3.6 Geology, Soils, Minerals, and Paleontology

This section contains a description of the environmental setting, regulatory setting, and potential impacts associated with the construction and operation of the proposed project and alternatives with respect to geology, soils, minerals, and paleontology.

3.6.1 Environmental Setting

The following section presents a discussion of the geology, geologic hazards, soils, mineral resources, and paleontology in the proposed project area. Data collection for this analysis consisted of (1) identifying and collecting readily available geology, soils, mineral resources, and paleontology information from local, state, and federal agency sources; and (2) reviewing readily available aerial images and topographic maps.

3.6.1.1 Geologic Setting

Topography

The topography within the proposed project area in Nevada ranges from an elevation low of less than 1,800 feet in the area of the Eldorado Substation to an elevation of approximately 5,000 feet along the redundant telecommunication line where it would cross the McCullough Mountains (California Division of Mines and Geology [CDMG] 1961). Within California, the proposed transmission line route would cross Ivanpah Dry Lake (lowest elevation approximately 2,605 feet), where it would rejoin Alternative C (at elevation approximately 2,620 feet) before continuing to the Ivanpah Substation within the alluvial fans sloping east from the Clark Mountain Range. The Mountain Pass Alternative Telecommunication Route would cross Ivanpah Dry Lake and then extend to the Mountain Pass substation, which has an elevation of just over 5,000 feet (CDMG 1961).

Regional Geology

The proposed project lies mostly within the Mojave Desert geomorphic province (Norris and Webb 1990), which is located primarily in California but extends eastward into Nevada, where it merges with the Basin and Range province (the Great Basin; Figure 3.6-1). In Nevada, the proposed project area lies within the Basin and Range province. A geomorphic province is a naturally defined geologic region with distinct and unique landforms that have developed due to a specific combination of geology units, faults and fault zones, and climate. The Great Basin province is characterized by interior drainage with lakes and playas (dry lake basins) and the typical mountain and valley structure including subparallel, fault-bounded ranges separated by down-dropped basins (California Geological Survey [CGS] 2002). Extensional tectonics (a pulling apart of the earth's crust) is predominant in the Basin and Range province, although some northwest-trending right-lateral strike-slip (mostly horizontal side-to-side motion) faulting is present.

The Mojave Desert geomorphic province is a broad interior region of isolated mountain ranges separated by expanses of desert plains. It has an interior enclosed drainage with playas being common. Fault trends largely control Mojave Desert topography. Mountain ranges in the Mojave Desert geomorphic province are composed of complexly faulted and folded basement rocks that range from pre-Cambrian (greater than 570 million years before present [mybp]) to Mesozoic (66 to 240 mybp). Volcanic and sedimentary rocks deposited in the Cenozoic (less than 66 mybp to present) are common as well. Younger faulting in the eastern half of the Mojave Desert geomorphic province is characterized by generally north- to northwest-trending normal faults associated with regional extension (pulling apart) in the Basin and Range province. Normal faulting is one of the most common types, exhibiting movement along a generally non-vertical plan such that the upper part moves downward along the plane causing an offsetting of the geologic unit(s).

Geology in the Clark Mountain Range, located along the western extent of the proposed project area and eastward into Nevada, is characteristic of both the Mojave Desert and Basin and Range geomorphic provinces. The Clark Mountain Range is bounded on the west side by the Halloran Hills Detachment Fault (Fowler and Calzia 1999). Although these mountains have been subjected to considerable faulting, the core of the range has remained unaffected by stretching of the crust in this region (regional extension). The adjacent Ivanpah Valley, with a lakebed elevation of 2,605 feet, could be primarily a product of the same relatively recent regional extension and normal faulting. The McCullough Mountains to the east, however, have also been affected by this crustal extension, and very low angle (detachment) faulting that has been dated as Miocene, with an age between 16.5 and 11.0 mybp (U.S. Geological Survey [USGS] 2006). Numerous unconformities (areas where rocks of different compositional types or structural orientations are in direct contact) and major thrust faults (locations where older rocks have been pushed up and over younger rocks) are present in these mountains.

Project Site Geology

The geologic units exposed in the proposed project area occur as three types:

- Alluvium: sedimentary deposits derived from the physical and chemical breakdown and transport in the flatter valley portions of the desert plains and along the slopes of alluvial fans;
- Alluvial fans: cone-shaped accumulations of alluvial material along the bases of mountains; and
- Bedrock: igneous, metamorphic, and sedimentary rock exposed in the mountain areas, typically surrounded by alluvium and alluvial fans.

Refer to Figure 3.6-1 for a simplified geologic map of the proposed project area.

Alluvium ranges from modern (Holocene; 0 to 11,000 years old) stream deposits to early- to late-Pleistocene (11,000 to 1.8 million years old) alluvial fan deposits usually flanking the mountain ranges. Bedrock is composed of Miocene (5.3 million years before present [mybp] to 23 mybp) volcanic (igneous) rock, and basement rock is Ordovician through Precambrian (greater than 435 mybp to at least 570 mybp) metamorphic rocks.

Although the alluvial units have been extensively subdivided (Nevada Bureau of Mines and Geology [NBMG] 2006), the approach taken here is to present a more utilitarian summary based on major characteristics rather than minor variations. To this end, a summary of the exposed geologic units in the proposed project area by state is provided in Table 3.6-1 and Figure 3.6-1. The text below provides more data from more detailed data sets than those used to produce Table 3.6-1 and Figure 3.6-1.

Nevada

In Nevada, alluvium ranges from Quaternary to Tertiary (as old as 66 mybp) alluvial and rocky fragments and debris (talus) deposits, alluvial fan deposits, and flat-lying playa deposits. These deposits generally overlie and/or are marginal to bedrock units that include Tertiary (1.6 to 66 mybp) volcanic flows; Paleozoic- to Mesozoic (66 to 570 mybp) sedimentary rocks; and Precambrian (greater than 570 mybp) metamorphic rocks.

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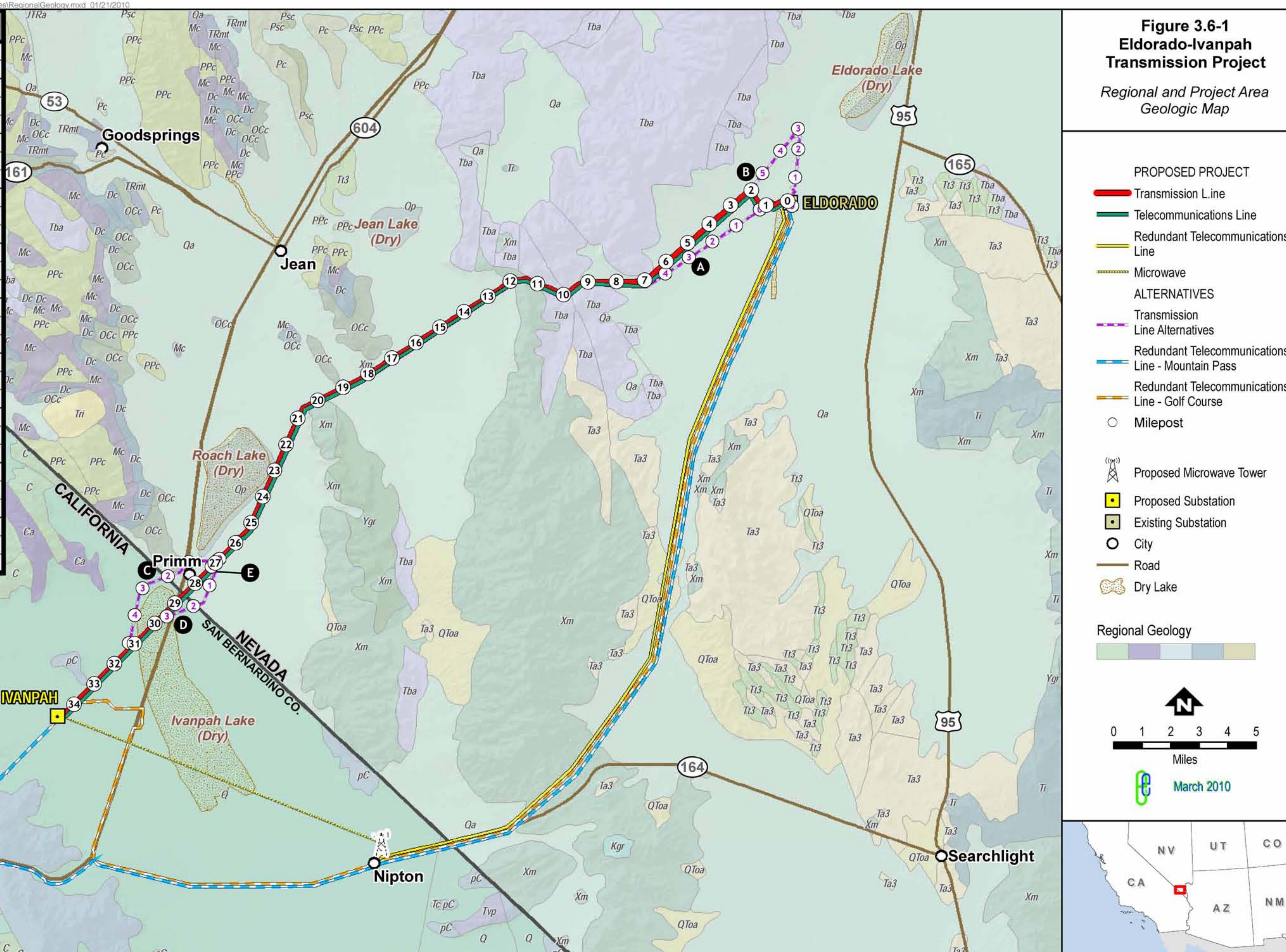
Figure 3.6-1
Eldorado-Ivanpah Transmission Project

Regional and Project Area Geologic Map



LABEL	ROCK TYPE
C	limestone
Ca	sandstone
D	limestone
Dc	dolostone (dolomite)
J	orthoquartzite
JTRa	sandstone
K	felsic volcanic rock
Kgr	granodiorite
Mc	limestone
OCc	dolostone (dolomite)
PPc	limestone
Pc	limestone
Psc	sandstone
Q	alluvium
QToa	alluvium
Qa	alluvium
Qp	playa
TRmt	shale
Ta3	andesite
Tba	basalt
Tc	conglomerate
Ti	alkali-granite (alaskite)
Tr	mudstone
Tri	granitoid
Tt3	rhyolite
Tvp	rhyolite
Xm	gneiss
Ygr	granite
pC	gneiss

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Table 3.6-1 Summary of Surficial and Bedrock Geologic Units

Map Symbol	Age	Formation Description
Nevada		
Qa	Quaternary (Holocene and Pleistocene) [< 1.8 mybp]	Surficial Deposits (undivided): Mixture of alluvial and broken rock deposits.
QToa	Quaternary–Tertiary (Early Pleistocene to late Miocene) [0.8 to 5 mybp]	Old Alluvium (undivided): Old alluvial fan deposits.
Tba (Tv)	Tertiary (Late to middle Miocene) [5 to 13 mybp]	Andesite and Basalt Flows: Numerous volcanic rocks.
OЄc (MzPzs)	Paleozoic to Mesozoic–(Cretaceous to Cambrian) [66 to 570 mybp]	Old Sedimentary Rocks (undivided)
Xm	Precambrian [>570 mybp]	Metamorphic Rocks
California		
Q	Quaternary (Pleistocene to Holocene) [0 to 1.8 mybp]	Quaternary Alluvium
pC (epЄ)	Precambrian [>570 mybp]	Earlier Precambrian Metamorphic Rocks

Source: USGS 2005
Key:
mybp = million years before present

Alluvial deposits have been mapped to various degrees of detail ranging from a generalized approach (CDMG 1961, Stewart and Carlson 1978, Miller et al. 1999) to a careful segregation of younger and older, active to inactive units (NBMG 2006, USGS 2006). Undivided Holocene to Pleistocene Surficial Deposits (Qa/Q) are composed of a mixture of alluvial and talus deposits consisting of poorly consolidated sand, silt, and gravel. Older young alluvial deposits are made up of sand and gravel fragments from granitic sources that weather and are characterized by weakly developed pavements that generally lack varnish (chemical staining). These pavements are composed predominantly of gravels from which the wind has removed most of the fine-grained sand and silt, giving an appearance like a paved surface. Older units are characterized by a covering of varnished desert pavement with a fairly rough surface topography and have been identified principally in Ivanpah Valley between Clark Mountain and the Lucy Gray Mountains, although they are likely much more widespread.

In the valley bottoms and flat areas, latest Holocene to late Pleistocene playa deposits of are characterized as predominately playas actively receiving water and sediment from the surrounding areas and include Ivanpah, Roach, and Jean dry lakes. These deposits are weakly bedded and poorly sorted (exhibit a range of grain sizes from clay to gravel). The areas are generally flat and prone to flooding and receiving stream flow and standing water, and are subject to wind-blown accumulation and wind erosion.

In summary, approximately 76 percent of the proposed project footprint and alternatives are located on alluvium (mostly alluvial fans), 46 percent on bedrock, and 17 percent on playa deposits. Less than one percent is located on land disturbed by human activities.

Most alluvial deposits in this region, with the exception of lake deposits, are formed within a larger deposition system called alluvial fans. Alluvial fans are significant because they are subjected to random flood events, which can be unpredictable. Early Pleistocene- to late Miocene alluvial fan deposits, indentified as undivided Old Alluvium (QToa), are derived from granitic bedrock sources consisting predominantly of gravel of varying sizes. These deposits are fairly dense to cemented and of mixed composition, and generally lack visual evidence of older surfaces and/or soil horizons. These deposits form deeply cut, steep topography with little or no evidence of previous surface topography being retained. These deposits are largely undivided (not segregated into other distinct identifiable geologic units) in terms of how the deposits were accumulated. The only extensive area within the proposed project area where this unit is directly observable is in the valley between the McCullough and Lucy Gray mountains.

Numerous Tertiary volcanic (andesite and basalt) flows (Tba/Tv) are exposed within the proposed project area and may contain some interbedded sedimentary rocks. Exposures of Paleozoic- to Mesozoic carbonate (limestone and dolomite) and siliclastic (sandstone, mudstone, and conglomerate) rocks are present within the proposed project area and are mapped as dolostone (OЄc). These rocks make up the bulk of Sheep Mountain north of the Lucy Gray Mountains, the Bird Spring Range, and the Spring Mountains.

The oldest metamorphic rocks (Xm) exposed in the proposed project area include highly metamorphosed, compositionally-layered, Precambrian rocks that overlie older basement rocks (Miller et al. 1999).

California

In California, Quaternary stream and valley alluvium, alluvial fan deposits (both younger and older), and lake and playa deposits are exposed along slopes and low-lying flats and valleys. These deposits generally overlie and/or are marginal to bedrock units that include Tertiary undifferentiated volcanic flows with some interbedded sedimentary rocks and Precambrian metamorphic and granitic rocks.

Alluvial fan deposits have been mapped mostly as generalized units (CDMG 1961, Miller et al. 1999), with some detailed segregation of younger and older, active to inactive units (USGS 2006). Recent Holocene alluvium (Qal) is a poorly sorted mixture of sand and gravel, typically uncemented, unconsolidated, and easily eroded by water or wind. The surface appears as an undulating topography, with little erosional cutting by stream channels. The alluvial fan deposits associated with this unit are characterized by surfaces and stream channels actively receiving sediments within the last few years or decades from ephemeral streams. These deposits may be prone to flooding in some areas. Unnamed lake and playa deposits in the valley bottoms and low-lying flat areas are identified as Quaternary Lake Deposits (Ql/Q). These deposits are similar to the playa deposits (Qp) mapped in Nevada. Older fan gravels that are characteristically elevated above the adjacent topography and eroded are identified as Middle and Early Pleistocene old alluvial fan deposits (Qoa) consisting of poorly sorted silt, sand, and gravel (CDMG 1971).

Earlier Precambrian Metamorphic rocks (pC/epЄ) are exposed within the proposed project area. These contain undifferentiated metamorphic rocks cut by roughly vertical igneous intrusions (dikes). These rocks are exposed in the Clark Mountains at and surrounding the Mountain Pass substation.

The above-described geological units are located within the proposed project area; however, the proposed routes do not intersect all of the above units. In general, longer routes encounter more geologically different units, although some of the more limited sections and alternatives may encounter a wider range of units as well. Table 3.6-2 provides a summary of the proposed routes, alternative routes, and associated geological unit(s).

In general, the important factors that affect construction in these units are foundation bearing capacity, slope/excavation stability (unit strength and slope angle), surface stability for roads/pads, excavatability (how easily the units can be excavated using standard earth-moving equipment), and chemical reactivity (typically corrosion) with concrete and steel. The cohesion (how well the sediments stick together) and composition (affects how easily the sediments can be made denser) of sediments down to tower foundation depths (20 to 40 feet) will impact foundation stability and excavatability. Material strength and cohesion and slope angles will affect slope stability (the tendency to slide); the steeper the slope and/or the weaker the unit, the more likely that the area is susceptible to landslides. Geologic unit cohesiveness and particle size gradation (a variety of particle sizes versus only one particle size) will impact road surface stability and pier excavation stability. Material type, age, and the natural environment within which the sediments were deposited will affect chemical characteristics, particularly corrosion potential.

Table 3.6-2 Geologic and Surficial Units Associated with the Proposed Project and Alternatives

Alternatives													
El Dorado–Ivanpah 220-kV Transmission Line – Telecommunication Line		Alternative Routes		State	Geologic Units								
					XM	pC (epЄ)	OЄc (MzPzs)	Tba	QToa		Qa	Q	
		(Proposed)		CA/NV	X			X			X	X	
		A		NV							X		
		B		NV							X		
		C		CA/NV			X				X	X	
		D		CA/NV							X	X	
		E (sub-)		NV							X		
Ivanpah Substation				State	Geologic Units								
					XM	pC (epЄ)	OЄc (MzPzs)	Tba	QToa		Qa	Q	
				CA							X		
Redundant Telecommunication Line + Alternatives	Section	Alternative Routes	Description	State	Geologic Units								
					XM	pC (epЄ)	OЄc (MzPzs)	Tba	QToa		Qa	Q	
	1		Mountain Pass + Golf Course	NV	X				X		X		
	2		Mountain Pass + Golf Course	CA/NV							X		
	3	1 + 2	Mountain Pass + Golf Course	CA							X		
	3	1	Mountain Pass	CA		X					X		
	3	2	Golf Course	CA							X	X	
	3A	MW Route		CA							X	X	

Source: USGS 2005

Slope stability issues are most important in the sections of the proposed and alternative transmission line routes where topography is steep and bedrock/basement rock is present (the McCullough Mountains and the hill northwest of Primm), which is a small portion of the overall project. Since most of the proposed project area is within the alluvial fan deposits, and most is underlain by younger and intermediate-age alluvial fan materials, foundation and excavation stability, chemical characteristics, and surface trafficability (ability of a given vehicle to traverse a specified terrain) are important.

