

## Section 4.6

# Geology, Soils, and Seismicity

## Introduction

This section describes existing geologic and soil conditions, potential geologic and geotechnical hazards, and potential impacts for the proposed power line project.

The project is located in a seismically active region. Geologic hazards with the greatest potential to affect the project include surface fault rupture, seismic groundshaking, landslides, localized liquefaction and lateral spreading, and soil erosion. Design constraints include the presence of expansive and corrosive soils.

Proper location of project components, design-level geotechnical investigations, and appropriate engineering and construction measures will avoid significant impacts associated with geology and geologic hazards.

## Methodology

Existing conditions were determined from review of publicly available published literature and maps (see references cited in text). Limited information is available about local groundwater levels and subsurface soil profiles along the project route and substation site. Fieldwork consisted of reconnaissance-level surveys, conducted over a period of months by several environmental analysts.

# Affected Environment

## Regulatory Setting

### Federal Regulations

#### Clean Water Act Section 402[p]

Amendments to the federal Clean Water Act (CWA) in 1987 added Section 402[p], which created a framework for regulating municipal and industrial storm water discharges under the National Pollutant Discharge Elimination System (NPDES) program. In California, the State Water Resources Control Board (State Water Board) is responsible for implementing the NPDES program; pursuant to the state's Porter-Cologne Water Quality Control Act, it delegates implementation responsibility to the state's nine Regional Water Quality Control Boards. The Central Coast Regional Water Quality Control Board (Central Coast Water Board) has jurisdiction over the project area.

Under the NPDES Phase II Rule, any construction project disturbing 1 acre or more must obtain coverage under the state's General Permit for Storm Water Discharges Associated with Construction Activity. The purpose of the Phase II rule is to avoid or mitigate the effects of construction activities, including earthwork, on surface waters. To this end, General Construction Permit applicants are required to file a Notice of Intent to Discharge Storm Water with the Regional Water Quality Board that has jurisdiction over the construction area, and to prepare a Storm Water Pollution Prevention Plan (SWPPP) stipulating BMPs that will be in place to avoid adverse effects on water quality.

### State of California

#### Alquist-Priolo Earthquake Fault Zoning Act

California enacted the Alquist-Priolo Act in 1972 (PRC Sections 2621 et seq.), which requires the establishment of "earthquake fault zones" (formerly known as "special study zones") along known active faults in California. Under the Alquist-Priolo Act, faults are zoned, and construction along or across them is strictly regulated if they are "sufficiently active" and "well-defined." A fault is considered *sufficiently active* if one or more of its segments or strands shows evidence of surface displacement during Holocene time (defined for purposes of the Act as referring to approximately the last 11,000 years). A fault is considered *well defined* if its trace can be clearly identified by a trained geologist at the ground surface or in the shallow subsurface, using standard professional

techniques, criteria, and judgment (Hart and Bryant 2007). Under the Alquist-Priolo Act, development of structures for human occupancy, defined as at least 2,000 hours occupancy per year, on or near active fault traces is regulated to reduce the hazard from surface fault rupture.

The Act requires that cities and counties regulate development projects within the identified surface fault zones, through permits and geologic investigations. Official maps of earthquake fault zones are prepared by the State Geologist and are described in California Geological Survey Special Publication 42 (Hart and Bryant 2007).

## Seismic Hazards Mapping Act

Like the Alquist-Priolo Act, the Seismic Hazards Mapping Act of 1990 (PRC Sections 2690–2699.6) is intended to reduce damage resulting from earthquakes. While the Alquist-Priolo Act addresses surface fault rupture, the Seismic Hazards Mapping Act addresses other earthquake-related hazards, including strong groundshaking, liquefaction<sup>1</sup>, and seismically induced landslides. Its provisions are similar in concept to those of the Alquist-Priolo Act: the state is charged with identifying and mapping areas at risk of strong groundshaking, liquefaction, landslides, and other corollary hazards; and cities and counties are required to regulate development within mapped Seismic Hazard Zones.

Under the Seismic Hazards Mapping Act, permit review is the primary mechanism for local regulation of development. Specifically, cities and counties are prohibited from issuing development permits for sites within Seismic Hazard Zones until appropriate site-specific geologic and/or geotechnical investigations have been carried out and measures to reduce potential damage have been incorporated into the development plans.

