mix may be done on slopes.
5	In areas where ground disturbance is substantial or where recontouring is required (e.g., marshaling yards, tower sites, spur roads from existing access roads), surface restoration would occur as required by the governmental agency having jurisdiction. The method of restoration normally would consist of returning disturbed areas back to their original contour, reseeding (if required), installing cross drains for erosion control, placing water bars in the road, and filling ditches for erosion control. Erosion would be minimized on access roads and other locations primarily with water bars. The water bars would be constructed using mounds of soil shaped to direct the flow of runoff and prevent erosion. Soil spoils created during ground disturbance or recontouring shall be disposed of only on previously disturbed areas, or used immediately to fill eroded areas. However, material for filling in eroded areas in roads or road ruts should never be obtained from the sides of the road that contain habitat without the approval of the on-site biological resource monitor. Cleared vegetation would be hauled off-site to a permitted disposal location. To limit impact to existing vegetation, appropriately sized equipment (e.g., bulldozers, scrapers, backhoes, bucket-loaders, etc.) would be used during all ground disturbance and recontouring activities.

TABLE D.5-5
APPLICANT PROPOSED MEASURES – GEOLOGY, SOILS, AND PALEONTOLOGY

APM No.	Description
6	Potential hydrologic impacts would be minimized through the use of BMPs such as water bars, silt fences, staked straw bales, and mulching and seeding of all disturbed areas. These measures will be designed to minimize ponding, eliminate flood hazards, and avoid erosion and siltation into any creeks, streams, rivers, or bodies of water.
7	Prior to construction, all SDG&E, contractor, and subcontractor project personnel would receive training regarding the appropriate work practices necessary to effectively implement the APM and to comply with the applicable environmental laws and regulations, including, without limitation, hazardous materials spill prevention and response measures, erosion control, dust suppression, and appropriate wildlife avoidance, impact minimization procedures, and SWPPP BMPs. To assist in this effort, the training would address: a. federal, state, local, and tribal laws regarding antiquities, fossils, plants, and wildlife, including collection and removal; b. the importance of these resources and the purpose and necessity of protecting them; and c. methods for protecting sensitive cultural, paleontological, and ecological resources.
15	If paleontological resources are encountered, appropriate field mitigation efforts would be implemented to protect the resources. For example, if significant resources are discovered, such as vertebrate fossils, construction would be stopped in this area while SDG&E and its designated paleontologist determine the appropriate method and schedule to recover or protect the resource. When it is not feasible to avoid paleontological sites, SDG&E would consult with the appropriate federal, state, and resource agencies and specialists to either develop alternative construction techniques to avoid paleontological resources or develop appropriate mitigation measures. Appropriate mitigation field measures may include actions such as protection-in-place by covering with earthen fill, removal and cataloging, and/or removal and relocation.
38	Secure any required General Permit for Storm Water Discharges Associated With Construction Activity (NPDES permit) authorization from the State Water Resources Control Board and/or the RWQCB to conduct construction-related activities to build the project and establish and implement a SWPPP erosion control measures during construction to minimize hydrologic impacts in areas sensitive from flooding or siltation into waterbodies.
64	During construction, SDG&E would remove boulders uphill of structures that pose potentially high risk of landslide damage to those structures and would position structures to span over potential landslide areas to the greatest extent feasible.
65	In disturbed areas where construction equipment has caused compaction of soils (e.g., staging areas, structure sites, temporary spur roads), soils would be decompacted as necessary prior to seeding and reclamation would occur to enhance revegetation and reduce potential for erosion.

D.5.3.3 230 kV Overhead Transmission Line

Impact G-1: Ground acceleration/ground shaking, which could damage components

Strong earthquake-induced ground shaking can result in damage to aboveground structures. However, due to the distance from active faults (both onshore and offshore) that would be a source of seismic shaking, only moderate to low ground shaking is predicted for central and southern San Diego County. In the Proposed Overhead Segment Project area, peak ground acceleration could range from 0.2 to 0.3 g in an earthquake event with a ten percent probability of occurring in the next 50 years. Given that transmission lines and support structures can withstand strong ground shaking and moderate ground deformations and that only moderate to low ground shaking is predicted for the project area, impacts associated with strong seismic shaking would result in less than significant impacts (Class III) and therefore, no mitigation is required.

Impact G-2: Ground rupture, which could displace surface deposits along faults

The proposed overhead segment of the project does not cross any mapped Alquist-Priolo Earthquake Hazard Zones, nor does it cross any mapped faults of Quaternary age that may be deemed active or potentially active. Therefore, it is anticipated that there would be no impacts associated with fault ruptures.