Faulting and Seismicity

Several active (fault rupture within the past 11,000 years) and potentially active (fault rupture within the past 1.6 million years) faults related to regional strike-slip (mostly horizontal side-to-side motion) faulting, as well as to extensional tectonics (a pulling apart of the earth's crust) in the Great Basin and eastern Mojave Desert are present within 100 miles of the proposed project area (Table 3.6-3). The fault locations can be found on the Fault Activity Map of California (CDMG 1994).

Table 3.6-3 Summary of Active and Potentially Active Faults within 100-mile Radius of Proposed Project Area

		Estimated Maximum Earthquake Event		
Fault Name, Zone, or System	**Approximate Distance**[a] (miles)	**Maximum Earthquake Magnitude** (Mw)	**Peak Site Surface Acceleration** (g)	**Estimated Site Intensity** (Modified Mercali Scale)
Stateline Fault System	**3**[a] **(28)**[b]	**7.0**[c]	N/A	VII
Black Hills	**34**[a] **(3)**[b]	**6.8**	N/A	VI
Death Valley (south)	50	7.1	0.080	VII
Garlock (East)	50	7.5	0.098	VII
Owl Lake	65	6.5	0.047	VI
Pisgah-Bullion Mountain – Mesquite Lake	75	7.3	0.065	VI
Black Mountains	76	N/A	N/A	na
Death Valley (Graben)	78	7.1	0.069	VI
Panamint Valley	80	7.4	0.065	VI
Calico – Hidalgo	83	7.3	0.060	VI
Landers	91	7.3	0.056	VI
Camp Rock-Emerson South – Copper Mountain	92	7.0	0.047	VI
Gravel Hills – Harper Lake	94	7.1	0.050	VI
Blackwater	93	7.1	0.049	VI
Johnston Valley (Northern)	97	6.7	0.039	V
Tank Canyon	98	6.4	0.040	V
Lenwood-Lockhart-Old Woman Springs	99	7.5	0.059	VI

Source: CEC and BLM 2009 (Active fault data modified from Table 2.)
Notes:
[a]Distance measured from the Ivanpah substation location
[b]Distance measured from the El Dorado substation location
[c]Guest et al. (2007)
Key:
Bold Text = Faults that are near or cross the proposed project
N/A = Not available

Potential earthquake capable (active) faults close to the proposed project area are shown in Figure 3.6-2. One active fault (Black Hills) is located just north of the proposed project on the eastern flank of the McCullough Mountains trending toward the proposed transmission line route and possibly Transmission Alternative Routes A and B. A second active fault (the Stateline Fault System [SFS]) trending northwest-southeast and parallel to the state line just within California crosses the proposed transmission line route and Alternative Routes C and D. Earthquake activity on distant (greater than 50 miles), larger-scale active fault zones (e.g., the Garlock, Eastern California Shear Zone, Panamint Valley, Death Valley, Sevier-Toroweap) and the San Andreas could produce large-magnitude earthquakes that would be felt in the project area.

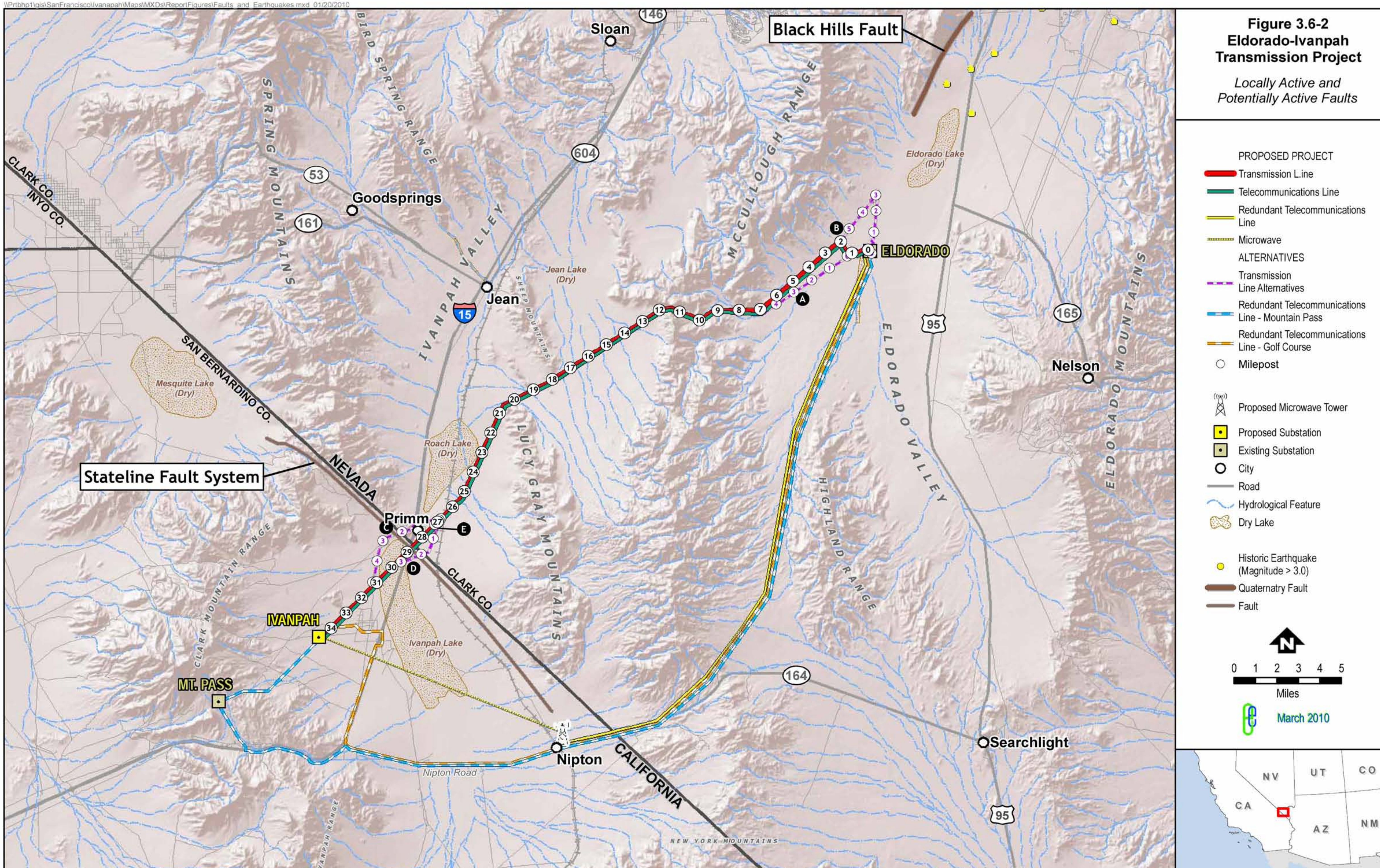

Figure 3.6-2
Eldorado-Ivanpah Transmission Project

Locally Active and Potentially Active Faults

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The Black Hills Fault is a complex, northeast trending, east-dipping (eastward sloping fault beneath the earth's surface) normal fault zone located in the northern McCullough Range along the western edge of Eldorado Valley that forms the northwestern structural boundary of the Eldorado Basin. A geologic basin is a structural depression in the earth's surface, a low area often filled with sediments, which may be folded or warped. The Black Hills Fault may be capable of producing a magnitude 6.4 to 6.8 earthquake.[1]

The SFS is the southern segment of the Pahrump Valley Fault Zone. This fault is an active right lateral (right-handed movement) shear zone and includes several previously recognized faults that are inactive, as well as some discontinuously exposed Quaternary faults (Guest et al. 2007). A shear zone is similar to a fault, but (unlike a fault) exhibits movement over a disperse area as opposed to movement that is offset along a distinct fracture. The SFS lies at the northeastern edge of the Eastern California shear zone, an active north–northwest trending, 124-mile-long right-lateral strike-slip shear zone (Guest et al. 2007, USGS 2006) located at the California-Nevada border. The SFS is defined as a continuous zone of faults and shear zones separated into three segments (the Amargosa Valley, Pahrump, and Mesquite segments), with the Mesquite segment passing through the proposed project Area (CDMG 1961, 1994; San Bernardino County 2007). These data suggest that earthquakes on the SFS may be large but infrequent. Although available evidence suggests that earthquakes greater than magnitude 7 occur on the SFS (Menges et al. 2003), recurrence intervals on the SFS have been estimated to be greater than 10,000 years (Anderson 1998, Menges et al. 2003), suggesting a low probability for a large earthquake associated with the fault system (Guest et al. 2007). Other faults in the proposed project area are pre-Quaternary (not active or potentially active based on existing data) and cross or project toward the proposed transmission line route in the McCullough Mountains (Stewart and Carlson 1978). Two of these faults (unnamed) appear to cross the route. It is likely that these faults are represented by highly fractured basement rock (rock beneath the overlying sediments) that may affect engineering qualities of the material and serve as conduits (pathways) for spring flow.

There are few earthquakes (USGS 2008b) greater than magnitude 3.0 reported within 50 miles of the central portion of the proposed project area (at the north end of the Lucy Gray Mountains). One event of magnitude 6.1 (November 1911) was reported about 40 miles to the southwest of the proposed project area, just north of Baker, California; no specific information was found for this event and its location is considered poorly defined. Approximately 30 to 45 miles to the northeast, four events of magnitude 4.5 to 5.0 occurred just north of Boulder City, Nevada. A cluster of nine magnitude 3.0 to 3.9 events occurred west-northwest of the proposed project area on the California side of the border between Pahrump and Mesquite valleys. At least seven magnitude 3.0 to 3.9 events occurred on a northeast to southwest trend from Boulder City to the north end of Eldorado Lake, likely associated with the active Black Hills Fault.

Soils

The soils within the proposed project area generally reflect the underlying geologic unit(s). Soil formation depends on the extent of weathering of the unit(s), which is governed by the ground surface slope, the long-term climate, vegetation cover, the degree of human modification, and time. All but a small portion of the proposed project is within close proximity to existing transmission lines towers and roads that pass through otherwise undeveloped land. Small portions are proposed to traverse the east or north edges of Primm, Nevada (proposed transmission line route, Transmission Alternative Routes C and D, and Transmission Sub-Alternative route E), and along State Route (SR) 164 or the Union Pacific Railroad (UPRR) tracks near Nipton. No agricultural or rural residential land is within the proposed project area.

[1] The most common measurements of earthquake magnitude are the moment magnitude (Mw) and Richter (local) magnitude, although sometimes surface wave magnitude or body wave magnitude may be used. Some data sources do not state which is provided, so the original source and further referenced sources should be consulted for more certain indication of which measurement was used.

A summary of the significant characteristics of the major soil associations (National Resources Conservation Service [NRCS] 2008) traversed by the Eldorado–Ivanpah route segments is presented in Table 3.6-4. The soil associations are listed in numerical, rather than geographic, order. There are 19 soil units identified; 14 are in Nevada and five are in California. Included in the table are the NRCS soil unit identification number, the soil association name, the estimated expansion potential, and the concrete and steel corrosion potential. The NRCS information is generalized data gathered at widely spaced locations and should be considered for planning purposes, rather than for site-specific engineering. The majority of the soils in the proposed project area are sand and gravel-rich and excessively drained to well-drained, which reduces erosion potential.

Table 3.6-4 Summary of the Significant Characteristics of Major Soil Associations

NRCS Unit ID	Soil Association	Description	Shrink/Swell Potential[1]	Concrete Corrosion[2]	Uncoated Steel Corrosion[2]
Nevada					
140 and 143	Haleburu	Colluvium and/or weathered from volcanic rock; well-drained.	L	L	H
150	Hypoint	Mixed alluvium; somewhat excessively drained.	L	L	H
313	Weiser-Oldspan-Wechech	Alluvium parent material derived from limestone and dolomite; well-drained.	L–M	L	H
380	Tonopah-Arizo	Alluvium parent material derived from mixed sources; excessively well-drained.	L–M	L	H
391	Tipnat-Bluepoint-Hypoint	Mixed alluvium parent material; well-drained.	L–M	H	H
400	Arizo-Cafetal	Mixed alluvium parent material; excessively drained.	L–M	L	H
430	Bluepoint-Tipnat-Grapevine	Eolian (wind blown) sands parent material; excessively drained.	L–M	L	H
450	Arizo	Mixed alluvium parent material; excessively drained.	L	H	H
500	Playa	Lacustrine (lake) deposits parent material; very poorly drained.	M–H	H	H
622	Orwash-Arizo-Lanip	Mixed alluvium parent material derived from granite; somewhat excessively drained.	L	L	H
651	Peskah-Arizo	Alluvium parent material derived from volcanic rock; well-drained	L–M	L	H
754	Haleburu-Hiddensun	Colluvium and/or weathered from volcanic rock; well-drained.	L	L	H
780	Prisonear	Eolian (wind blown) sands over alluvium derived from limestone; well-drained.	L	L	H
California					
3520	Arizo	Alluvium derived from metamorphic and sedimentary rock; excessively well-drained.	L–M	L	H
3650	Weiser	Alluvium parent material derived from limestone and dolomite; well-drained.	L–M	H	L
3660	Colosseum	Alluvium parent material derived from limestone and dolomite; somewhat excessively drained.	L–M	L	H

Table 3.6-4 Summary of the Significant Characteristics of Major Soil Associations

NRCS Unit ID	Soil Association	Description	Shrink/Swell Potential[1]	Concrete Corrosion[2]	Uncoated Steel Corrosion[2]
4180	Peskah-Arizo	Alluvium parent material derived from volcanic rock; well-drained.	L–M	L	H
Playa (see Nevada 500)	Playa	Lacustrine (lake) deposits parent material; very poorly drained.	M–H	H	H

Source: NCRS 2008

Notes:

[1]Shrink/swell potential (expansion potential) characteristics are very generally defined as “low = L”, “moderate = M”, or “high = H” based on the NCRS Unified Soil Classification of the soil unit. Shrink/swell characteristic descriptions are general in nature and adequate for planning purposes; the actual expansion coefficient for each soil unit may vary widely depending on site-specific subsurface conditions, which must be determined by site-specific geotechnical sampling, testing, and analysis.

[2]Corrosion risks for concrete and uncoated steel are generally defined as “low = L”, “medium = M”, or “high = H” based on the NCRS Unified Soil Classification of the soil unit. Corrosion characteristic descriptions are general in nature and adequate for planning purposes; the actual corrosion indices for each soil unit may vary widely depending on site-specific subsurface conditions, which must be determined by site-specific geotechnical sampling, testing, and analysis.

Key:
H = High
L = Low
M = Medium

3.6.1.2 Geologic Hazards

Fault Rupture

A factor considered in the seismic (earthquake) design of project structures is the location of active faults that may cross a transmission line route or affect a substation or other structures. An estimate of the amount and type of potential surface fault displacement (offset) within the proposed project area considers the SFS Mesquite segment and the Black Hills Fault (Figure 3.6-2). There is substantial uncertainty as to the location of these faults. The Mesquite Fault segment crosses the proposed transmission line route and Transmission Alternative Routes C and D along the California-Nevada border at Primm nearly perpendicular to the proposed transmission line route, at a 20- to 70-degree angle to Alternative Route C and at a 60- to 70-degree angle to Sub-Alternative Route D.

Ground Shaking

The intensity of the seismic shaking (strong ground motion) during an earthquake in the project area would depend on the distance between the area and the epicenter (point at the earth’s surface directly above the initial movement of the fault at depth) of the earthquake, the magnitude (seismic energy released) of the earthquake, and the geologic conditions underlying and surrounding the proposed project area. Earthquakes occurring on faults closest to the project area would most likely generate the largest ground motion.

The USGS provides a uniform estimate of the intensity (strength; not to be confused with magnitude) of earthquake-induced ground motion based on an up-to-date assessment of potential earthquake faults or other sources. A commonly used benchmark is peak horizontal ground acceleration. The probability of occurrence for this peak is given as a fraction of the acceleration of gravity (g; 0.2). The approximate estimated range of peak ground acceleration for a probability of 2 percent (0.02) in 50 years in the proposed project area is presented in Table 3.6-5. Applying the peak ground acceleration shaking map for the 7.3 magnitude Landers earthquake (CISN 2008) to the Mesquite segment of the SFS, the peak ground accelerations would have been similar to those shown in the table. Overall, this estimate of earthquake intensity at the Mesquite segment of the SFS suggests that strong ground shaking would be within the levels experienced in the Landers earthquake area in 1992 and the Hector Mine earthquake in 1999, both in the Mojave Desert region. Electrical transmission lines experienced some damage in each of these earthquakes.

Table 3.6-5 Approximate Estimated Range of Peak Ground Acceleration

Project Facility	Estimate Based on 2% in 50 Years Peak Horizontal Ground Acceleration (g)	Estimate of SFS Earthquake Intensity Based on Magnitude 7.3 Landers 1992 Earthquake (g)
Proposed Transmission Line Route Segments		
Eldorado to McCullough Mountains	0.16 to 0.20	0.20 to 0.25
McCullough Mountains	0.15 to 0.16	0.20 to 0.25
McCullough Mountains to Ivanpah	0.12 to 0.15	0.18 to 0.50
Transmission Alternative/Subalternative Routes		
A	0.16 to 0.17	0.18 to 0.20
B	0.17 to 0.20	0.15 to 0.18
C	0.13	0.40 to 0.50
D	0.13	0.40 to 0.50
E	0.13	0.40 to 0.50
Ivanpah Substation		
Ivanpah Substation	0.12	0.35
Telecommunications Alternatives and Microwave Tower		
Conduit Near Ivanpah Substation	0.13	0.35
Conduit East of Nipton	0.12 to 0.13	0.30 to 0.45
Conduit West of Nipton	0.12 to 0.14	0.30 to 0.45
Microwave Tower	0.12 to 0.13	0.30 to 0.45

Source: USGS 2008a, CISN 2008
Key:
g = Acceleration of gravity

Liquefaction

Liquefaction occurs primarily in saturated, loose, fine- to medium-grained soils in areas where the groundwater table is within approximately 50 feet of the ground surface. Shaking causes the soils to lose strength (that is, lose their ability to stick together) and behave as a liquid. Liquefaction, which can include lateral spreading, subsidence, buoyancy effects, and loss of bearing strength (the ability to support a load such as a building foundation), is caused when these sediments temporarily lose their shear strength during strong ground shaking. Susceptibility to liquefaction is a function of the sediment density, water content, depth, and peak ground acceleration. Over most of the proposed project area liquefaction would be very unlikely due to groundwater depth (generally much greater than 50 feet). Geologic material in the project area have the potential to include substantial clay- and silt-rich units (playas and playa fringe areas) and areas with a high percentage of coarse sedimentary particles such as gravel, cobbles, and boulders (intermediate and older alluvial fans), and some units with calcium carbonate cementation (some intermediate and older alluvial fans). Neither the San Bernardino County General Plan Safety Element nor the Clark County Comprehensive Plan indicates liquefaction potential within the proposed project area. The most likely exceptions would be around the perimeter of playas (playa fringes) where sand layers could be saturated with perched water; that is, shallow groundwater of limited extent that is situated on top of a layer of clay. Such conditions where liquefaction could be produced by rupture of a fault would be determined by geotechnical investigations as recommended in APM GEO-1.