## Local Regulations

No local regulations related to geology, soils, or seismicity apply to this project; PG&E activities are regulated by CPUC general orders, discussed in the following section.

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<sup>1</sup> *Liquefaction* is a phenomenon in which the strength and stiffness of a soil are reduced by earthquake shaking or other rapidly applied loading. Liquefaction and related types of ground failure are of greatest concern in areas where well-sorted sandy unconsolidated sediments are present in the subsurface and the water table is comparatively shallow.

## Engineering and Construction Codes and Standards for PG&E Activities

Design and construction of PG&E facilities are governed by a variety of codes and standards. A number of these specifically regulate topics relevant to geology and geotechnical engineering, such as earthwork standards and seismic safety, including the following.

- **CPUC General Order 95** provides general standards for design and construction of overhead electric transmission and distribution lines.
- **“IEEE 693” *Recommended Practices for Seismic Design of Substations*** contains guidelines for earthquake-resistant substation design and construction. The IEEE (Institute of Electrical and Electronics Engineers, Inc.) is an international professional organization and a widely recognized authority in the development of industry standards for electrical engineering and electric power generation and transmission.
- **The International Building Code (IBC)** is voluntarily adopted by jurisdictions and agencies. PG&E adheres to the IBC’s earthwork standards where they are not superseded by CPUC regulations.

## Project Setting

The following sections describe the physiographic setting, geomorphology, and geology of the project area, with an emphasis on Quaternary geology and geologic hazards.

### Physiography

The proposed project is located within the northern Coast Ranges geomorphic province of California. The Coast Ranges extend approximately 600 miles from southern California to the Oregon border and are comprised of a series of mountain ranges generally from 2,000 to 4,000 feet elevation above sea level and intervening valleys. Ranges and valleys trend northwest, subparallel to the San Andreas fault.

In the project area, the Coast Ranges are approximately 50 miles wide. The coastline is uplifted, terraced, and wave-cut (CGS 2002); in many areas, the mountains descend into the ocean. The mountains in the immediate vicinity of the project area are the Gabilan range. High peaks are Mount Johnson (3,465 feet), North Chalone Peak (3,304 feet), South Chalone Peak (3,269 feet), and Fremont Peak (3,171) (Peakbagger.com 2009).

In the project area, the San Benito Valley drains via the San Benito River to the Pajaro River, which in turn drains to Monterey Bay (Pajaro River Watershed 2006). Further north and east, the San Benito Valley meets the larger Santa Clara Valley.

The Hollister Tower Segment originates at the Lagunitas Switches near the intersection of Crazy Horse Road and San Juan Grade Road in Monterey County, just as the hills begin. The project corridor then traverses north through hilly terrain at the northeastern edge of the Gabilan Range, crossing a series of steep hills, and ending near the Anzar Junction, approximately 1.5 miles northwest of San Juan Bautista in San Benito County. Slopes in this section of the project area include relatively steep to moderately steep grades, ranging from approximately 10 to 80 percent. Elevations in this section of the project area range from approximately 140 to 1,300 feet above mean sea level (amsl).

The Hollister Pole Segment begins near Anzar Junction, at the eastern edge of the Gabilan Range, and runs east into the flat San Juan Valley, where it crosses the San Benito River. The line continues east along the northern edge of the San Juan Valley, in the foothills of the Lomerias Muertas Mountains (Flint Hills) of the Franciscan Complex (Jennings and Strand 1958), and ends at the Hollister Substation in Hollister. Relief for this segment is relatively gentle at each end of the alignment, while sections of the foothills include moderately steep grades. The elevations of the Hollister Pole Segment range from approximately 270 to 410 feet amsl.

## Geologic Framework

The Coast Ranges geomorphic province is characterized by an echelon of northwest-trending mountain ranges formed over the past 10 million years or less by active uplift related to complex tectonics of the San Andreas fault/plate boundary system (e.g., Norris and Webb 1990, Busing and Walker 1995, Atwater and Stock 1998). The eastern range front is defined by faults that have been interpreted as contractile features associated with shortening along an axis approximately normal to the range front (e.g., Wong et al. 1988, Sowers et al. 1992, Unruh et al. 1992; see also Jennings 1977 for regional mapping) but may also locally accommodate a right-lateral component of motion (e.g., Richesin 1996).