Impact G-3: Seismically Induced Ground Failures Including Liquefaction, Lateral Spreading, and Seismic Slope Instability

Earthquake-generated ground failure, including liquefaction, lateral spreading, and differential settlement could impact the Proposed Project where tower or pole structures are located adjacent to the San Diego Bay due to the anticipated presence of unconsolidated, sandy soil and, at certain times of the year, elevated groundwater levels. Shallow landslides could also be triggered by an exceptional seismic event or even project-related excavation anywhere along the alignment. The most likely areas susceptible to seismic slope instability occur between Sycamore Canyon Substation and Fanita Junction and near the Miguel Substation where tower footings are placed on ridges and slopes on sedimentary rock. Mitigation Measure G-3a would reduce potentially significant impacts associated with seismically-induced ground failure along the alignment to less than significant levels (Class II).

Mitigation Measure for Impact G-3, Ground Failure, Liquefaction

G-3a **Geotechnical Investigations for Liquefaction and Slope Instability**. The Applicant shall perform design-level geotechnical investigations to evaluate the potential for liquefaction, lateral spreading, seismic slope instability, and ground-cracking hazards to affect the approved project and all associated facilities. Where these hazards are found to exist, appropriate engineering design and construction measures shall be incorporated into the project designs. Appropriate measures for both overhead and underground project facilities could include construction of pile foundations, ground improvement of liquefiable zones, installation of flexible bus connections, and incorporation of slack in underground cables to allow ground deformations without damage to structures. SDG&E shall submit a report of the required investigations to the CPUC for review and approval at least 60 days before construction.

Impact G-4: Slope Instability Including Landslides, Earth Flows, and Debris Flows

Several landslides have been mapped in the project area between Sycamore Canyon Substation and Fanita Junction as well as near the Miguel Substation in the Friars Formation and Santiago Peak Formation, respectively. As described in APM 64, SDG&E will remove boulders uphill from structures that pose potential risk to structures as well as position structures to span over potential landslide areas to the extent feasible. In addition to APM 64, implementation of Mitigation Measure G-4a would reduce potentially significant impacts associated with slope instability to less than significant levels (Class II).

Mitigation Measure for Impact G-4, Landslides, Earth Flows, and Debris Flows

G-4a **Geotechnical Surveys for Landslides.** The Applicant shall perform design-level geotechnical surveys to evaluate the potential for unstable slopes, landslides, earth flows, and debris flows along the approved transmission line route and in the vicinity of other project facilities. Based on these surveys, approved project facilities shall be located away from very steep hillsides, debris flow source areas, the mouths of steep sidehill drainages, and the mouths of canyons that drain steep terrain. A report documenting these surveys shall be submitted to the CPUC for review and approval at least 60 days before construction.

Impact G-5: Soils Which Could Damage Foundations or Have High Erosion Potential

The proposed overhead alignment area contains areas of expansive soils and moderately erodible soils, with small areas of soils rated as high or low for erodibility. Construction and maintenance of the overhead line could trigger or accelerate erosion, especially in the small areas rated as high. In addition, potentially corrosive soils in the Project area could impact the chemical stability of concrete and uncoated steel used in support structures.

As described in APMs 3, 5, and 65, the Project includes measures to reduce soil erosion. In addition to these APMs, implementation of Mitigation Measures G-5a and G-5b would reduce potentially significant impacts associated with potentially corrosive or unstable soils to less than significant (Class II).

Mitigation Measures for Impact G-5 Soils

G-5a **Foundation in unstable slopes or erodible soils.** A geologist and geotechnical engineer shall evaluate the placement of towers on mesas, ridges, slopes, spurs, and in or near active streambeds. Their analyses shall describe the geologic stability and make recommendations for the best foundation type and depth for the local conditions. A report documenting the analysis and recommendations shall be submitted to the CPUC for review and approval at least 60 days prior to construction.

G-5b Corrosivity testing shall be performed on a site-specific basis for each support structure and substation to be located within areas mapped as having high potential for corrosive soils by the U.S. Department of Agriculture (USDA). 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. Study results and proposed solutions shall be provided to the CPUC for review and approval at least 60 days before construction.

Impact G-6: Mineral Resources

The proposed overhead transmission line would be located within an established right-of-way in which quarrying operations do not presently occur. Future development of sand, gravel, or rock quarries would be compatible with the Proposed Project. It is anticipated that the project would have no impact on mineral resource availability.

Impact G-7: Construction Activities May Destroy Paleontologic Resources

Fossils are known to occur in the Tertiary sediments in the project area. The potentially sensitive units include the Stadium conglomerate group and the Friars Formation between mile-posts 0 to 4 and 28 to 38 within the project alignment. The age of the geologic units, and the fact that they are primarily terrestrial deposits indicate that there is a likelihood that significant fossils could be found during excavation for new tower footings in several locations along the project route. As described in APM 15, the project includes paleontological monitoring during grading and excavation. In addition to APM 15, implementation of Mitigation Measure G-7a would ensure that potential impacts to paleontological resources would be less than significant (Class II).