Landslides

Landslides, rockfalls, and debris flows occur continuously on all slopes; some processes act very slowly, while others occur very suddenly, with potentially disastrous results. Rockfalls and debris flows are examples of earth movements that occur rapidly, often without warning. Landslides do occur rapidly without warning but can also provide signs of movement before the slide moves completely. Most of the proposed project area is in low to moderately sloping topography containing sandy and gravelly alluvium that is not susceptible to landslide effects. About 10 percent of the proposed transmission line route (McCullough Mountains segment) and 20 percent of Transmission Alternative Route C pass through areas with moderately steep to very steep topography containing highly weathered and fractured bedrock/basement rock. These areas may be susceptible to rockfall and rotational (landslide) movement of moderate to large sections of hillslope within or adjacent to the route. Such movements can have damaging effects. No landslides have been designated on maps reviewed for this study; however, rockfall hazards could include blocks from a few feet to over 10 feet in diameter.

Subsidence

Subsidence is the settling of the ground surface due to compaction (consolidation) of underlying unconsolidated (loosely packed) sediments. Subsidence is most common in uncompacted soil, thick unconsolidated alluvial material, and improperly constructed artificial fill. Subsidence due to groundwater withdrawal is possible due to substantial pumping; however, there are no known records of such conditions in the proposed project area. Continued and/or increased groundwater withdrawal or dewatering from the Ivanpah and Eldorado valleys may cause an overdraft condition (where groundwater removal exceeds recharge). If that occurs, signs of subsidence could be observed. Many years or decades may be needed for the effects of excessive removal of groundwater to be manifested. Local subsidence in the form of sinkholes has been observed along the northern edge of Ivanpah Dry Lake. While groundwater withdrawal or other factors may cause subsidence, in this case the cause is believed to be from dehydration of clays between the soil surface and the water table due to fluctuations in hydrology. This dehydration can result in a major loss of volume, and thus the collapse of overlying soils (CEC and BLM 2009).

Earthquake-induced ground cracking may have many causes, but on low to moderate slopes (a few to several degrees) there would be little to no impact expected from ground cracking for transmission line towers with deep foundations. Within the proposed project area, ground cracking potential exists along the McCullough Mountains segment and the bedrock portion of Alternative Route C.

Expansive Soil

Expansive soils shrink or swell with changes in moisture content. This characteristic is typically associated with high clay content soils. Changes in soil moisture could result from a number of factors, including rainfall, landscape irrigation, utility leakage, and/or perched groundwater. Expansive soils are typically very fine-grained with high to very high percentages of clay. In Nevada, the soils encountered in the areas of the proposed project and alternative routes exhibit expansion potential that is generally low or low to moderate, with one unit (playa) having a moderate to high potential. In California overall, the potential for expansive soils is generally low to moderate, with one high unit (playa).

Collapsible Soils

Collapsible soils are those that decrease in volume and settle when soil structure changes due to wetting of partially saturated subsoil. Typically, collapsible soils occur predominantly at the base of mountains, where Holocene alluvial fan and wash sediments have been deposited during rapid runoff events. Moreover, seismically-induced ground settlement can occur during strong ground shaking in alluvium if deposits have a low relative density and are dynamically compacted and their volume is thereby reduced. Differential settlement can damage structures placed across such susceptible areas.

3.6.1.3 Mineral Resources

Mineral resources consist of oil and gas and deposits of rock, sand, and gravel. Publically available literature, maps, and online sources were used to evaluate potential impact to mineral resources in the proposed project area. Non-metallic and metallic mineral deposits occur within the general proposed project area and to the west in the Clark Mountains (CDMG 1953). However, no mining of metallic deposits was identified within 1,000 feet of the project components considered herein. Non-metallic deposits within the project area include pumice, feldspar, limestone, and sand and gravel, with sand and gravel potential being the highest along the transmission and telecommunication routes.

North and south of SR 164, between 6 and 17 miles east of Nipton, in the general proximity of the proposed redundant telecommunications Line (Path 2), there are operations for perlite, gold, silver, lead, molybdenum, copper, fluorite, and feldspar (USGS 2009). The proposed Mountain Pass Telecommunications Line intersects the Molycorp Mine, a large rare-earth mine near Mountain Pass, California, hereafter called the Mountain Pass Mine. This may be the only active mine near the California portion of the project. Proximal to the proposed transmission line route in Jean Valley and the McCullough Mountains are sand and gravel and pumice surface mines. As shown in Figure 3.6-3, there are areas (green squares) within BLM land all along the proposed and alternative routes for which there have been mining claim activity. Based on 1996 claims data, approximately two-thirds of the claims are "closed" (Hyndman and Campbell 1999). Davis (2002) indicated that the "Money Pit" in Jean Valley more than 1 mile north of the proposed transmission line route may be the only active mine near the Nevada portion of the project area. However, the Jean Quarry and Sierra Ready Mix Quarry, which are both listed as active operations, are also located less than 1 mile north of the proposed transmission line route (NBMG 2006). While several other operations and mines are in the general area of the proposed routes, they do not appear to be close enough to experience any impact from the project.

The USGS Mineral Resource Data System (MRDS) indicates that there are a few past and current mining locations in the vicinity of the proposed project, but none are located within 1,000 feet of either side of the proposed transmission line route or alternative routes. Based on the available data, the proposed project is not expected to impact any mining activities. This is explained further below.

Eldorado to McCullough Mountains (Proposed Route)
There are no active mines identified in the USGS MRDS database within 1,000 feet of this segment, and there is no known ongoing mineral resource recovery near this segment. In addition, there is almost no mining claim activity along the segment.

McCullough Mountains (Proposed Route)
While there are mining claims in the general area along the segment, there is no known ongoing mineral resource recovery near or close to this segment that would potentially be impacted, and there are no active mines identified in the USGS MRDS database within 1,000 feet of this segment.

McCullough Mountains to Ivanpah Substation (Proposed Route)
There is substantial mining claim activity several miles to the northwest of this segment in the Spring Mountains. Other activity along this proposed route is recorded, but is typically set back 1 or more miles from the segment. There is no known ongoing mineral resource recovery close to this segment that would potentially be impacted; no active mines are identified in the USGS MRDS database within 1,000 feet of this segment.

Alternative Route A (South and West of Eldorado Substation)
There is no mining claim activity along this segment and no known ongoing mineral resource recovery near this segment, and no active mines are identified in the USGS MRDS database within 1,000 feet of this segment.

Alternative B (North and West of Eldorado Substation)
There is no mining claim activity along this segment, no known mineral resource recovery ongoing near this segment, and no active mines are identified in the USGS MRDS database within 1,000 feet of this segment.

Alternative Route C (West and Southwest of Primm, Nevada)
While there is substantial mining claim activity along this segment, there are no active mines identified in the USGS MRDS database within 1,000 feet of this segment, and there is no known ongoing mineral resource recovery near this segment.

Alternative Route D and Subalternative E (South and East of Primm, Nevada)
There is substantial mining claim activity along this segment; however, there are no active mines identified in the USGS MRDS database within 1,000 feet of this segment and there is no known ongoing mineral resource recovery near this segment.

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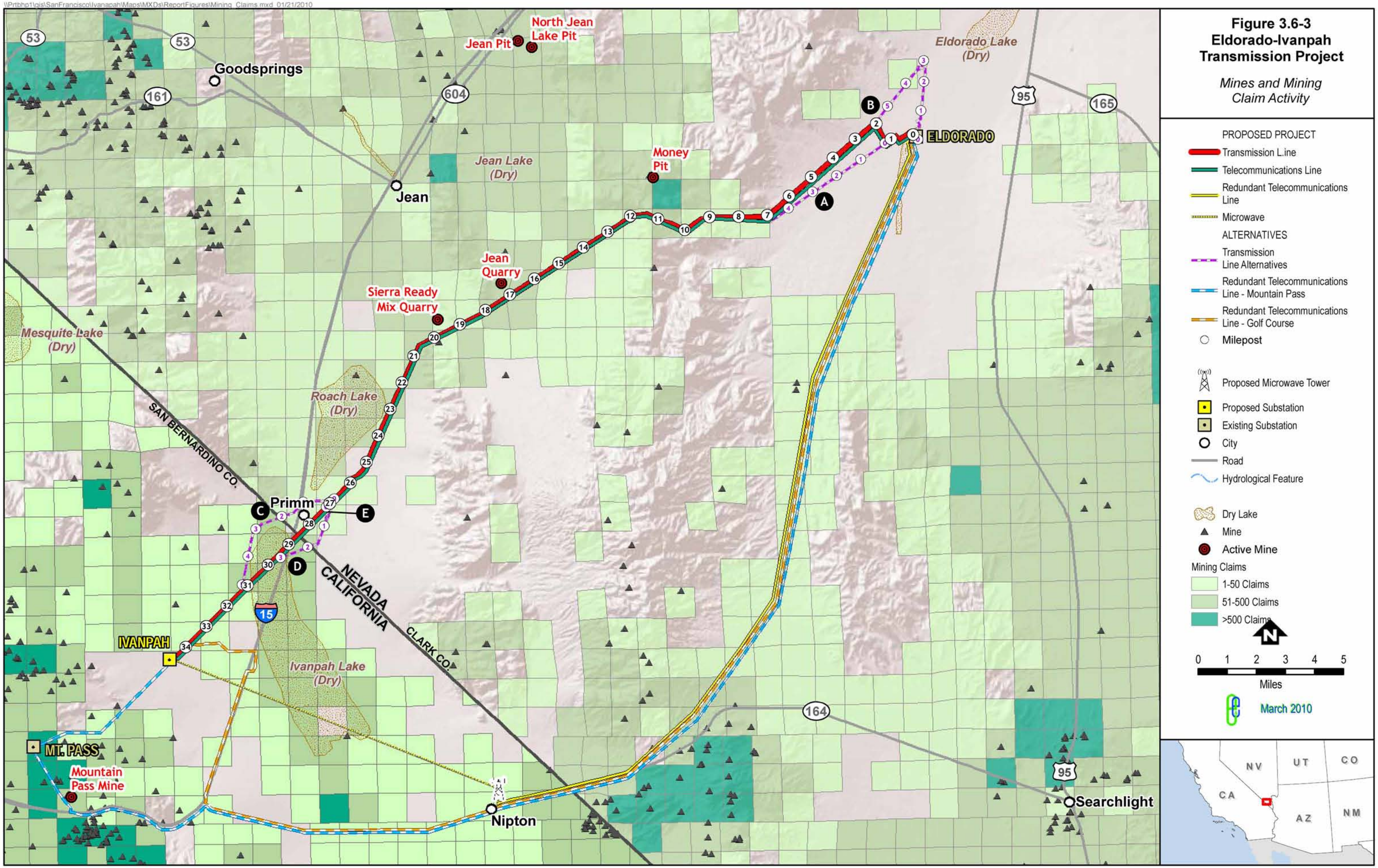

Figure 3.6-3
Eldorado-Ivanpah Transmission Project
Mines and Mining Claim Activity

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Ivanpah Substation

The USGS MRDS database indicates no mining claim activity at the substation site, no known ongoing mineral resource recovery near the site, and no active mines identified within 1,000 feet of the site.

Redundant Telecommunication System and the Microwave Tower

Mountain Pass Alternative and Golf Course Alternative

There is mining claim activity in the vicinity of these short conduit routes, but no known ongoing mineral resource recovery is near these segments, and no active mines are identified in the USGS MRDS database within 1,000 feet of these segment.

Microwave Tower Northeast of Nipton

There is some mining claim activity in the area of this site, including one operation about one-half mile east of this location and one active mining operation about one-half mile to the northeast, but there are no active mines identified in the USGS MRDS database within 1,000 feet of this site.

3.6.1.4 Paleontology

Regional Setting

The proposed project crosses over a number of geologic rock units (Table 3.6-2). The following section describes each geologic unit's extent, rock type, and age, with an emphasis on paleontology and paleontological sensitivity (likelihood of containing scientifically significant fossils). To provide more detailed paleontological data, the geologic unit classifications below are drawn from a different data set than that used to compile Figure 3.6-1. Therefore, not every unit described below is displayed in Figure 3.6-1.

The BLM's Potential Fossil Yield Classification (PFYC) system is used to classify geologic units (BLM 2007). The BLM established the PFYC system to quantify the occurrence of paleontological resources on public lands and the risk of impacting them. Geologic units are assigned a classification between 1 (lowest) and 5 (highest). The PFYC system is used by BLM to assess impacts to paleontological resources and suggest appropriate mitigation measures.

Table 3.6-6 shows that units in the project area have either a high or a low sensitivity for paleontological resources that may be present on the surface or could be exposed during ground-disturbing construction activities, based on the Society of Vertebrate Paleontology (SVP) guidelines (1995). The BLM PFYC is also included in the table.

Table 3.6-6 Paleontological Sensitivity of the Lithologic Units Underlying Portions of the Project Area in San Bernardino County, California ,and Clark County, Nevada

Lithologic Unit	Paleontological Sensitivity[a]	PFYC[b]
Quaternary alluvium	High	4
Quaternary lake/playa deposits	High	4
Quaternary nonmarine (Quaternary older alluvium)	High	3
Late Tertiary–Quaternary older alluvium	High	3
Tertiary volcanics	Low[c]	2
Paleozoic–Mesozoic sedimentary rocks	Low[d]	3
Precambrian intrusive and metamorphic rocks	Low	1

Notes:
[a]SVP 1995
[b]BLM 2007
[c]High, if sedimentary rocks are present
[d]High, if solution caves and/or vertebrates are present
Key:
PFYC = Potential Fossil Yield Classification (scale of 1–5, with 1 the lowest)

Quaternary alluvium (Qa, Qal)

Quaternary alluvium (late Pleistocene and Holocene) has been mapped at the surface along the length of the project corridor in California and Nevada (Jennings 1961, Longwell et al. 1965, NBMG 2006). Throughout southern California these units have been repeatedly demonstrated to be highly fossiliferous, yielding the remains of large extinct Ice-Age (Pleistocene) mammals such as mammoths, mastodons, camels, sabertoothed cats, tapirs, sloths, and horses as well as amphibians (salamanders, frogs, toads), reptiles, birds, and small mammals (Jefferson 1991a, 1991b; Reynolds et al. 1991e; Woodburne 1991; Springer and Scott 1994; Scott 1997; Springer et al. 1998, 1999, 2007; Anderson et al. 2002) and the Mojave Desert (Jefferson 1989, 1991a, 1991b; Reynolds 1989; Scott 1997; Scott and Cox 2002, 2008). Near the northern end of Ivanpah Dry Lake, for example, large mammal bone fragments were recovered from sediments mapped as Quaternary alluvium identical to that along portions of the proposed route (Longwell et al. 1965). Similarly, surface exposures of Quaternary alluvium near Glendale, Nevada, yielded mammal fossils including a tooth of extinct horse (*Equus* sp.). These sediments would have a high potential to contain significant paleontological resources. Under the BLM PFYC system, the units would be rated Class 4.

Quaternary lake/playa deposits (Ql/Qp)

These flat-lying deposits in Ivanpah and Roach Dry Lakes consist of light gray to light brown silt, clay, and minor sand. Although modern at the surface, these lake/ playa sediments increase in age with depth, perhaps to the late Pleistocene. These fine-grained sediments often preserve late Pleistocene and Holocene invertebrates (freshwater clams and snails; Taylor 1967, Reynolds et al. 1991d, Jefferson et al. 2004), smaller vertebrates (fish, amphibians, reptiles, birds, and small to medium-sized mammals), and larger extinct vertebrate fossils such as mammoths, mastodons, horses, sloths, and camels (Jefferson 1991b, Reynolds et al. 1991d, Jefferson et al. 2004). Mifflin and Carlson (1979) in their study of pluvial (late Pleistocene) lakes of Nevada could not find shoreline features or an overflow channel and interpreted the age of Ivanpah-Roach Dry Lake basin as recent. However, the Ivanpah-Roach Dry Lake may have been combined into one larger lake than the present lakebed and possibly present during the late Pleistocene, based on clasts of tufa (fragments of carbonate-based minerals deposited in a lake environment) from an Ivanpah Lake Dry high stand or shoreline. These sediments would have a high potential to contain significant paleontological resources. These units would be rated Class 4.

Quaternary non-marine deposits (Qoa/Qc)

Quaternary non-marine deposits (mapped as Quaternary older alluvium) have been mapped at the surface along the project corridor in the vicinity of the Clark Mountains in California (Jennings 1961). These deposits consist of poorly sorted debris that range from pebble to boulder in a matrix of brown silt derived from Clark Mountain. Elsewhere, older Pleistocene sediments throughout southern California (Jefferson 1991a, b; Reynolds and Reynolds 1991e; Woodburne 1991; Springer and Scott 1994; Scott 1997; Springer et al. 1998, 1999, 2007; Anderson et al. 2002) and the Mojave Desert (Jefferson 1989, 1991a, 1991b; Reynolds 1989; Scott 1997; Scott and Cox 2002, 2008) have been repeatedly demonstrated to be highly fossiliferous. Where present at the surface or at depth, these sediments have the potential to contain significant paleontological resources. The units would be rated Class 3.

Quaternary Tertiary Older Alluvium (Qtoa)

These alluvial fan deposits are derived from granitic rocks sources in the vicinity of the McCullogh and Lucy Gray mountains and are Late Miocene to early Pleistocene in age. Although these sediments are predominately coarse grained, that is, sand and gravel, old buried soils (paleosols) are present in several horizons (NBMG 2006). These soil horizons, which could yield significant vertebrate fossils such as small mammals, were present at the surface or at depth along the proposed project. These sediments would have high potential to contain significant paleontological resources. The units would be rated Class 3.