East of the San Andreas fault, the Coast Ranges are broadly antiformal. The core of the uplift consists primarily of metasedimentary rocks and mélangé of the Mesozoic Franciscan Complex (e.g., Jennings 1977). Outcrops of mafic and ultramafic units belonging to the Jurassic Coast Range Ophiolite are also locally present, and are particularly well developed along the Ortigalita fault in the vicinity of Del Puerto Canyon (Wagner et al. 1990, Evarts et al. 1999). Mesozoic ultramafic rocks are also well exposed in the vicinity of San Benito Mountain. The eastern Coast Range range front is flanked by a generally eastward-younging sequence of Cretaceous through Quaternary clastic sedimentary strata. The lower portion of this sequence, where it is present, typically records deep marine deposition, while the upper portion reflects progressive growth and erosional dissection of the Coast Range uplift (Unruh et al. 1992, Richesin 1996). Quaternary alluvial strata accumulated on essentially modern topography buttress against the range front, and are locally folded and/or faulted, particularly along the southern portion of the range front. Active alluvium and older Quaternary

terrace deposits are present in the larger active stream valleys throughout the eastern Coast Ranges (e.g., Jennings, 1977, Wagner et al. 1990, Richesin 1996).

West of the San Andreas fault near the project area, basement rock consists of metamorphic rocks and granitic plutons. The metamorphic rock includes gneiss, schist, quartzite, and marble. The granitic rocks vary in composition but generally are similar to the composition of the plutonic rocks of the Sierra Nevada and Peninsular Ranges (Norris and Webb 1990.). The Gabilan Range, the mountainous region adjacent to the project area, lies west of the San Andreas fault zone. The Gabilan Range is comprised of Mesozoic granitic rock and older metamorphic rocks. The central portion of the range is mainly comprised of Miocene rhyolite flows, and pyroclastic rocks are exposed in a down-faulted block (USFS 2008).

At the southern end of the Gabilan Range are the Pinnacles, an area approximately 5 miles long by 2.5 miles wide of weathered volcanic rock, largely rhyolite breccias but also composed of andesitic and basaltic flows. The features of the topography at Pinnacles include the spires, or pinnacles, for which the national park is named; steep slopes; narrow valleys; and large fallen boulders that have wedged in the valleys and have formed caves (Norris and Webb 1990).

## Soils

Soils in the project area and their characteristics are shown in Figures 4.6-2 through 4.6-12, and are described in Tables 4.6-1 and 4.6-2. The tables list closely related soils in *soil series*, which provide more specific detail. The tables then group these series into *soil associations*.

### Soil Associations

#### San Benito County

The two soil associations in San Benito County and their relationship to the proposed project are described below and in Table 4.6-1.

#### **SORRENTO-YOLO-MOCHO ASSOCIATION**

The Sorrento-Yolo-Mocho Association consists of nearly level to sloping, well-drained, medium-textured soils on floodplains and alluvial fans. The Hollister Substation is underlain by these soils, as well as portions of the Hollister Pole Segment that lie within the San Juan Valley floor.

#### **DIABLO-SOPER ASSOCIATION**

The Diablo-Soper Association consists of strongly sloping to very steep, well-drained, fine- and moderately coarse-textured soils, formed over sandstone and

shale or weakly cemented sand and gravel. The majority of the Hollister Tower Segment and portions of the Hollister Pole Segment are underlain by these soils.

Soil erosion potential throughout the San Juan Valley floor is generally low. Moderate potential exists on lower slopes adjacent to the valley floor, while the mountainous areas generally have a higher potential for erodibility. Streambank erosion may occur during periods of high water (San Benito County 1980).

Table 4.6-1 lists soil associations within the proposed project area and the estimated engineering properties of the soils.

### **Monterey County**

Fifteen identified soil series are located along the alignment in Monterey County; these soil series and their properties are described in Table 4.6-2. Of these 15 soils, six prominent soil series are located along the proposed alignment in Monterey County. These soils include Arnold loamy sand, Danville sandy clay loam, San Benito clay loam, and Vista coarse sandy loam. Erosion potential for these soils ranges from slight to high.