Mitigation Measure for Impact G-7, Paleontological Resources

G-7a A paleontologist or paleontological monitor shall be onsite to inspect for fossils during excavation activities at or below six feet within the potentially sensitive units including the Stadium Conglomerate Group and Friars Formation. In the event that fossils are encountered, the paleontologist will have the authority to divert or temporarily halt construction activities in the area of discovery to allow recovery of fossil remains in a timely fashion.

Fossil remains will be cleaned, sorted, repaired, catalogued, and then stored in a local scientific institution that houses paleontological collections. The qualified paleontologist will be responsible for preparation of fossils to a point of identification, and submittal of a letter of acceptance from a local qualified curation facility. Within 90 days of completion of the excavation phase of the project, the paleontologist shall provide to the CPUC a report summarizing the monitoring results for review and approval. The monitoring results report shall include appropriate graphics summarizing the results (even if negative), analyses, and conclusions of the above monitoring program. Any discovered fossil sites shall be recorded at the San Diego Natural History Museum.

D.5.3.4 230 kV Underground Cable

Soil liquefaction is considered a potential seismic hazard along the entire underground cable alignment (South Bay Power Plant Area to Sweetwater River Transition Area and Sicard Street Transition Area to Old Town Substation). The proposed underground cable portion of the project between Sicard Street to SDG&E's Old Town Substation also crosses potentially active and active fault traces associated with the Rose Canyon Fault Zone designated as an Alquist-Priolo special studies zone. Alquist-Priolo Zones were originally established to prevent structures from being located directly on a fault. The Rose Canyon Fault Zone is considered a significant seismic hazard to the entire San Diego Metropolitan area. Underground facilities are generally not subject to direct effects of shaking (Impact G-1) because they are confined by overlying soils. However, given the anticipated maximum fault displacement described in *Section D.5.1.2*, the integrity of the transmission cable could be compromised by potential differential settlements associated with liquefaction as well as fault rupture. Implementation of Mitigation Measures G-2a and G-3a would reduce potentially significant impacts associated with ground rupture (Impact G-2) and ground failures (Impact G-3) to less than significant (Class II).

Mitigation Measure for Impact G-2, Ground Rupture

G-2a **Minimize Project Structures within Active Fault Zone.** Any crossing of an active fault shall be made as close to perpendicular to the fault as possible to make the segment cross the shortest distance within an active fault zone. For underground crossings of active or potentially active fault traces, the cable vaults on either side of the fault shall be oversized, leaving as much slack as possible in the cables. The underground cable shall be installed in the shortest feasible segments, with splice vaults and manholes located as close as possible outside of the fault zone in order to minimize the area where post-earthquake repairs may be required. A rebar reinforcement duct bank design that will increase the ductility of the duct bank at key locations shall also be used. Adequate supplies of spare cable sections shall be maintained by SDG&E for rapid repair after an earthquake-caused failure. For aboveground installations such as transition stations, SDG&E shall follow standard design codes for facilities in seismic zones.

The underground portion of the project would primarily take place in previously graded areas associated with SDG&E's existing ROW and existing City of San Diego roadways; therefore, no impacts due to landslides, earth flows and debris flows (Impact G-4); or to mineral resources (Impact G-6) would occur. Impact G-5 (soils which could damage components) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-5a and G-5b. Implementation of Mitigation Measure G-7a would ensure that potential impacts to paleontological resources between mile-posts 45 and 52 would be less than significant (Class II).

D.5.3.5 Transition Station

The proposed transition station is located within the vicinity of potentially active and active fault traces associated with the Rose Canyon Fault Zone. It is likely that the project facilities associated with the transition station would be subjected to at least one moderate or larger earthquake occurring close enough to produce strong ground shaking in the project area. Implementation of Mitigation Measure G-1a, which requires incorporation of standard engineering practices as part of the project to ensure that people or structures are not exposed to hazards associated with strong seismic ground shaking, would reduce potential impacts associated with ground shaking (Impact G-1a) to less than significant (Class II).