Tertiary volcanic rocks (Tba/Tv)

Surface exposures of these rocks have been mapped along the project corridor in the McCullough Range in Nevada (Longwell et al. 1965). Tertiary volcanic rocks in the Mojave Desert have low potential to contain significant fossil resources. However, it is possible to have inclusions of sedimentary rocks within volcanic rocks. These sedimentary inclusions have the potential to contain significant fossil resources; therefore, these volcanic rocks would be assigned a high paleontological sensitivity. To the south near Needles, ash-rich lacustrine sediments within volcanic rocks yielded middle Miocene (15 mybp) flora and fauna consisting of the fossil remains of a sequoia, wood, conifer needles, ostracods, flamingo footprints, a pika, a coyote-sized dog, a bobcat-sized cat, a rodent, an antelope-sized cervoid, two camels, and a rhino. The rocks would be rated Class 2.

Paleozoic and Mesozoic sedimentary rocks (OЄc/MzPzs)

Undivided Paleozoic and Mesozoic rocks have been mapped at the surface along the proposed project corridor in the Clark Mountain vicinity, California (Jennings 1961, NBMG 2006). Because of mapping difficulties, Paleozoic-Mesozoic carbonate rocks such as limestone and dolomites, and terrigenous rocks such as sandstones, mudstones, and conglomerates, have been placed in this broad rock unit. In this area, some of these rocks were deposited in ancient shallow seas and generally yield a wide variety of marine fossil invertebrates such as sponges, brachiopods (primitive clams), gastropods (snails), pelecypods (advanced clams), trilobites, graptolites (marine kelp-like animals), and echinoderm crinoids (related to starfish, sand dollars, and sea urchins; Dames and Moore 1992). Fossils of this nature are abundant and widespread throughout the southern Nevada and eastern California region, to such a degree that these fossils are not generally considered to have high paleontological significance. Near Stateline, California, paleontology monitors on the Intermountain Power Project found many marine invertebrates in rocks of the Mississippian Monte Cristo Formation (Hewitt 1931, Reynolds 1986, Moore 1991). Also, during construction on the Kern River Pipeline project, marine invertebrates (clams, snails, corals) were collected from rocks of the Bird Spring Formation (Pennsylvanian) and Kaibab Limestone (Dames and Moore 1992). Time-diagnostic invertebrates from these limestone rocks have somewhat higher significance, but are still relatively common in the region. Elsewhere, middle- to late-Paleozoic limestone in this area has the potential to yield teeth and bones of early bony fishes and sharks. For example, just north of the City of Las Vegas, fossil shark teeth were collected from the surfaces of Mississippian limestone of the Battleship Wash Formation in the Arrow Canyon Range (Langenheim et al. 1962). Also, during construction of the Kern River Pipeline project, the first fossil bony fish remains (teeth) were recovered from the Mississippian Monte Cristo Formation and Kaibab Limestone in Nevada (Dames and Moore 1992). Any vertebrate remains recovered from Paleozoic or Mesozoic sedimentary rocks would be highly significant. There is a potential for vertebrate fossils and trackways in the Mesozoic sedimentary rocks. Recently, fossil dinosaur and pterosaur (flying reptiles) tracks have been reported from the early middle Jurassic Aztec Sandstone of the nearby Mescal Range in eastern San Bernardino County (Reynolds 2006a, 2006b).

The undivided Paleozoic and Mesozoic rocks have a low potential to contain significant paleontological resources, but in limestone and marble, there is a potential for solution caves that contain significant fossils. In the past, these caves were often open at the surface, and accumulated bones of various kinds of animals from raptors and other predators dropping remains into the opening, or from the remains of animals that inhabited the cave. Other animals such as pack rats built nests and also collected bones from around the cave entrance. Many of these caves are older than 10,000 years and elsewhere in the Mojave Desert have yielded the remains of large, extinct, late Pleistocene mammals such as camel, horse, and sloth (Mead and Murray 1991, Reynolds et al. 1991a, Whistler 1991, Gromney 2003, Jefferson et al. 2004, Museum of Paleontology, University of California, Berkeley 2009) as well as smaller mammals, amphibians, reptiles, and birds (Goodwin and Reynolds 1989; Force 1991; Reynolds et al. 1991a, 1991b, 1991c; Jefferson et al. 2004). If cave deposits were encountered during construction at depth anywhere along the proposed project, they would be considered scientifically significant. The Paleozoic-Mesozoic sedimentary rocks would be rated Class 3.

Earlier Precambrian intrusive and metamorphic rocks, undivided (pC/ePЄ) in California and Ancient intrusive and metamorphic rocks (Xm) (undivided Proterozoic) in Nevada

Two similar metamorphic (rocks that have been altered by heat and pressure) basement rocks occur in the southern McCullough Range in Nevada and in the Clark Mountain in California. Earlier Precambrian metamorphic rocks in the Clark Mountains (Jennings 1961, Longwell et al. 1965) and the ancient intrusive and metamorphic rock (NBMG 2006) undivided (Proterozoic) in the McCullough Range in the proposed project area consist of granite, granite gneiss, schist, granitic augen gneiss, quart monzonite, marble, and schist. Due to the heat and pressure associated with the formation of igneous and metamorphic rocks, these rocks have low potential to contain significant paleontological resources (SVP 1995). The rocks would be rated Class 1.

Records Search

The Regional Paleontological Locality Inventory at the San Bernardino County Museum (SBCM) shows that several paleontological resource localities are recorded within 1 mile of the proposed project. The applicant-prepared PEA stated that the nearest paleontological resource locality (SBCM 1.2.5) is located on the California-Nevada border approximately 300 feet northwest of the proposed route. This locality yielded indeterminate large mammal bone fragments from sediments mapped as Quaternary alluvium by Longwell et al. (1965). Additionally, localities SBCM 1.2.1 through 1.2.4 near the proposed route in Sections 35 and 36 of T 17N, R 14E have produced fossil remains of tortoise (*Gopherus* sp.), kangaroo rat (*Dipodomys* sp.), wood rat (*Neotoma* sp.), and other small vertebrates, as well as a partial hackberry seed (*Celtis* sp.) and clasts of tufa from the high stand of Ivanpah Dry Lake. Fossil hackberry seeds are abundant in nearby cave deposits which contain Pleistocene vertebrate faunas (Reynolds et al. 1991b). Tufa is common at the top of the sedimentary section at several Pleistocene lakes in San Bernardino County, including Piute Valley and Cadiz. However, none of the localities near Ivanpah Dry Lake has yielded temporally diagnostic fossil remains. For this reason, a Pleistocene age for these faunas can be suggested, but not demonstrated.

The online records search for microfossil, plant, invertebrate (clams and snails), and vertebrate (animals with backbones) localities conducted at the Museum of Paleontology, University of California, Berkeley (Museum of Paleontology, University of California, Berkeley 2009) indicated no previously recorded paleontological resources within a mile of the proposed project area.

A search of the data base of Late Pleistocene vertebrate localities for California (Jefferson 1991a, 1991b) and for Nevada (Jefferson et al. 2004), which included institutional records and published references, indicated no known paleontological resource localities are recorded within a mile of the proposed project.

3.6.2 Applicable Laws, Regulations, and Standards

Geologic resources and hazards are governed primarily by local jurisdictions. The conservation elements and seismic safety elements of city and county general plans contain policies for protection of geologic features and avoidance of hazards, but do not specifically address transmission line construction projects. Local grading ordinances establish detailed procedures for construction. The following section provides a summary of federal, state, and local laws, regulations, and standards that govern geology, soils, minerals, and paleontology in the project area.

3.6.2.1 Federal

National Environmental Policy Act of 1969, as amended

The National Environmental Policy Act (NEPA; 42 USC 4321 et seq.) was signed into law on January 1, 1970. NEPA establishes national environmental policy and goals for the protection, maintenance, and enhancement of the environment and it provides a process for implementing these goals within the federal agencies. The NEPA process consists of an evaluation of the environmental effects of a federal undertaking. It includes an evaluation of alternatives. There are three levels of analysis depending on whether an undertaking could significantly affect the environment. From least to greatest complexity, these are (1) categorical exclusion determination, (2) preparation of an Environmental Assessment/Finding of No Significant Impact, and (3) preparation of an EIS.

Under NEPA, the terms "effects" and "impacts" are used synonymously. Direct or primary impacts are those caused on site by the project itself, and that occur at the same time and place as the project. Indirect impacts can be reasonably foreseen to be caused by the project but that occur later or further away. Under NEPA, indirect impacts also may be referred to as secondary effects. The potential effects on geological, soil, mineral, and paleontological resources from construction and operation of the proposed project are considered in this analysis. The BLM is responsible for NEPA analysis for this project.

International Building Code

The 2006 International Building Code (IBC) is a model building code developed by the International Code Council (ICC). The IBC sets rules specifying the minimum acceptable level of safety for constructed objects such as buildings. It has been adopted throughout most of the U.S. The IBC has no legal status until it is adopted or adapted by government regulation, which it has been by both California and Nevada. The IBC was developed to consolidate existing building codes into one uniform code that provides minimum standards to ensure the public safety, health, and welfare insofar as they are affected by building construction and to secure safety to life and property from all hazards incident to the occupancy of buildings, structures, or premises. The IBC replaced the Uniform Building Code (UBC) in 2000.

Federal Land Policy and Management Act of 1976, as amended

The Federal Land Policy and Management Act (FLPMA) established policies and goals to be followed in the administration of public lands by the BLM. The intent of the FLPMA is to protect and administer public lands within the framework of a program of multiple-use and sustained yield, and to maintain environmental quality. Particular emphasis is placed on protection of the quality of scientific, scenic, historic, ecological, environmental, air and atmospheric, water resources, and archeological values. The FLPMA dictates how BLM regulates mineral resources extraction on BLM land.

Bureau of Land Management

The BLM, an agency within the U.S. Department of the Interior, administers 261 million surface acres of public lands, located primarily in 12 western states. The BLM's mission is to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations. The public lands provide myriad opportunities for commercial activities. Commercially valuable natural resources include energy and mineral commodities, forest products, grazing forage, and special uses such as rights-of-way (ROWs) for pipelines and transmission lines. The BLM is responsible for managing commercial energy and mineral production from the public lands in an environmentally sound and responsible manner, including leasing related to oil and gas and geothermal minerals. Geothermal resources include all products and byproducts capable of producing geothermal energy. The BLM is also responsible for supervising the exploration, development, and production operations of these resources on both federal and Native American lands. The BLM is responsible for maintaining viable national policies and processes for solid mineral resources under federal jurisdiction.

Classification and Multiple Use Act of 1964

Authorized the Secretary of the Interior to classify and manage BLM land for retention or disposal and for multiple use, including specification of dominant uses and preclusion of inconsistent uses in an area.

Mining and Mineral Policy Act of 1970

This act declared that the federal government policy is to encourage private enterprise in the development of a sound and stable domestic mineral industry and in orderly and economic development of mineral resources, research, and reclamation methods.

California Desert Conservation Area Plan

The California Desert Conservation Area (CDCA) plan defines multiple-use classes for BLM-managed lands in the CDCA, which includes the land area encompassing the proposed project location in California. With respect to geological resources, the CDCA plan aims to maintain the availability of mineral resources on public lands for exploration and development.

Paleontological Resources Preservation Act of 2009

The Paleontological Resources Preservation Act calls on the Secretary of the Interior to protect vertebrate paleontological resources on federal lands by allowing only permitted and qualified researchers to collect vertebrate fossils and scientifically important fossils.

Federal Antiquities Act of 1906

The Antiquities Act was the first law enacted to specifically establish that archaeological sites on public lands are important public resources, and it obligated federal agencies that manage public lands to preserve the scientific, commemorative, and cultural values of such sites (National Park Service [NPS] 2007). This act does not refer to paleontological resources specifically; however, the act does provide for protection of “objects of antiquity” (understood to include paleontological resources) by various federal agencies, including the BLM and the NPS.

3.6.2.2 State

California

California Building Code (2007)

The California Building Code (CBC 2007) includes a series of standards that are used in project investigation, design, and construction (including grading and erosion control). The 2007 CBC edition is based on the 2006 IBC (excluding Appendix Chapter 1) as published by the ICC, with the addition of more extensive structural seismic provisions. Chapter 16 of the CBC defines seismic sources and outlines the procedure used to calculate seismic forces on structures. Design of the proposed project should follow the requirements of that CBC chapter because the route lies within a seismic zone (UBC Seismic Zone 3).

Alquist-Priolo Earthquake Fault Zoning Act, Public Resources Code Sections 2621–2630

The Alquist-Priolo Earthquake Fault Zoning Act of 1972 (formerly the Special Studies Zoning Act) is documented in the Public Resources Code (PRC). It regulates development and construction of buildings intended for human occupancy, to avoid hazards from surface fault rupture. This act mitigates against surface fault rupture of known active faults beneath occupied structures. It requires disclosure to potential buyers of existing real estate and a 50-foot setback for new occupied buildings. While this act does not specifically regulate overhead transmission lines, it does help define areas where fault rupture is most likely to occur. This act categorizes faults as active, potentially active, and inactive. The proposed project area (in California) is not located within a designated Alquist-Priolo fault zone.

Seismic Hazards Mapping Act, PRC Sections 2690–2699

The Seismic Hazards Mapping Act of 1990 (PRC Chapter 7.8, Division 2) directs the California Department of Conservation, Division of Mines and Geology (now called California Geological Survey) to delineate seismic hazard zones. The purpose of the act is to reduce the threat to public health and safety and to minimize the loss of life and property by identifying and mitigating seismic hazards. These include identified areas that are subject to the effects of strong ground shaking, such as liquefaction, landslides, tsunamis, and seiches (waves in confined bodies of water resulting from seismic activity). City, county, and state agencies are directed to use seismic hazard zone maps developed by CGS in their land use planning and permitting processes. The act requires that site-specific geotechnical investigations be performed prior to permitting most urban development projects within seismic hazard zones.

PRC Chapter 1.7, Sections 5097.5, 5097.9, and 30244

This section of the PRC regulates the removal of paleontological resources from state lands, defines unauthorized removal of fossil resources as a misdemeanor, and requires mitigation of disturbed sites. Since the EITP would be located on federal lands, this code would not apply.

Warren-Alquist Act, PRC Sections 25527 and 25550.5(i)

The Warren-Alquist Act requires the California Energy Commission (CEC) to "give the greatest consideration to the need for protecting areas of critical environmental concern, including, but not limited to, unique and irreplaceable scientific, scenic, and educational wildlife habitats; unique historical, archaeological, and cultural sites…." With respect to paleontological resources, the CEC relies on guidelines from the SVP.

California Surface Mining and Reclamation Act

The State Mining and Geology Board implements state policy and regulations for reclamation of mined lands and conservation of mineral resources. The Surface Mining and Reclamation Act of 1975 (PRC Sections 2710–2796) set forth these policies in the California Code of Regulations, Title 14, Division 2, Chapter 8, Subchapter 1, and requires local governments within California to regulate mining operations and to develop planning policies that balance mineral production with maintenance of environmental quality. Since the EITP would be located on federal lands, this act would not apply.

Nevada

Mining

There is no single agency that regulates the use of mineral resources within Nevada. The Nevada Division of Minerals is responsible for permitting oil and gas and geothermal leases. The Division of Environmental Protection, Bureau of Mining Regulation and Reclamation is responsible for issuing permits for mining. The NBMG is a research and public service unit of the University of Nevada and is the state geological survey organization. NBMG scientists conduct research and publish reports on mineral resources, engineering geology, environmental geology, hydrogeology, and geologic mapping. NBMG cooperates with numerous state and federal agencies in conducting research and providing geologic and resource information, including information on mining claims and mineral leases.

Building Code

The State of Nevada has no statewide building code. All building standards and regulations for structures are deferred to counties and cities, which rely primarily on the IBC.

Nevada Revised Statutes

The Nevada Revised Statutes are the state laws that apply to a project's impacts on cultural resources. Nevada Revised Statutes Sections 381.195– 381.227 and 383.400–383.440 apply the term "prehistoric site" to paleontological sites (including fossilized footprints and other impressions) as well as archaeological sites, ruins, deposits, petroglyphs, pictographs, habitation caves, rock shelters, natural caves, burial grounds, and sites of religious or cultural importance to a tribe.

3.6.2.3 Regional and Local

California

Most counties and cities in California have regulations that address geologic, seismic, and soils hazards, as well as mineral resources. For hazards that could impact construction projects, these regulations generally adopt the state building standards, which for California are embodied in the 2007 CBC, and follow the geologic and seismic hazards mapping and investigation protocols discussed above. Projects requiring county approvals are permitted by the San Bernardino County Building and Safety Division. Transmission line construction projects are not specifically addressed.

San Bernardino County General Plan

The Safety Element of the San Bernardino County General Plan (2007) provides for mitigation of geologic hazards through a combination of engineering, construction, land use, and development standards. The plan addresses the geologic hazards present within the county, including fault rupture, ground shaking, liquefaction, seismically generated subsidence, inundation from seiches or dam breaches, landslides/mudslides, non-seismic subsidence, erosion, and volcanic activity. The county has prepared Hazard Overlay Maps to address fault rupture, liquefaction hazards, and landslide hazards. Special consideration, including possible engineering/geologic evaluation, is required for development of sites designated on the maps.

San Bernardino County 2007 Development Code

The County of San Bernardino (Development Code §82.20.030) requires that paleontologic mitigation programs include site evaluation for paleontological resources in the county including not limited to preliminary field surveys; monitoring during construction; specimens recovery; preparation, identification, and curation of specimens; and report of findings. Also defines qualifications of professional paleontologists.

Nevada

Clark County Building Code

The Building Code of Clark County, Nevada, consists of the 2006 IBC with Southern Nevada Amendments (County Code Chapter 22.04) that regulate residential and commercial construction in Clark County under the Building Services Division of the Development Services Department (Clark County Code Chapter 22.04). Transmission line construction projects are not specifically regulated by the county.

3.6.3 Impact Analysis

This section defines the methodology used to evaluate impacts for geologic, soil, mineral, and paleontological resources, including CEQA impact criteria. The definitions are followed by an analysis of each alternative, including a joint CEQA/NEPA analysis of impacts. At the conclusion of the discussion is a NEPA impact summary statement and CEQA impact determinations. For mitigation measures, refer to Section 3.6.4.

3.6.3.1 NEPA Impact Criteria

The NEPA analysis determines whether direct or indirect effects to geology, soils, mineral, and paleontological resources would result from the project, and explains the significance of those effects in the project area (40 CFR 1502.16). Significance is defined by Council on Environmental Quality regulations and requires consideration of the context and intensity of the change that would be introduced by the project (40 CFR 1508.27). Impacts are to be discussed in proportion to their significance (40 CFR 1502.2[b]). To facilitate comparison of alternatives, the significance of environmental changes is described in terms of the temporal scale, spatial extent, and intensity.