## **Geologic Hazards**

### **Primary Seismic Hazards—Surface Fault Rupture and Groundshaking**

#### **Surface Fault Rupture**

The project alignment crosses two faults zoned as active by the State of California pursuant to the Alquist-Priolo Act and thus recognized as hazardous with respect to surface fault rupture:

- San Andreas fault between Tower 6/39 and Pole 13/8, and
- Calaveras fault between Poles 21/15 and 22/00.

The proposed project also crosses one fault with likely Holocene displacement and that is thus considered likely to be active (Bryant 2000b, Clark et al. 1984) but has not been zoned as active:

- Zayante-Vergeles fault between Towers 2/14 and 2/15.

The Zayante-Vergeles fault also probably poses a surface fault rupture hazard.

**Table 4.6-1.** Mapped Soil Associations of San Benito County in the Project Area

Map Unit Number and Name	Soil Series and Percentage	Topographic Location	Erosion Potential <sup>a</sup>	Permeability <sup>b</sup>	Drainage	Shrink-Swell Potential	Corrosion Potential <sup>c</sup>
1. Sorrento-Yolo-Mocho Association	Sorrento: 45%	Flood plains to alluvial fans	Sorrento: none to moderate	Sorrento: – 0.2–2.5	Well drained	Sorrento: low to moderate	Sorrento: low to moderate
	Yolo: 20%		Yolo: none to moderate	Yolo: 0.8–2.5		Yolo: low to moderate	Yolo: low
	Mocho: 15%		Mocho: none to moderate	Mocho: 0.2–5.0		Mocho: low to moderate	Mocho: low
	Other: 20%						
6. Diablo-Soper Association	Diablo: 75%	Strongly sloping uplands	Diablo: moderate to high	Diablo: 0.05–0.2	Well drained	Diablo: high	Diablo: high
	Soper: 20%		Soper: moderate to severe	Soper: 0.2–10.0		Soper: low to moderate	Soper: low to moderate
	Other: 5%						

<sup>a</sup> Erosion hazard ratings throughout soil profiles.

<sup>b</sup> Permeability of surface horizon; may vary with depth.

<sup>c</sup> Corrosion potential for uncoated steel.

Source: Soil Conservation Service 1969.

**Table 4.6-2.** Mapped Soil Series of Monterey County in the Project Area

<b>Map Symbol</b>	<b>Soil Series</b>	<b>Topographic Location</b>	<b>Erosion Potential<sup>a</sup></b>	<b>Permeability<sup>b</sup></b>	<b>Drainage</b>	<b>Shrink-Swell Potential</b>	<b>Corrosion Potential for Uncoated Steel</b>	<b>Corrosion Potential for Concrete</b>
AkD	Arnold loamy sand, 9–15% slopes	Foot slopes and broad ridges on uplands	Moderate	6.0–20.0	Somewhat excessively drained	Low	Moderate	Moderate
AkF	Arnold loamy sand, 15–50% slopes	Steep uplands	High	6.0–20.0	Somewhat excessively drained	Low	Moderate	Moderate
Cf	Clear lake clay	Flood plains or basins	None	0.06–0.2	Poorly drained	High	High	High
DaA	Danville sandy clay loam, 0–2% slopes	Alluvial fans and valleys	Slight	0.06–0.6	Well drained	Moderate to high	High	Low to Moderate
DaC	Danville sandy clay loam, 2–9% slopes	Small alluvial fans adjacent to foothills	Slight to moderate	0.06–0.6	Well drained	Moderate to high	High	Low to Moderate
GhF	Gloria sandy loam, 15–50% slopes	Dissected terraces	High	2.0–6.0	Well drained	Low to high	High	Low to Moderate
MaF	McCoy clay loam, 30–50% slopes	Steep soil on hills	Moderate	0.2–.06	Well drained	Moderate to high	Moderate to high	Low
NaE	Nacimiento silty clay loam, 15–30% slopes	Steep soil on uplands	Moderate	0.2–0.6	Well drained	Moderate	High	Low
PnD	Placencia sandy loam, 9–15% slopes	Strongly sloping soil on terraces	Moderate	0.06–2.0	Well drained	Low to high	Moderate to high	Low
PnE	Placencia sandy loam, 15–30% slopes	Moderately steep soil on terraces	High	0.06–2.0	Well drained	Low to high	Moderate to high	Low
Rc	Rock outcrop–Xerorthents association	Strongly sloping to extremely steep mountains	Very high	No estimates	No estimates	No estimates	No estimates	No estimates