Mitigation Measure for Impact G-1, Ground Acceleration and Shaking

G-1a **Reduce Effects of Ground shaking**. The Applicant shall perform design-level geotechnical investigations including site-specific seismic analyses to evaluate the peak ground accelerations for design of project components. The Applicant shall follow the Institute of Electrical and Electronics Engineers (IEEE) 693 "Recommended Practices for Seismic Design of Substations," which has specific requirements to mitigate the types of damage that 230 kV equipment at substations have been subjected to in the past. These design guidelines shall be implemented during construction of substation modifications and transition station construction. Substation and transition station control buildings shall be designed in accordance with the Uniform Building Code for sites in Seismic Zone 4 with near-field factors. Compliance with this measure shall be documented and provided to the CPUC at least 60 days before construction by submittal of reports describing the potential peak ground accelerations expected for design level earthquake and a description of how the design will accommodate this anticipated motion.

Ground rupture (Impact G-2) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-2a. The Transition Station would be developed in a previously graded area associated with an existing parking lot; therefore, no impacts due to landslides, earth flows and debris flows (Impact G-4); or to mineral resources (Impact G-5) would occur. Impact G-5 (soils which could damage components) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-5a and G-5b. Implementation of Mitigation Measure G-7a would ensure that potential impacts to Paleontological resources would be less than significant (Class II).

D.5.3.6 Modifications to Sycamore Canyon, Miguel and Old Town Substations

Some types of substation equipment are very susceptible to damage from earthquakes; however, the existing Sycamore Canyon, Miguel and Old Town substations have been constructed with engineering and design standards for seismicity. These substations would be modified to accommodate the new 230 kV line. Seismic shaking (Impact G-1) could have an impact on these modifications. Mitigation Measure G-1a would reduce impacts to proposed substation modifications associated with seismic shaking to less than significant levels (Class II).

Damage resulting from fault rupture (Impact G-2) occurs only where structures are located astride fault traces that move. Faults classified as either active or potentially active by the State have not been identified onsite or in the immediate vicinity of the Sycamore Canyon or Miguel Substations. These existing substations are not located within a designated active earthquake fault zone where a site-specific fault investigation is required, and the modifications to these existing substations would take place within the existing substation sites. Therefore, no impacts are anticipated due to ground rupture to proposed substation modifications at the Sycamore Canyon and Miguel Substations. However, as shown in *Figure D.5-1*, the Old Town Substation is located within the vicinity of potentially active fault traces associated with the Rose Canyon Fault Zone. It is likely that the proposed modifications to the Old Town Substation would be subjected to at least one moderate or larger earthquake occurring close enough to produce strong ground shaking in the project area. Implementation of Mitigation Measure G-1a, which requires incorporation of standard engineering practices as part of the project to ensure that people or structures are not exposed to hazards associated with strong seismic ground shaking would reduce potential impacts associated with ground shaking (Impact G-1a) to less than significant (Class II).

Proposed modifications will be located within existing substation boundaries which have been previously graded and engineered to support substation equipment. Therefore, no impacts due to liquefaction (Impact G-3), landslide or unstable slope potential (Impact G-4), unstable soils or erosion (Impact G-5), mineral resources (Impact G-6) or paleontological resources (Impact G-7) would occur.

D.5.4 Project Alternatives

D.5.4.1 SDG&E Design Option Alternatives (*Pacific Highway Bridge Attachment, Sicard Street Transition Cable Pole, Harbor Drive Bridge Attachment and South Bay Power Plant to Sweetwater River Overhead Design Alternatives*)

Environmental Setting

Section D.5.1 describes the geologic setting of the region. Because SDG&E's design option alternatives would occur in the same geological area as the Proposed Project, the existing geological conditions would be the same as described for the Proposed Project.

Environmental Impacts and Mitigation Measures

Pacific Highway Bridge Attachment Design Alternative: This alternative would substitute a portion of the work related to directional drilling under the San Diego River with increased trenching. Under this alternative, approximately 1,400 additional feet of trenching within paved roadways would be required over the Proposed Project. Like the Proposed Project, the alignment associated with the Pacific Highway Bridge Attachment crosses inferred buried traces of the Rose Canyon Fault south of the San Diego River and is within an area of high liquefaction potential (Ninyo & Moore, October 2004). The geological impacts associated with this alignment are nearly identical to those associated with the proposed project as described in *Section D.5.3.4.* Implementation of Mitigation Measures G-2a and G-3a would reduce potentially significant impacts associated with ground rupture (Impact G-2) and ground failure (Impact G-3) to less than significant (Class II). Like the Proposed Project, the underground portion of the Project would take place in previously graded areas associated with existing City of San Diego roadways; therefore, no impacts due to landslides, earth flows and debris flows (Impact G-4); or to mineral resources (Impact G-6) would occur. Impact G-5 (soils which could damage components) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-5a and G-5b. Implementation of Mitigation Measure G-7a would ensure that potential impacts to paleontological resources would be less than significant (Class II).