Geologic resources that were evaluated included the geologic setting, geologic hazards, and unique geologic features within the proposed project area. Geologic effects are assessed in two distinct ways: 1) project development's potential to affect a sensitive soil or geologic unit; or 2) project development's potential to increase the risk associated with geologic hazards by installing project components impose additional risk or damage to people or the environment. The impact analysis considered the likelihood of physical alteration, damage, or destruction of geologic features that would result from the project. The analysis also considered the amount of access/activity where scientifically important paleontological resources are present. The analysis evaluated damage to the project components and subsequent risk to humans and the environment that could result from seismic-related activity, and also evaluated other unique geological phenomena. The potential of the project to restrict or remove from access potential sources of salable mineral resources was also evaluated.

Compliance with the laws, ordinances, regulations, and standards associated with the project components and location were considered during the evaluation process. Impacts resulting from the proposed project and its alternatives, whether direct or indirect, were identified and the associated feasible, reasonable, and practical mitigation measures to avoid or minimize those identified impacts are proposed in this document.

3.6.3.2 CEQA Impact Criteria

Under CEQA, the proposed project would have a significant impact if it would:

a. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving (i) rupture of a known earthquake fault; (ii) strong seismic ground shaking; (iii) seismic-related ground failure, including liquefaction; or (iv) landslides;

b. Result in substantial soil erosion or loss of topsoil;

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 onsite or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse;

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

e. Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state;

f. Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan; or

g. Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

3.6.3.3 Methodology

The geology, soils, minerals, and paleontology impacts of the proposed project are discussed below under subheadings corresponding to each of the significance criterion presented in the preceding section. The analysis describes the impacts of the proposed project related to geologic hazards, soils, minerals, and paleontological resources for each criterion. The analysis also determines whether implementation of the project would result in significant impacts by evaluating effects of construction and operation against the affected environment described above in Section 3.6.1.

The potential impact to the geology, soils, minerals, and paleontological resources resulting from the project was evaluated in two ways. First, geologic hazards were assessed that could impact the proper functioning of the proposed facility and create life/safety concerns. Second, the potential impacts of the proposed facility on existing geologic, mineralogical, and paleontological resources in the area were evaluated. Available published resources including books, journals, maps, and government websites were reviewed. This information was evaluated within the context of the applicable federal, state, and local regulations. In addition, information in the Final Staff Assessment/Draft Environmental Impact Statement (FSA/DEIS) prepared for the proposed ISEGS project located near the proposed Ivanpah Substation was also evaluated. Published geologic maps and reports provided information on regional and project-specific geology. Geologic maps used included quadrangles at various scales from 1:50,000 to 1:250,000 and state-wide maps at a scale of 1:750,000. The geologic units identified in the geologic mapping were not consistent either between Nevada and California or by mapped scale. For example, some maps identified only surficial units, while others indicated both surficial units and bedrocks. Mapping of the surficial units also varied in level of detail and segregation. This analysis tended more to generalizing (grouping) the numerous alluvial surficial units while maintaining the unique identity between units of different genesis. Other important sources were government websites, including databases maintained and updated by both federal and state governmental agencies providing information on topics such as seismic hazards, faulting, and soil classification.

To evaluate potential paleontological impacts due to construction of the transmission lines, substation, and other facilities, the BLM's PFYC system was used. This system rates the potential of each geologic unit to yield significant fossils. The BLM established the PFYC system to quantify the occurrence of paleontological resources on public lands and the risk of impacting them. Geologic units are assigned a classification between 1 (lowest) and 5 (highest). The PFYC system is used by the BLM to assess impacts to paleontological resources and suggest appropriate mitigation measures. Additionally, a paleontological records and literature search was conducted. Pertinent published literature and unpublished manuscripts on the geology and paleontology of eastern California (San Bernardino County) and southern Nevada (Clark County) were reviewed. These included published articles on late Pleistocene vertebrate localities of California (Jefferson 1991a and 1991b) and Nevada (Jefferson et al. 2004). An online records search was conducted at the Museum of Paleontology, University of California, Berkeley (Museum of Paleontology, University of California, Berkeley, 2009). Also, persons with knowledge of the geology and paleontological resources of the proposed project area were consulted.

3.6.3.4 Applicant Proposed Measures

The applicant would implement the applicant proposed measures (APMs) described below to reduce adverse effects to geologic, soil, minerals, and paleontological resources and reduce impacts from geologic hazards.

APM GEO-1: Geotechnical Engineering and Engineering Geology Study. Prior to final design of substation facilities and transmission and subtransmission line tower foundations, a combined geotechnical engineering and engineering geology study would be conducted to identify site-specific geologic conditions and potential geologic hazards in sufficient detail to support sound engineering practices.

APM GEO-2: Recommended Practices for Seismic Design of Substations. For new substation construction, specific requirements for seismic design would be followed based on the Institute of Electrical and Electronics Engineers Standard 693, "Recommended Practices for Seismic Design of Substations," which includes probabilistic earthquake hazard analysis. Other project elements would be designed and constructed in accordance with the appropriate industry standards, as well as good engineering and construction practices and methods.

APM GEO-3: Project Construction Stormwater Pollution Prevention Plan Protection Measures Regarding Soil Erosion/Water Quality. Transmission line and substation construction activities would be conducted in accordance with the soil erosion/water quality protection measures to be specified in the project construction stormwater pollution prevention plan (SWPPP). New access roads would be designed to minimize ground disturbance from grading. They would follow natural ground contours as closely as possible, and would include specific features for road drainage. Measures could include water bars, drainage dips, side ditches, slope drains, and velocity reducers. Where temporary crossings would be constructed, they would be restored and repaired as soon as possible after completion of the discrete action associated with construction of the line in the area.

APM PALEO-1: Retention of Paleontologist and Preparation of a Paleontological Resource Management Plan. Prior to construction, a certified paleontologist would be retained by SCE to supervise monitoring of construction excavations and to produce a Paleontological Resource Management and Monitoring Plan (PRMMP) for the proposed project. This PRMMP would be prepared and implemented under the direction of the paleontologist and would address and incorporate APMs PALEO-2 through PALEO-8. Paleontological monitoring would include inspection of exposed rock units and microscopic examination of matrix to determine whether fossils are present. The monitor would have authority to temporarily divert grading away from exposed fossils in order to recover the fossil specimens. More specific guidelines for paleontological resource monitoring could be found in the PRMMP.

APM PALEO-2: Pre-construction Paleontological Field Survey. The paleontologist and/or his or her designated representative would conduct a pre-construction field survey of the project area underlain by Tertiary rock units and older alluvium. Results of the field inventory and associated recommendations would be incorporated into the PRMMP.

APM PALEO-3: Worker Environmental Awareness Program (see BIO-6, CR-2b, W-11). A Worker Environmental Awareness Program would be provided to construction supervisors and crew for awareness of requirements regarding the protection of paleontological resources and procedures to be implemented in the event fossil remains are encountered by ground-disturbing activities.

APM PALEO-4: Construction Monitoring. Ground-disturbing activities would be monitored on a part-time or full-time basis by a paleontological construction monitor only in those parts of the project area where these activities would disturb previously undisturbed strata in rock units of moderate and high sensitivity. Quaternary alluvium, colluvium, and Quaternary landslide deposits have a low paleontological sensitivity level and would be spot-checked on a periodic basis to ensure that older underlying sediments were not being penetrated. Monitoring would not be implemented in areas underlain by younger alluvium unless these activities had reached a depth 5 feet below the present ground surface and fine-grained strata were present. Ground-disturbing activities in areas underlain by rock units of low sensitivity would be monitored on a quarter-time basis or spot-checked if fine grained strata were present.

APM PALEO-5: Recovery and Testing. If fossils were encountered during construction, construction activities would be temporarily diverted from the discovery and the monitor would notify all concerned parties and collect matrix for testing and processing as directed by the project paleontologist. In order to expedite removal of fossil-bearing matrix, the monitor may request heavy machinery to assist in moving large quantities of matrix out of the path of construction to designated stockpile areas. Construction would resume at the discovery location once the necessary matrix was stockpiled, as determined by the paleontological monitor. Testing of stockpiles would consist of screen washing small samples to determine if important fossils were present. If such fossils were present, the additional matrix from the stockpiles would be water screened to ensure recovery of a scientifically significant sample. Samples collected would be limited to a maximum of 6,000 pounds per locality.

APM PALEO-6: Monthly Progress Reports. The project paleontologist would document interim results of the construction monitoring program with monthly progress reports. Additionally, at each fossil locality, field data forms would record the locality, stratigraphic columns would be measured, and appropriate scientific samples would be submitted for analysis.

APM PALEO-7: Analysis of and Preparation of Final Paleontological Resource Recovery Report. The project paleontologist would direct identification, laboratory processing, cataloging, analysis, and documentation of the fossil collections. When appropriate, and in consultation with SCE, splits of rock or sediment samples would be submitted to commercial laboratories for microfossil, pollen, or radiometric dating analysis. After analysis, the collections would be prepared for curation (see APM PALEO-8). A final technical report would be prepared to summarize construction monitoring and present the results of the fossil recovery program. The report would be prepared in accordance with SCE, Society of Vertebrate Paleontology guidelines, and lead agency requirements. The final report would be submitted to SCE, the lead agency, and the curation repository.

APM PALEO-8: Curation. Prior to construction, SCE would enter into a formal agreement with a recognized museum repository, and would curate the fossil collections, appropriate field and laboratory documentation, and final Paleontological Resource Recovery Report in a timely manner following construction.

3.6.3.5 Proposed Project / Proposed Action

<u>Construction</u>

Eldorado–Ivanpah Transmission Line

The potential to expose people to adverse effects due to fault rupture during construction of the transmission line would be negligible, localized, and short term. Fault rupture can result in structural failure that poses a risk to people. The Mesquite segment of the SFS crosses the proposed transmission line route along the California-Nevada border at Primm nearly perpendicular to the proposed transmission line route, although there is substantial uncertainty about the location of this fault. No other faults within the proposed project area known to have the potential for earthquake ground rupture cross the transmission line route. Due to the infrequent nature of movement along the SFS relative to the construction period, fault rupture resulting in impact to construction of the transmission line would be unlikely. Therefore, the impact to people due to fault rupture would be less than significant without mitigation.

The potential impact on people and structures by exposing them to adverse effects due to seismic ground shaking during construction would be negligible, localized, and short term. Ground movement associated with earthquakes can cause structural damage that poses a risk to human safety. Earthquakes occurring on faults closest to the transmission line would most likely generate the largest ground motion. Applying the Landers earthquake peak ground acceleration data to the Mesquite segment of the SFS, an approximate ground acceleration ranging from 0.12 g to 0.50 g can be expected along the transmission line route, with the higher value possible at the location where this fault crosses the transmission line route. Overall, strong ground shaking would be within the levels experienced in the Landers earthquake area in 1992 and the Hector Mine earthquake in 1999, both in the Mojave Desert region and where electrical transmission lines experienced some damage in each of these earthquakes. Due to the short duration of construction and infrequent nature of significant ground shaking in the project area, potential adverse effects to people associated with seismic ground shaking during construction would be less than significant without mitigation. Additionally, design measures would reduce the impact of risk to people associated with a considerable ground shaking event to less than significant without mitigation.

Seismic-related ground failure is not expected over most of the transmission line route due to the general lack of shallow groundwater. Liquefaction typically occurs primarily in saturated, loose, fine- to medium-grained soils in areas where the groundwater table is within approximately 50 feet of the ground surface; soils may temporarily lose their shear strength during strong ground shaking. Neither the San Bernardino County General Plan Safety Element nor the Clark County Comprehensive Plan indicates liquefaction potential within the project area. The most likely exceptions could be at the playa fringes, where sand layers could be saturated with perched water. In this case, the potential for negligible impact to human safety would be localized and short term; therefore, less than significant impact without mitigation would be expected.

Landslides effects are assessed in two distinct ways: 1) project development could destabilize a soil or geologic unit and induce a landslide; or 2) project components could be transported in a landslide and introduce additional risk or damage to people or the environment. Construction activities, including service roads, may cause minor adverse conditions suitable for landslides at locations where geologic conditions are susceptible to this type of hazard. These geologic conditions along the transmission line route would be expected to occur in areas on or adjacent to hill slopes. About 10 percent of the proposed transmission line route (in the McCullough Mountains) passes through areas with moderately steep to very steep topography containing highly weathered and fractured bedrock/basement rock. These areas may be susceptible to rockfall and rotational movement of moderate to large sections of hillslope within or adjacent to the route. Such movements can have potentially damaging effects. MM GEO-2 requires the applicant to complete a geotechnical analysis to assess site-specific geologic conditions and hazards and adjust engineering and design practices accordingly. Although these conditions would be local in extent, their potential for impact may extend over a long period of time but would be less than significant with mitigation.

Activities associated with construction of access road and tower footings along the transmission line route would disturb the existing ground surface and natural drainage(s), causing minor adverse erosion-related adverse impacts at these locations. This adverse impact would be localized and expected to act over the entire construction period. As required by law, the applicant would adhere to a SWPPP (APM GEO-3). MM W-1 (Erosion Control Plan and Compliance with Water Quality Permits) would further reduce potential adverse impacts related to soil erosion. Therefore, this impact would be less than significant with mitigation.

Construction of the transmission line route in areas of unstable geologic units or expansive soil could result in further destabilization of geologic units and/or structural failure of the towers. The adverse impacts of construction in these areas, ranging from negligible to minor over most of the transmission line route, could be localized to extensive, depending on conditions and type of impact. For example, the impact to existing surface topography related to subsidence due to groundwater withdrawal would be possible if substantial pumping were to occur related to development in the region; continued and/or increased groundwater withdrawal from the Ivanpah and Eldorado valleys may cause an overdraft condition resulting in settling of the ground surface due to compaction of underlying unconsolidated sediments resulting in unsafe changes in surface topography. Impact to towers due to earthquake-induced ground cracking would be negligible to non-existent for transmission line towers with deep foundations. Expansive soils, which shrink or swell with changes in moisture content and can affect the stability of foundations, could be encountered. Soils along the transmission line route in Nevada exhibit expansion potential that is generally low or low to moderate, with one united rated as moderate to high (playa). In the California portions of the project area, the potential for expansive soils is generally low to moderate, with one unit rated as high (playa). MM GEO-2 requires the applicant to complete a geotechnical analysis to assess site-specific geologic conditions and hazards and adjust engineering and design practices accordingly. MM GEO-4 requires the applicant to expand on the geotechnical analysis to mitigate specifically for expansive soils. These potential impacts from expansive soils on project structures would be less than significant with mitigation.

Numerous non-metallic and metallic mineral deposits occur along or near the transmission line route. No mining of metallic deposits was identified within 1,000 feet of the proposed project area. Non-metallic deposits within the general project area include rare earth minerals from the Molycorp Mine, pumice, feldspar, limestone, and sand and gravel, with sand and gravel potential being the highest along the routes. There are a few past and current mining locations in the vicinity of the proposed project, but none located within 1,000 feet of either side of the proposed transmission line route or alternative routes. Any adverse impacts to the availability of currently-identified mineral resources would be negligible; the potential resource is area-wide but would be only locally developed. The development of mineral deposits within the proposed project area would result in a less than significant impact to no impact.

Construction of the transmission line could cause direct impacts to buried paleontological resources due to ground-disturbing activities. The potential for direct impacts to paleontological resources during construction of the transmission line would be adverse, negligible, area-wide, and short term. Preconstruction ground-disturbing activities (augering and trenching) as part of geotechnical investigations of transmission tower locations might impact buried paleontological resources in underlying sedimentary formations of high paleontological sensitivity. During tower construction, ground-disturbing activities such as augering and trenching for support footings and grading for tower pads, service roads, and staging areas might impact paleontological resources in areas where underlying formations have high paleontological sensitivity. The rock units of high paleontological sensitivity (see Table 3.6-6) along the proposed line route are Quaternary alluvium (Qa/Qal), and Quaternary lake/playa deposits (Ql/Qp). All other underlying rock units present along the proposed transmission line, including ancient intrusive and metamorphic rocks (Xm; undivided Proterozoic) and Tertiary volcanic (Tba) rocks are of low paleontological sensitivity. However, as part of construction of the proposed project, the applicant would implement APMs PALEO-1 through PALEO-8. These measures (provision of a project paleontologist to oversee potential impacts; pre-construction surveys; construction worker awareness programs; construction monitoring; and recovery, testing, and curation of any significant paleontological findings) would prevent significant impacts. Therefore, possible impacts would be less than significant without mitigation.

Ivanpah Substation

The potential impact on people and structures by exposing them to adverse effects of fault rupture during construction of the Ivanpah Substation would not be expected since known faults do not cross the site. However, the potential does exist for exposure of people to adverse effects of seismic ground shaking during construction. Although considered minor and negligible, earthquakes occurring on SFS would most likely generate the largest ground motion (up to 0.35 g), similar to the motion that would be experienced by the transmission line route. Any impact experienced would be short term and localized, although an earthquake event would affect a larger region. Due to the infrequent nature of movement along the SFS relative to the short duration of the construction period, the impact of fault rupture on people would be less than significant without mitigation.

Seismic-related ground failure is not expected in the substation area due to the general lack of shallow groundwater. Construction activities related to the substation would not be expected to cause temporary conditions suitable for landslides, nor would service roads expose people or structures to adverse landslide effects, because the topography slopes gently at this location.

Construction associated with access roads and the substation would disturb the existing ground surface and natural drainage(s), causing a minor, adverse impact of erosion or loss of topsoil that would be localized but could act over a long term. Grading at the substation location would be permitted as part of the ISEGS project. MM W-6 requires the applicant to submit the ISEGS Drainage, Erosion, and Sedimentation Control Plan (DESCP) and SWPPP to CPUC. Implementation of proper engineering control measures outlined in the DESCP and SWPPP, this impact would be less than significant with mitigation.

The proposed location of the substation is in an area that may be susceptible to subsidence caused by removal of groundwater and in an area of expansive soil. Construction in such an area may result in negligible to minor impacts of local extent; subsidence could occur over a more extensive area with the impact to the proposed project being localized to the substation. Expansive soils shrink or swell with changes in moisture content, affecting the stability of foundations. Either impact would have a long-term effect on the project. MM GEO-2 requires the applicant to complete a geotechnical analysis to assess site-specific geologic conditions and hazards and adjust engineering and design practices accordingly. With the implementation of proper engineering control measures, this impact would be less than significant with mitigation.

Non-metallic mineral deposits occur near the proposed substation area. Any currently identified adverse impacts to the availability of mineral resources would be negligible; the potential resource is area-wide but would be only locally developed. The development of mineral deposits within the proposed project area would result in a less than significant impact to no impact on the availability of currently-identified mineral resources. Non-metallic deposits within the general project area include rare earth minerals from the Molycorp Mine, pumice, feldspar, limestone, and sand and gravel, with sand and gravel potential being the highest. There are a few past and current mining locations in the vicinity of the proposed project, but none located within 1,000 feet of the substation. Any adverse impacts are negligible; the potential resource is area-wide but would be only locally developed. The development of mineral deposits within the proposed project area would result in a less than significant impact or no impact.