**Table 4.6-2. Continued**

<b>Map Symbol</b>	<b>Soil Series</b>	<b>Topographic Location</b>	<b>Erosion Potential<sup>a</sup></b>	<b>Permeability<sup>b</sup></b>	<b>Drainage</b>	<b>Shrink-Swell Potential</b>	<b>Corrosion Potential for Uncoated Steel</b>	<b>Corrosion Potential for Concrete</b>
SbA	Salinas clay loam, 0–2% slopes	River terraces	Slight	0.2–0.6	Well drained	Low to moderate	High	Low
SdG	San Benito clay loam, 50–75% slopes	Very steep soil on uplands	High	0.2–0.6	Well drained	Moderate	High	Low
VaE	Vista coarse sandy loam, 15–30% slopes	Hilly uplands	Moderate	2.0–6.0	Well drained	Low	Moderate	Moderate
VaG	Vista coarse sandy loam, 30–75% slopes	Steep soil on ridges	High	2.0–6.0	Well drained	Low	Moderate	Moderate

<sup>a</sup> Erosion hazard ratings throughout soil profiles.

<sup>b</sup> Permeability of surface horizon; may vary with depth.

Source: Soil Conservation Service 1978.

All of these faults are dominantly right-lateral strike- or oblique-slip structures. The San Andreas fault passes through the project near Anzar Junction, at the intersection of the two power line segments. This part of the San Andreas fault is known as the Santa Cruz Mountains Section (Bryant and Matthew 2002a, Peterson 1996, USGS 2003 Working Group on California Earthquake Probabilities 2003). A segment of the San Andreas Fault approximately 7 miles southeast of the project area (the Creeping section) experiences slow gradual movement known as fault creep (Bryant and Matthew 2002b). The Calaveras fault, Southern section passes south through Santa Clara County and enters San Benito County at San Felipe Lake (approximately 15 miles north of Hollister), and the Paicines section extends from near the junction of the San Benito River and Tres Pinos Creek southeast to near Stone Canyon. A historic creep rate has been reported at 4–12 mm/year on the Southern section of the Calaveras in the Hollister area (Bryant and Cluett 1999a). This creep has caused damage to roads, building foundations, and other infrastructure along the Calaveras fault, requiring periodic repairs. The Zayante-Vergeles fault is a major fault with late Pleistocene and possible Holocene displacement. This fault's latest Pleistocene and possible Holocene vertical displacement and estimated vertical slip rate have been measured at 0.1 mm/yr (Bryant 2000b). It is not known to experience creep. Figure 4.6-1 shows faults in the study area.

### **Ground Shaking**

In addition to the faults that cross the project alignment, other active faults are present in the project region; and strong seismic groundshaking is likely within the project's operational lifespan. Recent studies estimate a 62% probability of at least one earthquake with a magnitude of 6.7 or greater occurring on one of the faults of the greater San Francisco Bay Area in the next 30 years, and a 10% probability of a magnitude 7.0 or greater event during the same timeframe (USGS Working Group on California Earthquake Probabilities 2003). Table 4.6-3 summarizes current information on earthquake recurrence intervals and the maximum credible earthquake (MCE) for key structures in and near the project area.

### **Secondary Seismic Hazards—Liquefaction and Ground Failure**

*Secondary seismic hazards* refers to liquefaction and related types of ground failure, as well as seismically induced landsliding.

As discussed in “Regulatory Framework” above, the State of California maps areas subject to secondary seismic hazards pursuant to the Seismic Hazards Mapping Act of 1990. To date, this effort has focused on areas such as the Los Angeles Basin–Orange County region and the immediate San Francisco Bay region, where dense populations are concentrated along active faults; seismic hazards maps have not been issued for the project area, and no such mapping is planned in the foreseeable future (CGS 2009).