Harbor Drive Bridge Attachment Design Alternative: The Harbor Drive Bridge Attachment Design Alternative is an alternative to boring under the Harbor Drive Bridge as proposed by the OMPPA Transmission Project. Because this alternative entails only the attachment of the proposed 230 kV cable to the existing Harbor Drive Bridge, no impacts due to geologic hazards or to geologic resources would occur due to implementation of this alternative.

Sicard Street Transition Cable Pole Design Alternative: The geologic impacts for this alternative design option would not be significantly different from the Proposed Project. Localized geologic hazards (ground rupture Impact G-2 and ground failure Impact G-3) would occur in the same manner as described in *Section D.5.3.5* for the Proposed Transition Station. Implementation of Mitigation Measures G-2a and G-3a would reduce potentially significant geologic impacts (G-1 and G-2) associated with the construction of the Sicard Street Transition Cable Pole to less than significant (Class II).

South Bay Power Plant Area to Sweetwater River Overhead Design Alternative: Given that the South Bay Power Plant Area to Sweetwater River Overhead Design Alternative primarily consists of minor modifications to existing structures that are assumed to have been designed and built to withstand geologic hazards, geologic impacts associated with seismic shaking (Impact G-1), ground rupture (Impact G-2), seismically-induced ground failure including liquefaction (Impact G-3), slope instability (Impact G-4), erosion (Impact G-5), mineral resources (Impact G-6) and paleontological resources (Impact G-7) would be less than significant (Class III) and therefore, no mitigation is required.

Comparison to the Proposed Project

Geologic impacts resulting from the construction of SDG&E's Pacific Highway Bridge Attachment and Sicard Street Transition Cable Pole design alternatives would not be significantly different from the Proposed Project. Geologic impacts resulting from construction of SDG&E's Harbor Drive Bridge Attachment Design Alternative would decrease from Class II requiring mitigation to Class III no mitigation required, due to the elimination of the proposed boring under the Harbor Drive Bridge. Geologic impacts associated with the South Bay Power Plant Area to Sweetwater River Overhead Design Alternative would decrease from (Class II) requiring mitigation, to less than significant, no mitigation is required (Class III).

D.5.4.2 Transmission System Alternative 7 PV1 Variation - Miguel Substation to South Bay Power Plant

Environmental Setting

Section D.5.1 describes the geologic characteristics of the region. Because this alternative would occur in the same geologic area as the Proposed Project, the existing geological conditions would be the same as described for the Proposed Project.

Environmental Impacts and Mitigation Measures

The Transmission System Alternative would be located in the existing SDG&E's ROW and would be subject to the same geologic conditions as the Proposed Project. Due to the distance from active faults (both onshore and offshore) that would be a source of seismic shaking, only moderate to low ground shaking is predicted. Because transmission lines and support structures can withstand strong ground shaking and moderate ground deformations and only moderate to low ground shaking is predicted for the study area, impacts associated with strong seismic shaking (Impact G-1) would be less than significant impact (Class III). Additionally, this alternative would not cross any mapped Alquist-Priolo Earthquake Hazard Zones or mapped faults of Quaternary age that may be deemed active or potentially active. Therefore, it is anticipated that there would be no impacts associated with fault ruptures (Impact G-2).

Localized geologic hazards (ground failure Impact G-3 and slope instability Impact G-4) could occur in the same manner as described in *Section D.5.3.4* and *D.5.3.5* for the Proposed Project. Implementation of Mitigation Measures G-3a and G-4a would reduce potentially significant geologic impacts (Impacts G-3 and G-4) associated with the construction of the Transmission System Alternative to less than significant (Class II).

Construction and maintenance of the overhead line could trigger or accelerate erosion, especially in the small areas rated as high for erodibility. In addition, potentially corrosive soils in the study area could impact the chemical stability of concrete and uncoated steel used in support structures. APMs 3, 5, and 65, as well as Mitigation Measures G-5a and G-5b, would reduce potentially significant impacts associated with potentially corrosive or unstable soils to less than significant (Class II).

Geologic impacts to mineral resources (Impact G-6) would be similar to the Proposed Project, which was determined to be less than significant (Class III). Geologic impacts to paleontologic resources have the potential to occur due to the likelihood that significant fossils could be found during excavation for new tower footings in several locations along the alternative route. With implementation of APM 15 (paleontological monitoring during grading and excavation), as well as Mitigation Measure G-7a, potential impacts to paleontological resources would be less than significant (Class II).

Comparison to the Proposed Project

Geologic impacts resulting from the construction of the Transmission System Alternative would not be significantly different from the Proposed Project, as the majority of the new structures proposed under this alternative would be the same as those proposed under the OMPPA Transmission Project. Additional transmission structures proposed under this alternative would be placed between the Proctor Valley Substation and Miguel Substation within the same alignment as the Proposed Project and therefore subject to the same geologic, soils and paleontological impacts as the Proposed Project.