Construction of the Ivanpah Substation could cause direct impacts to buried paleontological resources due to ground-disturbing activities. The potential for direct impacts to paleontological resources during construction of the Ivanpah Substation would be adverse, negligible, localized, and short term. Preconstruction ground-disturbing activities (augering and trenching) as part of geotechnical investigations of substation foundation(s) might impact buried paleontological resources in underlying sedimentary formations of high paleontological sensitivity. Ground-disturbing activities such as grading and trenching the substation foundation(s), attendant facilities, and utilities could impact paleontological resources in areas where underlying formations have high paleontological sensitivity. The rock units of high paleontological sensitivity (see Table 3.6-6) within the substation footprint are Quaternary non-marine or older alluvium (Qc/Qoa) and Quaternary alluvium (Qa/Qal). However, as part of construction of the proposed project, the applicant would include APMs PALEO-1 through PALEO-8. These measures (provision of a project paleontologist to oversee potential impacts; pre-construction surveys; construction worker awareness programs; construction monitoring; and recovery, testing, and curation of any significant paleontological findings) would prevent significant impacts. Therefore, impacts would be less than significant without mitigation.

Telecommunications Line

The potential impact to people and structures by exposing them to adverse effects due to fault rupture during construction of the telecommunications line would be non-existent since the proposed route does not cross any active faults. However, the potential to expose people to adverse effects due to seismic ground shaking during construction would be negligible, localized, and short term. Earthquakes occurring on faults closest to the telecommunications line route would most likely generate the largest ground motion, with expected approximate ground acceleration ranging from 0.12 g to 0.45 g. Overall, strong ground shaking would be within the levels experienced in the Landers earthquake area in 1992 and the Hector Mine earthquake in 1999, both in the Mojave Desert region, where some damage in each of these earthquakes was experienced. Design considerations can be implemented so the impact would be less than significant without mitigation.

Seismic-related ground failure is not expected in the project area due to the general lack of shallow groundwater along the proposed route. Construction activities, including service roads, may cause temporary conditions suitable for landslides at locations where geologic conditions are susceptible to this type of hazard. These geologic conditions along the telecommunications line route would be expected to occur in areas on or adjacent to hill slopes. About 10 percent of the proposed telecommunications line route (along the southern end of the McCullough Mountains) passes through areas with moderately steep to very steep topography containing highly weathered and fractured bedrock/basement rock. These areas may be susceptible to rockfall and rotational movement of moderate to large sections of hillslope within or adjacent to the route. Such movements can have potentially damaging effects. These conditions would be local in extent, but their potential for impact on the project could extend over a long period of time. MM GEO-2 requires the applicant to complete a geotechnical analysis to assess site-specific geologic conditions and hazards and adjust engineering and design practices accordingly. The impact of these conditions would be less than significant with mitigation.

Activities associated with the construction of access roads and tower footings along the proposed telecommunications line route would disturb the existing ground surface and natural drainage(s), causing minor adverse erosion-related impact at these locations. This impact would be localized but expected to act over the entire construction period. However, with the implementation of proper engineering control measures such as those outlined in the SWPPP, this impact would be less than significant with mitigation.

Construction of the proposed telecommunications line route in areas of unstable geologic units or expansive soil could result in further destabilization of geologic units and/or structural failure of the towers. The adverse impacts of construction in these areas, ranging from negligible to minor over most of the telecommunications line route, could be localized to extensive, depending on conditions and type of impact. For example, the impact to existing surface topography related to subsidence due to groundwater withdrawal would be possible if substantial pumping were to occur related to construction of the proposed project; continued and/or increased groundwater withdrawal from the Ivanpah and Eldorado valleys may cause an overdraft condition resulting in settling of the ground surface due to compaction of underlying unconsolidated sediments resulting in unsafe changes in surface topography. Impact to telecommunication structures due to earthquake-induced ground cracking would be negligible to no impact for towers with deep foundations. Expansive soils, which shrink or swell with changes in moisture content and can affect the stability of foundations, could be encountered. Soils along the telecommunications line route in Nevada exhibit expansion potential that is generally low or low to moderate, with one unit rated as moderate to high (playa). In the California portions of the project area, the potential for expansive soils is generally low to moderate, with one unit rated as high (playa). MM GEO-2 requires the applicant to complete a geotechnical analysis to assess site-specific geologic conditions and hazards and adjust engineering and design practices accordingly. MM GEO-4 requires the applicant to expand on the geotechnical analysis to mitigate specifically for expansive soils. These potential impacts from expansive soils on project structures would be less than significant with mitigation.

Numerous non-metallic and metallic mineral deposits occur along or near the telecommunications line route. No mining of metallic deposits was identified within 1,000 feet of the proposed project area. Non-metallic deposits within the general project area include rare earth minerals, pumice, feldspar, limestone, and sand and gravel, with sand and gravel potential being the highest along the routes. There are a few past and current mining locations in the vicinity of the proposed project, but none located within 1,000 feet of either side of the proposed telecommunications line route or alternative routes. Any adverse impacts to the availability of currently-identified mineral resources would be negligible; the potential resource is area-wide but would be only locally developed. The development of mineral deposits within the proposed project area would result in a less than significant impact to no impact.

Construction of the redundant telecommunication system (partially underground) could cause direct impacts to buried paleontological resources due to ground-disturbing activities associated with trenching and tower placement. The potential for direct impacts to paleontological resources during construction of the redundant telecommunication system would be adverse, moderate, area-wide, and short term. Preconstruction ground-disturbing activities (augering and trenching) performed as part of geotechnical investigations along the route of the telecommunications line could impact buried paleontological resources in underlying sedimentary formations of high paleontological sensitivity. During construction, ground-disturbing activities such as trenching for installation and burial of the line could impact paleontological resources in areas where underlying formations have high paleontological sensitivity. The rock units of high paleontological sensitivity (see Table 3.6-6) along the proposed telecommunication line route are Quaternary alluvium (Qa/Qal) and Quaternary lake/playa deposits (Ql/Qp). All other underlying rock units present along the proposed transmission line that include Ancient intrusive and metamorphic rocks (Xm; undivided Proterozoic) and Tertiary volcanic (Tba) rocks are of low paleontological sensitivity. However, as part of construction of the proposed project, the applicant would implement APMs PALEO-1 through PALEO-8. These measures (provision of a project paleontologist to oversee potential impacts; pre-construction surveys; construction worker awareness programs; construction monitoring; and recovery, testing, and curation of any significant paleontological findings) would prevent significant impacts. Therefore, possible impacts would be less than significant without mitigation.

Because the primary telecommunication line would be above ground and strung along the transmission towers, construction would not result in any additional impacts to buried paleontological resources. These possible impacts would be less than significant.

Operation & Maintenance

Eldorado–Ivanpah Transmission Line

The potential impact to people and structures by exposing them to adverse effects due to fault rupture and/or seismic ground shaking during the operation and maintenance would be negligible during the life of the proposed project. Fault rupture can result in structural failure that poses a risk to people. Although the probability of some occurrence of seismic ground shaking increases as longer time periods are considered, the likelihood of exposing people to adverse effects still remains negligible. Seismic-related ground failure such as liquefaction would not be expected in the project area due to the general lack of shallow groundwater, although areas in the valley bottoms (old lake deposits and playas) could pose a negligible impact; therefore, the impact would be less than significant without mitigation.

Maintenance of service roads could expose people or structures to minor adverse landslide effects over the life of the proposed project. In addition, operation and maintenance activities could expose people and structures to landslide hazards during the life of the project. Geologic conditions along the transmission line route favorable to landslides would be expected to occur in areas on or adjacent to hill slopes, particularly where access roads have been built. Although these landslide-prone conditions would be local in extent, their potential for impact could extend over a long period of time. The impact of landslide conditions on the project would be less than significant with mitigation. Operation and maintenance of service roads would cause continued ground disturbance that would result in sites of potential erosion, particularly in areas of hill slopes. These activities would continue to disturb the existing ground surface and natural drainage(s), causing minor adverse erosion-related impact. This impact would be localized but would act over the entire life of the proposed project. However, with the implementation of proper engineering control measures, this impact would be less than significant without mitigation.

The proposed transmission line could experience adverse negligible to minor impacts during operation and maintenance due to subsidence related to potentially unstable geologic units or expansive soil causing structural failure of the towers. These impacts could be localized to extensive, depending on geologic conditions and degree of subsidence. For example, subsidence due to groundwater withdrawal would be possible due to substantial pumping; continued and/or increased groundwater withdrawal from the Ivanpah and Eldorado valleys may cause an overdraft condition, resulting in settling of the ground surface due to compaction of underlying unconsolidated sediments. As part of MM GEO-1, the applicant will contact the California Department of Water Resources and the Nevada Division of Water Resources on an annual basis to determine if groundwater withdrawals in the area are causing ground subsidence. If subsidence threatens any project facility, the applicant will develop a mitigation plan to prevent damage to structures. However, with the implementation of proper engineering control measures, this impact from subsidence on project structures would be less than significant with mitigation.

Numerous non-metallic and metallic mineral deposits occur along or are near the transmission line route; however, no mining of these deposits was identified within 1,000 feet of the proposed project area. Any adverse impacts to the availability of currently-identified mineral resources would be negligible; the potential resource is area-wide but would be only locally developed. The development of mineral deposits within the proposed project area would result in less than significant impacts.

Operation and maintenance of the proposed project would not result in additional ground disturbance beyond the areas disturbed during construction. Areas where fossils are located would be identified during preconstruction surveys and construction monitoring. Therefore, there would be no additional potential impacts to paleontological resources during operation and maintenance.

Ivanpah Substation

The potential impact to people and structures by exposing them to adverse effects due to fault rupture during operation and maintenance of the substation would not be expected, since known faults do not cross the site. However, the potential does exist for the negligible exposure of people and structures to adverse effects due to seismic ground shaking during the operation and maintenance of the substation. Earthquakes occurring on faults closest to the substation (such as the SFS) would most likely generate the largest ground motion (up to 0.35 g), similar to that experienced by the transmission line route. Any impact experienced would be short term and localized, although the causative event would affect a larger region. However, design considerations (APM GEO-2 Recommended Practices for Seismic Design of Substations) would be implemented so the impact would be less than significant without mitigation.

Operation and maintenance activities associated with the substation and access roads would disturb the existing ground surface and cause minor adverse erosion impacts that would be localized in extent but could be long term. Erosion could result from re-directed stormwater and wind. However, with the implementation of proper engineering control measures, this impact would be less than significant without mitigation.

The proposed location of the substation is in an area that may be susceptible to subsidence caused by the removal of groundwater and in an area of expansive soil. This could cause a negligible to minor adverse impact to the project during its operation and maintenance. Although expected to be of local extent; subsidence could occur over a more extensive area. The long-term impact on the project; however, with the implementation of proper engineering control measures, would be less than significant with mitigation.

Numerous non-metallic and metallic mineral deposits occur along or are near the proposed substation; however, no mining of these deposits was identified within 1,000 feet of the proposed project. Any adverse impacts to the availability of currently-identified mineral resources would be negligible; the potential resource is area-wide but would be only locally developed. The development of mineral deposits within the proposed project would result in less than significant impacts.

Operation and maintenance of the proposed project would not result in additional ground disturbance beyond the areas disturbed during construction. Areas where fossils are located would be identified during preconstruction surveys and construction monitoring. Therefore, there would be no additional potential impacts to paleontological resources during operation and maintenance.

Telecommunications Line

Operation and maintenance of the telecommunications line would result in impact conditions consistent with the operation and maintenance of the transmission line.

The potential impact to people and structures by exposing them to adverse effects of fault rupture and/or seismic ground shaking during operation and maintenance would be negligible during the life of the proposed telecommunications line. Fault rupture can result in structural failure that poses a risk to people. Although the probability of an occurrence of seismic ground shaking increases as longer periods of time are considered, the likelihood of exposing people to adverse effects still remains negligible. Seismic-related ground failure such as liquefaction is not expected in the project area due to the general lack of shallow groundwater, although areas in the valley bottoms (old lake deposits and playas) may pose a negligible potential for a highly localized impact.

Maintenance of service roads could expose people or structures to minor adverse landslide effects over the life of the proposed telecommunications line. In addition, operation and maintenance activities could expose people to landslide hazards during the life of the project. Geologic conditions along the telecommunications line route favorable to landslides would be expected to occur in areas on or adjacent to hill slopes, particularly where access roads have been built. Although these landslide-prone conditions would be local in extent, their potential for impact may extend over a long period of time. The impact of these conditions on the project would be less than significant with mitigation. Operation and maintenance of service roads would lead to continued ground disturbance that would result in sites of potential erosion, particularly in areas of hill slopes. These activities would continue to disturb the existing ground surface and natural drainage(s) over the entire life of the proposed project, causing minor adverse erosion-related impacts. However, with the implementation of proper engineering control measures, this impact would be less than significant without mitigation.

The proposed telecommunications line may experience adverse negligible to minor impacts during the operation and maintenance period due to subsidence related to potentially unstable geologic units or expansive soil causing structural failure of the towers. The impacts from subsidence or expansive soil to the towers could be localized to extensive, depending on geological conditions and degree of subsidence. Subsidence due to groundwater withdrawal is possible due to substantial pumping; continued and/or increased groundwater withdrawal from the Ivanpah and Eldorado valleys could cause an overdraft condition resulting in the settling of the ground surface due to compaction of underlying unconsolidated sediments. As part of MM GEO-1, the applicant will contact the California Department of Water Resources and the Nevada Division of Water Resources on an annual basis to determine if groundwater withdrawals in the area are causing ground subsidence. If subsidence threatens any project facility, the applicant will develop a mitigation plan to prevent damage to structures. However, with the implementation of proper engineering control measures, this impact on project structures would be less than significant with mitigation.

Numerous non-metallic and metallic mineral deposits occur along or are near the telecommunications line route; however, no mining of these deposits was identified within 1,000 feet of the proposed project area. In the region, the potential resource is area-wide but would be only locally developed. The development of mineral deposits within the proposed project area would result in less than significant impacts without mitigation.

Operation and maintenance of the proposed project would not result in additional ground disturbance beyond the areas disturbed during construction. Areas where fossils are located would be identified during preconstruction surveys and construction monitoring. Therefore, there would be no additional potential impacts to paleontological resources during operation and maintenance.

NEPA Summary

The proposed project would result in direct negligible to minor geology- and soils-related impacts due to the construction of the transmission line, substation, and telecommunications line. The impacts would be local in extent for most of the proposed project, but could be extensive to area-wide. The impacts would occur over either short- or long-term time spans. Impacts associated with operation and maintenance of the transmission line, substation, and telecommunications line would mostly be related to the occasional presence of people engaged in maintaining the facilities during the life of the project, and would be potentially due to changing geologic conditions including seismic events (fault rupture and ground shaking), subsidence, and/or liquefaction.

The proposed project would result in direct negligible impacts to paleontological resources during construction of the transmission line, substation, and telecommunications line. However, as part of construction of the proposed project, the applicant would include APMs PALEO-1 through PALEO-8. These measures (provision of a project paleontologist to oversee potential impacts; pre-construction surveys; construction worker awareness programs; construction monitoring; and recovery, testing, and curation of any significant paleontological findings) would prevent significant impacts.

Therefore, possible impacts would be less than significant. Operation and maintenance of the proposed project would not result in additional ground disturbance beyond the areas disturbed during construction. Therefore, there would be no impacts to paleontological resources during operation and maintenance.

CEQA Significance Determinations

IMPACT GEO-1: Rupture of Earthquake Fault Across the Transmission Line Route
Less than significant without mitigation

The proposed project would result in impacts related to the potential for damage to transmission line towers resulting from the rupture of an earthquake fault that crosses the transmission line route. The potential for exposure of people to fault rupture during construction of the transmission line is very low. The Mesquite segment of the SFS crosses the proposed transmission line route along the California-Nevada border at Primm nearly perpendicular to the proposed transmission line route, although there is substantial uncertainty as to the location of this fault. No other faults within the proposed project area known to have the potential for earthquake ground rupture cross the transmission line route, and APM GEO-1 states that the applicant would complete a geotechnical engineering and engineering geology study to identify site-specific geologic conditions and potential geologic hazards prior to final engineering. MM GEO-2 strengthens APM GEO-1 by stating that the applicant will use the findings of the geotechnical analysis to guide engineering and design. Therefore, the impact would be less than significant with mitigation.

The potential for exposing people to adverse effects of fault rupture during operation and maintenance is also unlikely during the life of the proposed project. Although the probability of an earthquake occurring increases as longer time periods are considered, the likelihood of exposing people to adverse effects still remains negligible. Given the relative lack of active faults in the project area and the fact that the applicant would conduct preconstruction geotechnical engineering and engineering geology studies, the impact would be less than significant without mitigation.

IMPACT GEO-2: Exposure of People or Structures to Potential Adverse Effects Due to Seismic Ground Shaking
Less than significant without mitigation

The project could impact people and structures by exposing them to adverse effects due to seismic ground shaking during construction. Earthquakes occurring on faults closest to the transmission line and substation facility would most likely generate the largest ground motion experienced at that location. Estimated approximate ground accelerations range from 0.12 g to 0.50 g for the transmission line route, could be up to 0.35 g for the substation facility, and range from 0.12 g to 0.45 g along the telecommunications route. Due to the short nature of construction and infrequent nature of significant ground shaking in the project area, potential adverse effects to people associated with seismic ground shaking during construction would be less than significant without mitigation. Additionally, design measures would reduce the impact of risk to people associated with a considerable ground shaking event to less than significant without mitigation. Design considerations outlined in APM GEO-2 (Recommended Practices for Seismic Design of Substations) would further lessen the potential for adverse effects due to seismic ground shaking at the substation to less than significant levels without mitigation.

The potential exists to expose people and structures to adverse effects of seismic ground shaking during operation and maintenance of the facilities. Earthquakes occurring on faults closest to the proposed project would most likely generate the largest ground motion experienced by the transmission line route, substation, and telecommunications line. However, although the probability of an occurrence of seismic ground shaking increases as longer time periods are considered, the likelihood that people would be exposed to adverse effects is limited; structures would be more likely to experience an impact. Any impact would be short term and localized for the proposed project, although the causative event would affect a larger region. Design considerations outlined in APM GEO-2 would lessen the potential for adverse effects due to seismic ground shaking at the substation to less than significant levels without mitigation. MM GEO-1 requires the applicant to design structures to withstand site-specific geologic conditions. With this mitigation measure in place, potential adverse effects to people and structures associated with ground shaking would be reduce to less than significant levels with mitigation.