**Table 4.6-3.** Maximum Credible Earthquake and Recurrence Interval for Principal Active Faults

<b>Fault</b>	<b>Magnitude of Maximum Credible Earthquake</b>	<b>Approximate Recurrence Interval</b>	<b>Slip-Rate Category</b>
San Andreas (Santa Cruz Mountains section)	7.0 <sup>a</sup>	224 years <sup>b</sup>	> 5.0 mm/year <sup>c</sup>
San Andreas (Creeping section)	Not available	“[T]he Creeping section may not accumulate sufficient strain for release in a large earthquake (Working Group on California Earthquake Probabilities, 1988 #5494), in which case the concept of recurrence intervals is not appropriate.” <sup>d</sup>	> 5.0 mm/year <sup>e</sup>
Calaveras (Southern section)	6.2 <sup>f</sup>	75 years <sup>b</sup>	> 5.0 mm/year <sup>g</sup>
Calaveras (Paicenes section)	Not available	Not available	> 5.0 mm/year <sup>g</sup>
Zayante-Vergeles Fault	Not available	3,130 years <sup>h</sup>	0.2–1.0 mm/year <sup>h</sup>
Ortogonalita	6.5–6.75 <sup>i</sup> , 6.9 <sup>f</sup>	2,000–5,000 years <sup>b</sup>	1.0–5.0 mm/year <sup>c</sup>
Sargent (Southeastern section)	Not available	350–1,485 years (<6 ka) <sup>k</sup>	1.0–5.0 mm/year <sup>k</sup>
Quien Sabe	Not available	Not available	0.2–1.0 mm/year <sup>l</sup>
San Gregorio	Not available	Not available	1.0–5.0 mm/year <sup>e</sup>

<sup>a</sup> Source: Peterson 1996.

<sup>b</sup> Source: USGS Working Group on California Earthquake Probabilities 2003.

<sup>c</sup> Source: Bryant and Matthews 2002a.

<sup>d</sup> Source: Bryant and Matthews 2002b.

<sup>e</sup> Source: Bryant and Cluett 1999b.

<sup>f</sup> Source: ICBO 1997.

<sup>g</sup> Source: Bryant and Cluett 1999a.

<sup>h</sup> Source: Bryant 2000b.

<sup>i</sup> Source: Anderson et al. 1982.

<sup>j</sup> Source: Bryant and Cluett 2000.

<sup>k</sup> Source: Bryant 2000a.

<sup>l</sup> Source: Bryant 1998.

## Liquefaction

Liquefaction is a phenomenon in which unconsolidated soils lose cohesion and acts as fluids because of ground shaking. Soil liquefaction causes ground failure that can damage roads, pipelines, underground cables, and buildings with shallow foundations. Liquefaction typically occurs in areas characterized by water-saturated granular materials at depths less than 40 feet (ABAG 2001).

In the project area, liquefaction hazard is typically low in upland areas. Valley floor areas are at moderate to high risk (Monterey County 2007). In general, the Hollister Tower Segment is in an area expected to have a low potential to experience liquefaction. Portions of the Hollister Pole Segment located near the

San Benito River, including the new river crossing section, have a higher potential for liquefaction.

### **Landslide and Other Slope Stability Hazards**

Landslides and other forms of slope failure occur in response to the long-term geologic cycle of uplift, mass wasting, and slope disturbance. Mass wasting refers to a variety of erosional processes from gradual downhill soil creep to rapid failures such as landslides, and rock fall.

Regionally, the topography of mountain ranges dominated by Franciscan Complex is typified by landslides (CGS 2002). Landslides are common in some areas near the project area, such as the Flint Hills and some slopes along the San Andreas fault (CDC 2000).

Relative susceptibility to landslides in the project area can be described according to the following geologic conditions (Monterey County 2007):

- **Low:** Flatlands and low-relief terrain, includes mainly Quaternary deposits. In steep terrain, includes mainly crystalline basement rock, volcanic rock, and Cretaceous sandstone.
- **Moderate:** Moderately steep terrain underlain by mainly unconsolidated and weakly cemented sandstone, shale, and Franciscan Complex.
- **High:** Steep terrain underlain by mainly unconsolidated and weakly cemented sandstone, shale, Franciscan Complex, and existing landslides.