D.5.4.3 Environmental Impacts of the No Project Alternative

Under the No Project Alternative, none of the facilities associated with the Project or alternatives evaluated in this EIR would be constructed by SDG&E and, therefore, none of the impacts in this section would occur. However, under the No Project Alternative, SDG&E could be forced to upgrade other existing facilities or add new transmission and generation capacity elsewhere to compensate for existing system limitations and anticipated future loads. Pursuit of such transmission and power generation options by SDG&E would result in construction and operational impacts. These impacts would be expected to be similar to those described in *Section D.5.3* for new transmission and generation, but could vary depending on length of transmission line and location pursued.

D.5.5 Mitigation Monitoring, Compliance and Report Table

Table D.5-6 shows the mitigation monitoring, compliance, and reporting program for geology, soils and paleontology. The CPUC is responsible for ensuring compliance with the provisions of the monitoring program. The Agency mitigation measures (MMs) as well as the APMs that SDG&E has made part of the Proposed Project are listed. *Table D.5-6* indicates whether the measure is applicant-proposed or agency-recommended. As indicated in *Table D.5-6*, the APMs are provided in shaded text and agency mitigation measures are provided in non-shaded text.

TABLE D.5-6
MITIGATION MONITORING PROGRAM – GEOLOGY, SOILS, PALEONTOLOGY

No.	Impact	MM	APM #s	Mitigation Measure/ Applicant Proposed Measure	Implementation Actions	Monitoring Requirements and Effectiveness Criteria	Timing of Action and Location
G-1	Ground acceleration/ ground shaking, which could damage components	G-1a		**Reduce Effects of Ground shaking.** The Applicant shall perform design-level geotechnical investigations including site-specific seismic analyses to evaluate the peak ground accelerations for design of project components. The Applicant shall follow the Institute of Electrical and Electronics Engineers (IEEE) 693 "Recommended Practices for Seismic Design of Substations," which has specific requirements to mitigate the types of damage that 230 kV equipment at substations have been subjected to in the past. These design guidelines shall be implemented during construction of substation modifications and transition station construction. Substation and transition station control buildings shall be designed in accordance with the Uniform Building Code for sites in Seismic Zone 4 with near-field factors. Compliance with this measure shall be documented and provided to the CPUC at least 60 days before construction by submittal of reports describing the potential peak ground accelerations expected for design level earthquake and a description of how the design will accommodate this anticipated motion.	SDG&E to implement measures as defined and provide copies of geotechnical evaluations to the CPUC and local planning agencies.	CPUC to verify that design has incorporated specific conditions to remediate impacts caused by ground shaking.	Prior to construction of new transition cable poles, transition station and substation modifications.
G-2	Ground rupture, which could displace surface deposits along faults	G-2a		**Minimize Project Structures within Active Fault Zone.** Any crossing of an active fault shall be made as close to perpendicular to the fault as possible to make the segment cross the shortest distance within an active fault zone. For underground crossings of active or potentially active fault traces, the cable vaults on either side of the fault shall be oversized, leaving as much slack as possible in the	SDG&E to implement measures as defined and provide copies of geotechnical evaluations to the CPUC and local planning agencies.	CPUC to verify that design has incorporated specific conditions to remediate impacts caused by ground rupture.	Prior to construction of underground cable within the vicinity of the Rose Canyon Fault and other areas deemed necessary by the project's geotechnical engineer.

Applicant Proposed Measure (APM) – As part of project design and in order to avoid certain environmental impacts, SDG&E has included design features (e.g., APMs) in the project design. The APMs are considered part of the project design, but project approval is contingent upon SDG&E's adherence to all aspects of the Proposed Project as described in this document, including project description, APM and mitigation measures (MM) proposed by the CPUC.