IMPACT GEO-3: Exposure of People or Structures to Potential Adverse Effects Due to Seismic-Related Ground Failure
Less than significant without mitigation

The proposed project would result in impacts on people and structures due to seismic-related ground failure only for those areas where conditions are potentially conducive to ground failure. Areas within the proposed project area that may be susceptible to seismic-related ground failure during construction include structures located at or near playa fringes, where sand layers could be saturated with perched water. In this case, the potential for negligible impact would be highly localized. For most of the proposed project area, seismic-related ground failure is not expected, due to the general lack of shallow groundwater. In addition, neither the San Bernardino County General Plan Safety Element nor the Clark County Comprehensive Plan indicates liquefaction potential within the proposed project area.

The potential exists for exposure of people or structures to seismic-related ground failure during operation and maintenance of the proposed project. Areas within the proposed project near playa fringes where sand layers could be saturated with perched water are the most likely places for this impact to occur. For most of the proposed project area, seismic-related ground failure would not be expected due to the general lack of shallow groundwater. In addition, neither the San Bernardino County General Plan Safety Element nor the Clark County Comprehensive Plan indicates liquefaction potential within the proposed project area. APM GEO-1 states that the applicant would complete a geotechnical engineering study to identify site-specific geologic conditions and potential geologic hazards prior to final engineering; therefore, the impact would be less than significant without mitigation.

IMPACT GEO-4: Exposure of People or Structures to Adverse Effects Due to Landslides
Less than significant without mitigation

The proposed project would result in impacts on people or structures along the access roads for the transmission line and telecommunication line routes during construction. Installing, upgrading, or re-grading access roads could lead to landslides at locations where geologic conditions are conducive to this type of hazard. Such geologic conditions occur in areas on or adjacent to hill slopes. About 10 percent of the proposed transmission line route (in the McCullough Mountains) and the telecommunications line route (along the southern end of the McCullough Mountains) passes through areas with moderately steep to very steep topography containing highly weathered and fractured bedrock/basement rock. These areas may be susceptible to rockfall and rotational movement of moderate to large sections of hillslope within or adjacent to the route. Such movements can have potentially damaging effects. Although these conditions would be local so the impact from construction-caused landslides on people or structures would be localized, the potential for these impacts could extend over a long time.

In addition, operation and maintenance activities could expose people and structures to landslide hazards during the life of the project. Geologic conditions along the transmission line and telecommunications line routes favorable to landslides would occur in areas on or adjacent to hill slopes, particularly where access roads have been built and maintained. Although these conditions would be local so the impact from operation- or maintenance-caused landslides on people or structures would be localized, the potential for these impacts could extend over a long time. APM GEO-1 states that the applicant would complete a geotechnical engineering study to identify site-specific geologic conditions and potential geologic hazards prior to final engineering. MM GEO-2 requires the applicant to complete a incorporate the results of the geotechnical analysis to assess site-specific geologic conditions and hazards and adjust engineering and design practices accordingly. Therefore, the impact would be less than significant with mitigation.

IMPACT GEO-5: Erosion of Soil at Towers and the Substation and Along Access Roads
Less than significant with mitigation

The proposed project would impact soil by resulting in erosion at the transmission and telecommunication towers, at the substation, and along the access roads. Construction of access roads and tower footings along the transmission line and telecommunications line routes would disturb the existing ground surface and natural drainage(s), causing minor adverse erosion-related impacts on soil at these locations. This impact would be localized but would act over the entire construction period.

Operation and maintenance of transmission and telecommunication line service roads would lead to continued ground disturbance that would result in sites of potential erosion, particularly in areas of hill slopes. These activities would continue to disturb the existing ground surface and natural drainage(s), causing minor adverse erosion-related impacts on soil and water resources (further discussed in Section 3.8, "Hydrology and Water Resources"). Erosion associated with the substation could result from re-directed stormwater and wind. This impact would be localized (hilly areas and substation area) but could act over the life of the proposed project. Although a SWPPP would be followed (APM GEO-3), impacts soil conditions due to construction and operation of the project could be significant. With the implementation of MM W-1, however, impacts under this criterion would be less than significant.

IMPACT GEO-6: Structural Failure of Towers and Substation Facility Due to Unstable Soil Conditions Resulting in Subsidence or Collapse
Less than significant with mitigation

Ground subsidence or collapse due to groundwater withdrawal could lead to the structural failure of the transmission line and telecommunication line towers and substation facility. This adverse impact on the project, ranging from negligible to minor, could be localized to extensive, depending on the degree to which continued and/or increased groundwater withdrawal from the Ivanpah and Eldorado valleys causes an overdraft condition resulting in settling of the ground surface due to compaction of underlying unconsolidated sediments. The likelihood of this impact could increase over time with continued and/or increased groundwater withdrawal. Although prior to final design a geotechnical engineering study would be performed (APM GEO-1), impacts on proposed project facilities could still be significant. With the implementation of MM W-2, MM GEO-1 and MM GEO-2, however, impacts under this criterion would be less than significant.

IMPACT GEO-7: Structural Failure of Towers or Substation Facility Due to Expansive Soils
Less than significant with mitigation

Building on expansive soils could lead to the structural failure of the transmission line and telecommunication line towers and substation facility. Expansive soils shrink or swell with changes in moisture content, affecting the stability of foundations. Soils encountered along the transmission line route in Nevada exhibit expansion potential that is generally low and low to moderate, but the expansion potential along the route is moderate to high in one unit (playas). In California, the potential for expansive soils is generally low to moderate, but also is high in one unit (playas). The areas most prone to experience expansive soils lie within or adjacent to playas or old lake deposits with clay rich sediments. Although prior to final design a geotechnical engineering study would be performed (APM GEO-1), impacts on proposed project facilities could be significant. With the implementation of MM GEO-4, however, impacts under this criterion would be less than significant.

IMPACT MR-1: Loss of Mineral Resource of Value to Region and the Residents of the State
Less than significant without mitigation

Numerous non-metallic and metallic mineral deposits occur along or near the telecommunications line route. No mining of metallic deposits was identified within 1,000 feet of the proposed project. Non-metallic deposits within the general project area include rare earth minerals from the Molycorp Mine, pumice, feldspar, limestone, and sand and gravel, with sand

and gravel potential being the highest along the routes. There are a few past and current mining locations in the vicinity of the proposed project, but none are within 1,000 feet of either side of the proposed telecommunications line route or alternative routes. Proposed future activities at mines can easily avoid the proposed project area. Any identified adverse impacts at current mines are negligible. The potential for mineral resources in the project vicinity is area-wide. However, since no specific locations for valuable mineral resources have been identified within the project area, there would be no loss of availability of a known mineral resource as a result of the proposed project. Impacts under this criterion would be less than significant without mitigation.

NO IMPACT. Loss of Locally Important Mineral Resource Recovery Site Delineated on a Local General Plan, Specific Plan, or Other Land Use Plan. The proposed project would have no impact under this criterion because there are no identified mineral resources delineated on a local general plan, specific plan, or other land use plan that would result in loss of availability due to the construction, operation, or maintenance of the proposed project.

IMPACT PALEO-1: Direct or Indirect Damage or Destruction of Paleontological Resources
Less than significant without mitigation

The proposed project would include ground disturbance that could impact buried and undiscovered paleontological resources. Various actions would help reduce impacts on paleontological resources discovered during the preconstruction and construction phases of the proposed project. These actions include APMs PALEO-1 through PALEO-8. These measures (provision of a project paleontologist to oversee potential impacts; pre-construction surveys; construction worker awareness programs; construction monitoring; and recovery, testing, and curation of any significant paleontological findings) would prevent significant impacts. Therefore, impacts would be less than significant without mitigation.

3.6.3.6 No Project / No Action Alternative

In the No Project/No Action Alternative, the proposed action would not be undertaken. The BLM land on which the project is proposed would continue to be managed within BLM's framework of a program of multi-role use, sustained yield, and maintenance of environmental quality [43 USC 1781 (b)] in conformance with applicable statutes, regulations, policy, and land use plans.

Under the No Project / No Action Alternative, the impacts of the proposed project would not occur. However, except for the Ivanpah Substation, the land on which the project is proposed would not become available to other uses that are consistent with BLM's land use plan. The No Project / No Action Alternative would leave the proposed project area in its current use and would therefore have no additional effect on existing geologic or paleontological resources in the area other than to maintain their availability for potential future development. No impacts would occur.

3.6.3.7 Transmission Alternative Route A

Transmission Alternative Route A is similar to the proposed transmission line route in that it is located in similar geology, soils, and mineralogical materials. It is also similar in topography. Several direct impacts would be associated with this alternative route. Negligible localized short-term impacts would include those associated with seismic ground shaking and seismic-related ground failure. With the implementation of APMs GEO-1 and GEO-2, the impacts would be less than significant without mitigation. A minor localized long-term impact to soils from erosion would occur. With the implementation of MM GEO-3, this impact would be less than significant with mitigation. A minor extensive long-term impact on the structures of the alternative route would be associated unstable geologic units (subsidence). With the implementation of MMs GEO-1 and GEO-2, this impact would be less than significant with mitigation. A negligible localized long-term impact would be associated with expansive soil. With the implementation of MM GEO-4, this impact would be less than significant with mitigation. A negligible area-wide long-term impact would be associated with non-metallic mineral resources. However, this impact would be less than significant without mitigation.

Construction of the Transmission Alternative Route A may cause direct impacts to buried paleontological resources due to ground-disturbing activities. Potential direct impacts to paleontological resources during construction of Transmission Alternative Route A would be adverse, negligible, localized, and short term. Preconstruction ground-disturbing activities (augering and trenching) as part of geotechnical investigations along the route of Alternative Route A could impact buried paleontological resources in underlying sedimentary formations of high paleontological sensitivity. During later tower construction, ground-disturbing activities such as augering and trenching for support footings and grading for tower pads, service roads, and staging areas could impact paleontological resources in areas where underlying formations have high paleontological sensitivity. The rock unit of high paleontological sensitivity (see Table 3.6-6) along Transmission Alternative Route A is Quaternary alluvium (Qa/Qal). However, as part of construction of the proposed project, the applicant would implement APMs PALEO-1 through PALEO-8. These measures (provision of the project paleontologist to oversee potential impacts; pre-construction surveys; construction worker awareness programs; construction monitoring; and recovery, testing, and curation of any significant paleontological findings) would prevent significant impacts. Therefore, impacts would be less than significant without mitigation.

3.6.3.8 Transmission Alternative Route B

Transmission Alternative Route B is similar to the proposed transmission line route in that it is located in similar geology, soils, and mineralogical materials. It is also similar in topography. The direct impacts and mitigation associated with this alternative route are similar to those for Alternative Route A.

3.6.3.9 Transmission Alternative Route C

Transmission Alternative Route C would relocate a portion of the proposed transmission line to the west of the proposed project route, a portion of which crosses near the southern tip of the Spring Mountains near Milepost 2. This route is similar to the proposed transmission line route in this area in that it is located in similar geology, soils, and mineralogical materials. It is also similar in topography. However, the exposed geologic unit at the southern tip of the Spring Mountains includes exposures of Paleozoic- to Mesozoic carbonate (limestone and dolomite) and siliclastic (sandstone, mudstone, and conglomerate) bedrock (MzPzs).

Several direct impacts are associated with this alternative route. The Mesquite segment of the SFS crosses the Transmission Alternative Route C along the California-Nevada border at Primm nearly perpendicular to the proposed route. This impact to people and structures associated with fault rupture would be negligible and localized, and would be short term relative to construction but long term with respect to operations and maintenance. With the implementation of APM GEO-1, this impact would be less than significant without mitigation. Negligible localized short-term impacts related to this alternative route include those associated with seismic ground shaking and seismic-related ground failure. With the implementation of APMs GEO-1 and GEO-2, impacts would be less than significant without mitigation. A minor localized long-term impact on soils would be associated with erosion. With the implementation of MM GEO-3, this impact would be less than significant with mitigation. A minor extensive long-term impact would be associated with unstable geologic units (subsidence). With the implementation of MMs GEO-1 and GEO-2, this impact would be less than significant with mitigation. A negligible, localized, long-term impact on project structures would be associated with expansive soil. With the implementation of MM GEO-4, this impact would be less than significant with mitigation. The project could result in a negligible, area-wide, long-term impact to the availability of currently-identified non-metallic mineral resources. However, since no specific locations for valuable mineral resources have been identified within the project area, there would be no loss of availability of a known mineral resource as a result of the proposed project. This impact would be less than significant without mitigation.

Construction of the Transmission Alternative Route C could cause direct impacts to buried paleontological resources from ground-disturbing activities. Potential direct impacts to paleontological resources during construction of Transmission Alternative Route C would be adverse, negligible, localized, and short term. Preconstruction ground-disturbing activities (augering and trenching) as part of geotechnical investigations along the route could impact buried paleontological resources in underlying sedimentary formations of high paleontological sensitivity. During later tower construction, ground-disturbing activities such as augering and trenching for support footings and grading for tower pads, service roads, and staging areas could impact paleontological resources in areas where underlying formations have high paleontological sensitivity. The rock units of high paleontological sensitivity (see Table 3.6-6) along Transmission Alternative Route C are Quaternary lake/playa deposits (Ql/Qp) and Quaternary alluvium (Qa/Qal). Another underlying rock unit present along Alternative Route C is composed of Paleozoic and Mesozoic sedimentary rocks (PzMzs) of low paleontological sensitivity. As part of construction of the proposed project, the applicant would implement APMs PALEO-1 through PALEO-8. These measures (provision of a project paleontologist to oversee potential impacts; pre-construction surveys; construction worker awareness programs; construction monitoring; and recovery, testing, and curation of any significant paleontological findings) would prevent significant impacts. Therefore, impacts would be less than significant with mitigation.

3.6.3.10 Transmission Alternative Route D and Subalternative E

With the exception of crossing a portion of Paleozoic- to Mesozoic bedrock at the southern tip of the Spring Mountains, Transmission Line Alternative Route D and Subalternative E are both similar to the proposed Transmission Line Alternative Route C and the proposed project route. They both are located in similar geology, soils, and mineralogical materials. The alternative routes are also similar in topography. The direct impacts and mitigation associated with these alternative and subalternative routes are similar to those in Alternative Route C.

3.6.3.11 Telecommunication Alternative (Golf Course)

The Golf Course Telecommunication Alternative is similar to the proposed route, except it does not cross the SFS Mesquite segment. This route extends along an alluvial apron (fan) from the Clark Mountains near Mountain Pass, and is parallel to the I-15 ROW. The Golf Course Telecommunication Alternative is located in similar geology, soils, and mineralogical materials. Negligible, localized, short-term impacts related to this alternative would include those occurring to the project from seismic ground shaking and seismic-related ground failure. With the implementation of APMs GEO-1 and GEO-2, those impacts would be less than significant without mitigation. The project would result in a minor, localized, long-term impact on soils due to erosion. With the implementation of MM GEO-3, this impact would be less than significant with mitigation. A minor, extensive, long-term impact on the project would be associated with unstable geologic units (subsidence). With the implementation of MMs GEO-1 and GEO-2, this impact would be less than significant with mitigation. A negligible, localized, long-term impact on the project would be associated with expansive soil. With the implementation of MM GEO-4, this impact would be less than significant with mitigation. The project would result in a negligible, area-wide, long-term impact on non-metallic mineral resources. However, since no specific locations for valuable mineral resources have been identified within the project area, there would be no loss of availability of a known mineral resource as a result of the proposed project. This impact would be less than significant without mitigation.

Construction of the Golf Course Telecommunication Alternative could cause direct impacts to buried paleontological resources due to ground-disturbing activities associated with positioning the line underground along Nipton Road. Potential direct impacts to paleontological resources during construction of the Golf Course Telecommunication Alternative would be adverse, negligible, localized, and short term. Preconstruction ground-disturbing activities (augering and trenching) as part of geotechnical investigations along the route of the Golf Course Telecommunication Alternative could impact buried paleontological resources in underlying sedimentary formations of high paleontological sensitivity. During later tower construction, ground-disturbing activities such as augering and trenching for support footings and grading for tower pads, service roads, and staging areas could impact paleontological resources in areas where underlying formations have high paleontological sensitivity. The rock units of high paleontological sensitivity (see Table 3.6-6) along the proposed Golf Course Telecommunication Alternative are Quaternary Tertiary older alluvium (QT0a), Quaternary non-marine (Qc/Qoa), Quaternary alluvium (Qa/Qal), and Quaternary lake/playa deposits (Ql/Qp). Another underlying rock unit present along the Golf Course Telecommunication Alternative is Ancient intrusive and metamorphic rocks (Xm), which are of low paleontological sensitivity. As part of construction of the proposed project, the applicant would implement APMs PALEO-1 through PALEO-8. These measures (provision of a project paleontologist to oversee potential impacts; pre-construction surveys; construction worker awareness programs; construction monitoring; and recovery, testing, and curation of any significant paleontological findings) would prevent significant impacts. Therefore, impacts would be less than significant with mitigation.

3.6.3.12 Telecommunication Alternative (Mountain Pass)

The Mountain Pass Telecommunication Alternative is located in similar geology, soils, and mineralogical materials as Transmission Alternative Routes C and D and Subalternative E in the lower elevations, but also includes earlier Precambrian metamorphic bedrock of the Clark Mountains. The topography ranges from relatively flat low-lying valley bottoms and playa to moderately steep hill slopes of the Clark Mountains in the area of Mountain Pass substation.

Several direct impacts are associated with this alternative route. Negligible, localized, short-term impacts include those associated with seismic ground shaking and seismic-related ground failure. With the implementation of APMs GEO-1 and GEO-2, the impacts would be less than significant without mitigation. Minor, localized, long-term impacts of the project could result from both landslides and erosion. With the implementation of MMs GEO-2 and GEO-3 these impacts would be less than significant with mitigation. A minor, extensive, long-term impact to project structures could result from unstable geologic units (subsidence). With the implementation of MMs GEO-1 and GEO-2, this impact would be less than significant with mitigation. A negligible, localized, long-term impact to people and structures could result from building in expansive soil. With the implementation of MM GEO-4, this impact would be less than significant with mitigation. The project could result in negligible, area-wide, long-term impact to the availability of currently identified non-metallic mineral resources. However, since no specific locations for valuable mineral resources have been identified within the project area, there would be no loss of availability of a known mineral resource as a result of the proposed project. This impact would be less than significant without mitigation.