TABLE D.5-6
MITIGATION MONITORING PROGRAM – GEOLOGY, SOILS, PALEONTOLOGY

No.	Impact	MM	APM #s	Mitigation Measure/ Applicant Proposed Measure	Implementation Actions	Monitoring Requirements and Effectiveness Criteria	Timing of Action and Location
				cables. The underground cable shall be installed in the shortest feasible segments, with splice vaults and manholes located as close as possible outside of the fault zone in order to minimize the area where post-earthquake repairs may be required. A rebar reinforcement duct bank design that will increase the ductility of the duct bank at key locations shall also be used. Adequate supplies of spare cable sections shall be maintained by SDG&E for rapid repair after an earthquake-caused failure. For aboveground installations such as transition stations, SDG&E shall follow standard design codes for facilities in seismic zones.			
G-3	Seismically induced ground failures including liquefaction, lateral spreading, and seismic slope instability	G-3a		**Geotechnical Investigations for Liquefaction and Slope Instability.** The Applicant shall perform design-level geotechnical investigations to evaluate the potential for liquefaction, lateral spreading, seismic slope instability, and ground-cracking hazards to affect the approved project and all associated facilities. Where these hazards are found to exist, appropriate engineering design and construction measures shall be incorporated into the project designs. Appropriate measures for both overhead and underground project facilities could include construction of pile foundations, ground improvement of liquefiable zones, installation of flexible bus connections, and incorporation of slack in underground cables to allow ground deformations without damage to structures. SDG&E shall submit a report of	SDG&E to implement measures as defined and provide copies of geotechnical evaluations to the CPUC and local planning agencies.	CPUC to verify that design has incorporated specific conditions to remediate impacts caused by ground failures including liquefaction.	Prior to construction along the San Diego Bayfront and other areas deemed necessary by the geotechnical engineer.

Applicant Proposed Measure (APM) – As part of project design and in order to avoid certain environmental impacts, SDG&E has included design features (e.g., APMs) in the project design. The APMs are considered part of the project design, but project approval is contingent upon SDG&E's adherence to all aspects of the Proposed Project as described in this document, including project description, APM and mitigation measures (MM) proposed by the CPUC.

TABLE D.5-6
MITIGATION MONITORING PROGRAM – GEOLOGY, SOILS, PALEONTOLOGY

No.	Impact	MM	APM #s	Mitigation Measure/ Applicant Proposed Measure	Implementation Actions	Monitoring Requirements and Effectiveness Criteria	Timing of Action and Location
				the required investigations to the CPUC for review and approval at least 60 days before construction.			
G-4	Slope instability including landslides, earth flows, and debris flows	G-4a	64	See *Table D.5-5* for description of APM. **Geotechnical Surveys for Landslides.** The Applicant shall perform design-level geotechnical surveys to evaluate the potential for unstable slopes, landslides, earth flows, and debris flows along the approved transmission line route and in the vicinity of other project facilities. Based on these surveys, approved project facilities shall be located away from very steep hillsides, debris flow source areas, the mouths of steep sidehill drainages, and the mouths of canyons that drain steep terrain. A report documenting these surveys shall be submitted to the CPUC for review and approval at least 60 days before construction.	SDG&E to implement measures as defined and provide copies of geotechnical evaluations to the CPUC and local planning agencies.	CPUC to verify that design has incorporated specific conditions to remediate tower or offsite damage due to failure of unstable slopes.	Prior to construction of new tower foundations.
G-5	Soils which could damage foundations or have high erosion potential	G-5a		**Foundation in unstable slopes or erodible soils.** A geologist and geotechnical engineer shall evaluate the placement of towers on mesas, ridges, slopes, spurs, and in or near active streambeds. Their analyses shall describe the geologic stability and make recommendations for the best foundation type and depth for the local conditions. A report documenting the analysis and recommendations shall be submitted to the CPUC for review and approval at least 60 days prior to construction.	SDG&E to implement measures as defined and provide copies of geotechnical evaluations to the CPUC and local planning agencies.	CPUC to verify that design has incorporated specific conditions to remediate erosion and excessive erosion.	Prior to construction of new tower foundations.
		G-5b		Corrosivity testing shall be performed on a site-specific basis for each support structure and substation to be located within areas	SDG&E to implement measures as	CPUC to verify that design has incorporated specific conditions to	Prior to construction of new tower foundations, transition station, transition cable poles

Applicant Proposed Measure (APM) – As part of project design and in order to avoid certain environmental impacts, SDG&E has included design features (e.g., APMs) in the project design. The APMs are considered part of the project design, but project approval is contingent upon SDG&E's adherence to all aspects of the Proposed Project as described in this document, including project description, APM and mitigation measures (MM) proposed by the CPUC.

TABLE D.5-6
MITIGATION MONITORING PROGRAM – GEOLOGY, SOILS, PALEONTOLOGY

No.	Impact	MM	APM #s	Mitigation Measure/ Applicant Proposed Measure	Implementation Actions	Monitoring Requirements and Effectiveness Criteria	Timing of Action and Location
				mapped as having high potential for corrosive soils by the U.S. Department of Agriculture (USDA). 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. Study results and proposed solutions shall be provided to the CPUC for review and approval at least 60 days before construction.	defined.	remediate for damage due to corrosive soils.	and substation modifications.
			APMs 3, 5, 6, 7, 38 and 65 (see *Table D.5-5* for description of APMs) apply. The following APMs are highlighted as they were factored into the impact analysis.				
			APM-3	Project construction activities shall be designed and implemented to avoid or minimize new disturbance, erosion on manufactured slopes, and off-site degradation from accelerated sedimentation. In situations where revegetation would improve the success of erosion control, planting or seeding with native hydroseed mix shall be done on slopes.	SDG&E to implement measures as defined.	CPUC to verify that design has incorporated specific conditions to minimize disturbance and erosion.	Prior to construction in all construction areas.