A portion of the Mountain Pass Telecommunication Alternative would go through the Molycorp Mine. Negligible to minor, short-term, adverse impacts from construction, operation, and maintenance of the project on mining operations are anticipated. Contaminated soils from the mine could be encountered during project construction. If that were to happen, the project could result in adverse impacts to water quality in local streams and spreading of contamination. As part of APM GEO-1, the applicant would identify contaminated soils along this alternative. Careful planning of soil segregation and treatment along the Mountain Pass Telecommunication Alternative route would minimize these impacts.

Construction of the Mountain Pass Telecommunication Alternative could cause direct impacts to buried paleontological resources due to ground-disturbing activities. Potential direct impacts to paleontological resources during construction of the Mountain Pass Telecommunication Alternative would be adverse, negligible, localized, and short term. Preconstruction ground-disturbing activities (augering and trenching) as part of geotechnical investigations along the route of the Mountain Pass Telecommunication Alternative could impact buried paleontological resources in underlying sedimentary formations of high paleontological sensitivity. During later tower construction, ground-disturbing activities such as augering and trenching for support footings and grading for tower pads, service roads, and staging areas could impact paleontological resources in areas where underlying formations have high paleontological sensitivity. The rock units of high paleontological sensitivity (see Table 3.6-6) along the proposed Mountain Pass Telecommunication Alternative are Quaternary Tertiary older alluvium (Qtoa), Quaternary non-marine (Qc/Qoa), and Quaternary alluvium (Qa/Qal). Another underlying rock unit present along the Mountain Pass Telecommunication Alternative is undivided Earlier Precambrian intrusive and metamorphic rocks (epC), which are of low paleontological sensitivity. As part of construction of the proposed project, the applicant would implement APMs PALEO 1 through PALEO 8. These measures (provision of a project paleontologist to oversee potential impacts; pre-construction surveys; construction worker awareness programs; construction monitoring; and recovery, testing, and curation of any significant paleontological findings) would prevent significant impacts. Therefore, impacts would be less than significant with mitigation.

3.6.4 Mitigation Measures

MM GEO-1: Monitor and Mitigate Damage to Tower Structures. SCE will contact the California Department of Water Resources and the Nevada Division of Water Resources on an annual basis to determine if groundwater withdrawals are threatening to cause ground subsidence within the project area. If subsidence threatens tower locations, SCE will develop a plan to mitigate potential damage to tower structures using standard foundation remediation techniques available.

MM GEO-2: Geotechnical Engineering Study. The applicant will prepare a geotechnical engineering study prior to the final project design to identify site-specific geological conditions and potential geologic hazards. The data collected from the study will be used to guide sound engineering practices and to mitigate potential geologic hazards.

MM GEO-3: Preparation and Implementation of SWPPP. The applicant will prepare a SWPPP for review and approval by the Lahontan Regional Water Quality Control Board (Region 6) and the Clark County Stormwater Quality Management Committee that addresses construction and post-construction project-related ground disturbances and associated erosion. The plan will provide the necessary engineering controls and procedures to minimize impact to the ground surface caused by construction, operation, and maintenance activities. A copy of the approved plan will also be submitted to the CPUC.

MM GEO-4: Expansive Soils Mitigation. The applicant will prepare a geotechnical study of the areas of expansive soil(s) identified in APM GEO-1 to develop appropriate design and mitigation measures prior to construction.

3.6.5 Whole of the Action / Cumulative Action

Below is a brief summary of information related to geology, mineral, and paleontological resources in the ISEGS FSA/DEIS prepared by the CEC and the BLM. This section focuses on differences in the ISEGS setting and methodology compared with the setting and methodology discussed above for the EITP. This section also discloses any additional impacts or mitigation imposed by the CEC for ISEGS.

3.6.5.1 ISEGS Setting

The ISEGS project would be constructed on the west side of Ivanpah Valley. Existing conditions for the ISEGS project site are primarily consistent with the EITP as described in Section 3.6.1. Any discrepancies between the ISEGS project site and the EITP site are described below.

Project Site Geology

The three ISEGS power plant sections (from south to north, Ivanpah 1, 2, and 3) would be located on a broad alluvial slope of coalescing alluvial fans along the eastern flank of the Clark Mountain Range. These alluvial fans may be relatively thin near the margins where carbonate and metamorphic rock are exposed, and there is only limited data on its thickness away from these margins.

Geologic Hazards

Fault Rupture

No active faults have been identified crossing the boundary of new construction on the proposed ISEGS site or in the vicinity of the proposed gas pipeline. The potential for surface rupture on a fault at any of the three power plant sites (Ivanpah 1, 2, and 3) is very low since no faults are known to have ruptured the ground surface of the proposed ISEGS location.

Groundshaking

The intensity of seismic shaking expected in the area of the Ivanpah Substation site is consistent with the EITP site. Due to the uncertainty in the uppermost soil profile, a design-level geotechnical investigation is proposed as part of the

Condition of Certification (GEO-1) to further evaluate this potential hazard and provide appropriate seismic design parameters.

Liquefaction

The potential for liquefaction in the area of the Ivanpah Substation is consistent with the EITP site and is low within the ISEGS project area based on a soil boring in one of the power plant sites (Ivanpah 2). Due to the uncertainty of the liquefaction potential in the other two power plant sites (Ivanpah 1 and 3), a geotechnical investigation is proposed as part of the Condition of Certification (GEO-1) to further evaluate this potential hazard.

Landslides

The landslide potential at the ISEGS site is negligible since ISEGS is located on a broad, gently east-sloping alluvial fan.

Expansive Soils

The potential for expansive soils within the ISEGS project area is uncertain, although the soil encountered in the boring in power plant site Ivanpah 2 were not expansive. There are no data for the other two (Ivanpah 1 and 3) power plant areas. Due to the lack of expansion testing in power plant site Ivanpah 2, and the uncertainty of the expansion potential in the other two power plant sites (Ivanpah 1 and 3), a geotechnical investigation is proposed as part of the Condition of Certification (GEO-1) to further evaluate this potential hazard.

Collapsible Soils

The potential for collapsible soils within the ISEGS project area is uncertain, although the soils encountered in the boring in power plant site Ivanpah 2 were not susceptible to either dynamic compaction or hydrocompaction, due to their medium dense to very dense granular composition. There are no soil composition data for the other two (Ivanpah 1 and 3) power plant areas; a geotechnical investigation is proposed as part of the Condition of Certification (GEO-1) to further evaluate this potential hazard.

Mineral Resources

There are a variety of active mining operations in the general area near the ISEGS project location, but no active operations occur within the proposed ISEGS project boundaries. In addition, the general area is considered to have low potential for leasable minerals such as oil and gas. The applicant may need to move sand and gravel off site, or between different units of the facility, which would require compliance with BLM regulations (40 CFR Part 3600). Other adjacent claims along the western boundary, Limestone Hill, have two active locatable minerals claims with underground workings; the current extent is unknown, and there is no indication that these would become active economic commercial operations. The ISEGS project area is currently not used for mineral production, nor is it under claim, lease, or permit for the production of locatable, leasable, or salable minerals.

Paleontological Resources

The ISEGS project area is underlain by two surficial geologic units (Quaternary alluvium and Quaternary older alluvium). These are alluvial fan deposits developed on the base of the Clark Mountain Range. Because of the coarseness and youth of Quaternary alluvium and Quaternary older alluvium, the ISEGS FSA/DEIS rates paleontological sensitivity of this rock unit as low. Because fossil resources were found in Quaternary older alluvium in adjacent areas, the EITP DEIS rated paleontological sensitivity of this rock unit high at the Ivanpah Substation. The ISEGS FSA/DEIS notes that there would be the potential to encounter geologic units with a higher paleontological sensitivity below the alluvium during construction and site grading. The Staff rates these units (Quaternary lacustrine sediments and Paleozoic carbonate rock) as having high paleontological sensitivity. The pre-Cambrian to Cambrian metamorphic rocks have been rated as having negligible paleontological sensitivity. No paleontological resources were identified by the paleontological record searches conducted for the ISEGS project area.

Applicable Laws, Regulations, and Standards

Due to the variation in project components and location between EITP and ISEGS, different laws, regulations, and standards would apply to ISEGS than those listed in Section 3.6.2. Since ISEGS would be developed entirely within California on BLM land, the Nevada regulations associated with the EITP would not apply Table 3.6.7 identifies the laws, regulations, and standards that are applicable to the ISEGS project but not the EITP.

Table 3.6-7 Laws, Regulations, and Standards Applicable to the ISEGS Project

Law, Regulation, or Standard	Description	Project Component
Federal		
The Natural Gas Pipeline Safety Act of 1968	The Natural Gas Pipeline Safety Act of 1968 as amended through March 2006 (Title 49 Section VIII USC Chapter 601) specifies, among others, the minimum safety standards for designing, installing, constructing, initially inspecting, and initially testing a new natural gas pipeline facility. These standards include the characteristics of the material used in constructing the facility, design factors for specific locations, and the public safety factors, particularly its ability to prevent and contain a natural gas spill. The design standards for specific locations reflect site-specific geological, topographical, seismic, and soils conditions.	Natural gas pipeline
State		
CEQA, PRC Sections 15000 et seq., Appendix G	CEQA mandates that public and private entities identify the potential impacts on the environment during proposed activities. Appendix G outlines the requirements for compliance with CEQA and defines significant impacts.	Geological, soil, mineral, and paleontological resources
CPUC General Order 112-E	CPUC General Order 112-E establishes minimum requirements for the design, construction, quality of materials, locations, testing, operations and maintenance of facilities to safeguard life or limb, health, property, and public welfare and to provide that adequate service will be maintained by gas utilities operating under the jurisdiction of the CPUC.	Natural gas pipeline
Local		
San Bernardino County Ordinance Code, Title 3, Division 3, Chapter 8, Waste Management, Article 5, Liquid Waste Disposal	This ordinance requires the following compliance for all liquid waste disposal systems: (1) compliance with applicable portions of the Uniform Plumbing Code and the San Bernardino County Department of Environmental Health (DEHS) standards; (2) approval by the DEHS and building authority with jurisdiction over the system; or (3) for alternative systems, approval by the DEHS, the appropriate building official of this jurisdiction, and the appropriate California Regional Water Quality Control Board.	New septic tank and leach field
San Bernardino County Ordinance Code, Title 6, Division 3, Chapter 3, Uniform Plumbing Code	This ordinance describes the installation and inspection requirements for locating disposal/leach fields and seepage pits.	New septic tank and leach field

3.6.5.2 ISEGS Methodology

In the ISEGS FSA/DEIS, BLM and CEC staff (Staff) reported on existing conditions and assessed impacts to geology, mineral, and paleontological resources in the same section. In addition, staff evaluated the potential of the ISEGS project to restrict or remove from access potential sources of salable mineral resources. Staff considered compliance with the laws, ordinances, regulations, and standards associated with the project components and location. Staff also considered whether there would be a significant impact under CEQA using the impact criteria described in Section 3.6.3.

3.6.5.3 ISEGS Impacts

The Staff determined that construction, operation, and decommissioning of the ISEGS project could impact geologic, mineralogical, or paleontological resources. Where impacts were identified, the Staff proposed mitigation measures (Conditions of Certification) to reduce impacts to less than significant levels.

The CEC and BLM have published the following impacts related to geology, soils, minerals, and paleontological resources for the ISGES project:

Construction Impacts

Geologic hazards have been identified associated with the ISEGS project area and include strong ground shaking, liquefaction, settlement due to compressible soils, subsidence associated with shrinkage of clay soils, hydrocompaction (or dynamic compaction), and the presence of expansive clays.

The ISEGS project would directly remove approximately 4,072.5 acres from potential use for sand and gravel production under BLM's salable mineral program. The ISEGS FSA/DEIS states that this removal is not expected to have any significant impact since it represents a small fraction of the total sand and gravel resource available within the valley. In addition, the applicant may need or desire to move sand and gravel either off site or between the different units of the facility. Should this occur, the applicant would be required to comply with BLM regulations in 43 CFR Part 3600, which regulates the production and use of sand and gravel from public lands. Use of sand and gravel or other mineral materials within the boundaries of an authorized ROW is permitted; however, removal of these materials from an authorized ROW would require payment to the U.S. of the fair market value of those materials. The ISEGS project would not have any direct or indirect impact on the production of locatable or leasable minerals outside of the ISEGS project boundaries. The only potential conflict would occur if the claimant or another person located a new claim, for locatable minerals underneath the proposed project, within the project boundaries. This could occur, as the proposed project location has not been withdrawn from mineral entry. The potential for this scenario is expected to be low. If it did occur, conflicts between the surface use of the land for solar energy production and access to the subsurface minerals would be addressed in accordance with appropriate regulations. Therefore, the ISEGS FSA/DEIS states that the ISEGS project would not impact any current or reasonably foreseeable development of mineral resources.

The ISEGS FSA/DEIS states that paleontological resources are known to exist in the region but that no paleontological resources have been documented on the ISEGS site. If they were encountered, potential impacts to them from construction activities would be minimized through worker training and monitoring by qualified paleontologists. The ISEGS project would include grading, foundation excavation, utility trenching, and possibly drilled shafts. The ISEGS FSA/DEIS considers the probability of encountering paleontological resources to be generally high on portions of the site, particularly the west side of Ivanpah 3, based on the soils profile, SVP assessment criteria, and the near surface occurrence of the sensitive geologic units. The potential for encountering fossils hosted in Quaternary lake bed sediments will increase with the depth of cut. Excavations for ancillary facilities and new pipelines and onsite excavations deeper than 5 feet may have a higher probability of encountering potentially high sensitivity materials, although sensitive materials could occur nearer the surface.

Based on the literature and archives search, field surveys, and compliance documentation for the ISEGS, the applicant has proposed monitoring and mitigation measures (Conditions of Certification) to be followed during the construction of the ISEGS project. The ISEGS FSA/DEIS states that the facility can be designed and constructed to minimize the effect of geologic hazards at the site during project design life and that impacts to vertebrate fossils encountered during construction of the power plant and associated linear projects would be mitigated to a level of insignificance.

Operational Impacts

The ISEGS FSA/DEIS states that operation of the ISEGS project facilities would not have any adverse impact on geologic, mineralogical, or paleontological resources. The ISEGS FSA/DEIS also states that the potential geologic hazards, including strong ground shaking; liquefaction; settlement due to compressible soils, subsidence associated with shrinkage of clay soils, hydrocompaction, or dynamic compaction; and the presence of expansive clay soils could be effectively mitigated through facility design such that these potential hazards should not affect operation of the facility.

Decommissioning Impacts

The ISEGS project would be decommissioned at the end of its 50-year life by removing all facilities to 3 feet below grade, restoring original contours, and revegetating the site. The ISEGS FSA/DEIS states that this removal should not negatively affect geologic, mineralogical, or paleontological resources since the majority of the ground disturbed during plant decommissioning and closure would have been already disturbed, and mitigated as required, during construction and operation of the project. Facility closure would make land occupied by the proposed project once again available for potential future development of geologic or mineralogical resources within the former project borders.

3.6.5.4 ISEGS Conditions of Certification

The ISEGS FSA/DEIS recommends that the following Conditions of Certification be required by the CEC and the BLM to lessen impacts to related to geology, paleontology, and mineral resources if the project is approved. This document presents a summary for the ISEGS Conditions of Certification. For the complete language of the Conditions of Certification, refer to the ISEGS FSA/DEIS. Since the ISEGS document presented geology, mineral, and paleontological resources in one section, the Conditions of Certification listed below apply to these resource areas. The ISEGS documents presented soil and water resources in one chapter. The applicable Conditions of Certification for soil resources are presented in Section 3.8, "Hydrology and Water Quality."

GEO-1 requires the ISEGS project applicant to prepare a Soils Engineering Report required that meets Section 1802A of the 2007 CBC to specifically include laboratory test data, associated geotechnical engineering analyses, and a thorough discussion of the potential for liquefaction; settlement due to compressible soils, subsidence associated with shrinkage of clay soils, hydrocompaction, or dynamic compaction; and the presence of expansive clay soils. The report would also include recommendations for ground improvement and/or foundation systems necessary to mitigate these potential geologic hazards, if present.

PAL-1 requires the project applicant to provide BLM's Authorized Officer and the Compliance Project Manager (CPM) with the resume and qualifications of its Paleontological Resource Specialist (PRS) for review and approval. Any changes to the PRS will be approved by the BLM's Authorized Officer and CPM.

PAL-2 requires the project applicant to provide to the PRS, BLM's Authorized Officer, and the CPM, for approval, maps and drawings showing the footprint of the power plants, construction lay down areas, and all related facilities identifying all areas of the project where ground disturbance is anticipated. Any changes must be approved by the PRS, BLM's Authorized Officer and CPM. A letter identifying the proposed schedule of each project power plant shall be provided to the PRS, BLM's Authorized Officer and CPM. At a minimum, the project owner shall ensure that the PRS or PRM consults weekly with the project superintendent or construction field manager to confirm area(s)

PAL-3 requires, if after review of the plans provided pursuant to **PAL-2**, the PRS determines that materials with moderate, high, or unknown paleontological sensitivity could be impacted, the project applicant to ensure that the PRS prepares, and the project owner submits to BLM's Authorized Officer and the CPM for review and approval, a PRMMP to identify general and specific measures to minimize potential impacts to paleontological resources. Approval of the PRMMP by BLM's Authorized Officer and the CPM shall occur prior to any ground disturbance.

PAL-4 requires, if after review of the plans provided pursuant to **PAL-2**, the PRS determines that materials with moderate, high, or unknown paleontological sensitivity could be impacted then, prior to ground disturbance and for the duration of construction activities involving ground disturbance, the project applicant and the PRS shall prepare and conduct weekly BLM Authorized Officer- and CPM-approved training for the following workers: project managers, construction supervisors, foremen and general workers involved with or who operate ground-disturbing equipment or tools.

PAL-5 requires the project applicant to ensure that the PRS and PRM(s) monitor consistent with the PRMMP all construction-related grading, excavation, trenching, and augering in areas where potential fossil-bearing materials have been identified, both at the site and along any constructed linear facilities associated with the project. In the event that the PRS determines full-time monitoring is not necessary in locations that were identified as potentially fossil-bearing in the PRMMP, the project owner shall notify and seek the concurrence of BLM's Authorized Officer and the CPM.

PAL-6 requires the project applicant, through the designated PRS, to ensure that all components of the PRMMP are adequately performed including collection of fossil materials, preparation of fossil materials for analysis, analysis of fossils, identification and inventory of fossils, the preparation of fossils for curation, and the delivery for curation of all paleontological resource materials encountered and collected during project construction.

PAL-7 requires the project applicant to ensure preparation of a Paleontological Resources Report (PRR) by the designated PRS. The PRR shall be prepared following completion of the ground-disturbing activities. The PRR shall include an analysis of the collected fossil materials and related information, and submit it to the CPM for review and approval.

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