Applicant Proposed Measure (APM) – As part of project design and in order to avoid certain environmental impacts, SDG&E has included design features (e.g., APMs) in the project design. The APMs are considered part of the project design, but project approval is contingent upon SDG&E's adherence to all aspects of the Proposed Project as described in this document, including project description, APM and mitigation measures (MM) proposed by the CPUC.

TABLE D.5-6
MITIGATION MONITORING PROGRAM – GEOLOGY, SOILS, PALEONTOLOGY

No.	Impact	MM	APM #s	Mitigation Measure/ Applicant Proposed Measure	Implementation Actions	Monitoring Requirements and Effectiveness Criteria	Timing of Action and Location
			APM-5	In areas where ground disturbance is substantial or where recontouring is required (e.g., marshaling yards, tower sites, spur roads from existing access roads), surface restoration shall occur as required by the governmental agency having jurisdiction. The method of restoration normally shall consist of returning disturbed areas back to their original contour, reseeding (if required), installing cross drains for erosion control, placing water bars in the road, and filling ditches for erosion control. Soil spoils created during ground disturbance or recontouring shall be disposed of only on previously disturbed areas, or used immediately to fill eroded areas. However, material for filling in eroded areas in roads or road ruts shall never be obtained from the sides of the road that contain habitat without the approval of the on-site biological resource monitor. Cleared vegetation shall be hauled off-site to a permitted disposal location.	SDG&E to implement measures as defined.	CPUC to inspect periodically to ensure that disturbance and erosion are minimized.	During construction of new overhead transmission line.
			APM-65	In disturbed areas where construction equipment has caused compaction of soils (e.g., staging areas, structure sites, temporary spur roads), soils shall be decompacted as necessary prior to seeding and reclamation shall occur to enhance revegetation and reduce potential for erosion.	SDG&E to implement measures as defined.	CPUC to inspect periodically to ensure disturbance and erosion are minimized.	During construction in all work areas.
G-7	Construction activities may destroy Paleontologic resources	G-7a	15	See *Table D.5-5* for description of APM. A paleontologist or paleontological monitor shall be onsite to inspect for fossils during excavation activities at or below six feet within the potentially sensitive units including the Stadium Conglomerate Group and Friars Formation. In the event that fossils are	SDG&E to implement measures as defined.	CPUC to inspect periodically to prevent destruction of non-renewable Paleontologic resources.	During construction in all areas where there is a possibility or certainty of encountering potentially fossil-bearing strata (mainly between mile-posts 0 to 4 and 28 to 38 within the project alignment).

Applicant Proposed Measure (APM) – As part of project design and in order to avoid certain environmental impacts, SDG&E has included design features (e.g., APMs) in the project design. The APMs are considered part of the project design, but project approval is contingent upon SDG&E's adherence to all aspects of the Proposed Project as described in this document, including project description, APM and mitigation measures (MM) proposed by the CPUC.

TABLE D.5-6
MITIGATION MONITORING PROGRAM – GEOLOGY, SOILS, PALEONTOLOGY

No.	Impact	MM	APM #s	Mitigation Measure/ Applicant Proposed Measure	Implementation Actions	Monitoring Requirements and Effectiveness Criteria	Timing of Action and Location
				encountered, the paleontologist will have the authority to divert or temporarily halt construction activities in the area of discovery to allow recovery of fossil remains in a timely fashion. Fossil remains will be cleaned, sorted repaired, catalogued, and then stored in a local scientific institution that houses paleontological collections. The qualified paleontologist will be responsible for preparation of fossils to a point of identification, and submittal of a letter of acceptance from a local qualified curation facility. Within 90 days of completion of the excavation phase of the project, the paleontologist shall provide to the CPUC a report summarizing the monitoring results for review and approval. The monitoring results report shall include appropriate graphics summarizing the results (even if negative), analyses, and conclusions of the above monitoring program. Any discovered fossil sites shall be recorded at the San Diego Natural History Museum.		CPUC to review and approve monitoring results report that provides the fossils found and their significance.	

Applicant Proposed Measure (APM) – As part of project design and in order to avoid certain environmental impacts, SDG&E has included design features (e.g., APMs) in the project design. The APMs are considered part of the project design, but project approval is contingent upon SDG&E's adherence to all aspects of the Proposed Project as described in this document, including project description, APM and mitigation measures (MM) proposed by the CPUC.

D.5.6 References

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