In general, hilly terrains underlain by Franciscan bedrock are at higher risk of slope failures, although areas in the Gabilan range on the Salinian Block are also at risk of slope failure. Much of the tower section is located on hilly terrain, while much of the pole portion—except for the section in the foothills of the Flint Hills—is predominately flat. Landslide in general is more likely where the soil and rock have been disturbed for installation of structures such as buildings, roads, towers, or poles (Keller 1996, USGS 2004).

## **Environmental Effects**

### **Significance Criteria**

For this analysis, an impact pertaining to geology, soils, and seismicity was considered potentially significant under CEQA if the project would result in any of the following environmental effects; these criteria are based on professional practice and Appendix G of the State CEQA Guidelines:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

- Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault.
- Strong seismic ground shaking.
- Seismic-related ground failure, including liquefaction.
- Result in substantial soil erosion or the loss of topsoil.
- Location on a geologic unit or soil that is unstable, or that would become unstable because of the project, and potentially result in on- or off-site landslide, subsidence, or collapse.
- Location on expansive or corrosive soils, creating substantial risks to life or property.

## Impacts and Mitigation Measures

The proposed project may be affected by the following geologic conditions and hazards and conditions in the project area.

- Steep and/or unstable slopes.
- Expansive and/or corrosive soils.
- Fault creep and potential for surface fault rupture.
- Earthquake groundshaking.

Project grading may also result in localized loss of topsoil.

### **Potential for damage to project facilities caused by surface fault rupture—less-than-significant impact, potentially beneficial**

Surface fault rupture occurs along active fault traces, because of earthquake movement or fault creep. The project alignment crosses known active faults in two locations:

- San Andreas fault between Tower 6/39 and Pole 13/8, and
- Calaveras fault between Poles 21/15 and 22/00.

The project alignment also crosses one fault that is not currently zoned by the State of California but is considered likely to be active:

- Zayante-Vergeles fault between Towers 2/14 and 2/15.

Transmission line facilities at these fault crossings are subject to some level of existing risk related to surface fault rupture. For overhead power lines, the flexible capacity of the power lines themselves generally can accommodate surface fault displacements. The power poles themselves may be susceptible to

damage or failure if they directly overlie a fault trace that experiences surface rupture and surface displacement that increases the distance between poles or could result in the following.

- A reduction of slack and increased tension in the conductors.
- For suspension TSPs and insulator strings, the insulator strings would be pulled at an angle at the TSP adjacent to the fault crossing and decreasingly so for suspension TSPs along the line away from the fault crossing.
- For dead-end TSPs, the steel poles would deflect (bend).
- Additional conductor wire would need to be spliced into the conductors after a large earthquake event with significant fault displacement in order to restore normal operating conditions. (Tafarodi pers. comm.)

However, none of these existing risks would be increased by the proposed project because the project would not construct new facilities across any active fault trace—the only new section of power line proposed by the project would be located across and adjacent to the San Benito River on the east side of San Benito Valley, more than 1 mile from the closest active fault (the San Andreas)—and towers and poles would be replaced in the same location as existing facilities. Impacts would be less than significant.

Where poles or towers are proposed for replacement at a known active fault crossing, the project offers the opportunity to benefit seismic safety, and PG&E has accordingly committed to the following APM.

**APM GEO-1: PERFORM SITE-SPECIFIC GEOLOGIC STUDIES AT ACTIVE FAULT CROSSINGS AND MODIFY SITING/DESIGN AS FEASIBLE TO REDUCE DAMAGE**

For all pole or tower replacements proposed within a State-designated Earthquake Fault Zone or within 500 feet on either side of a fault considered likely to be active but not zoned by the State, PG&E will perform site-specific geologic investigations with the purpose of locating any active fault trace(s) and ensuring that project facilities are sited and designed to avoid and reduce damage due to surface fault rupture. Studies may include any appropriate combination of literature research, air photo evaluation, reconnaissance field survey, and/or subsurface investigation (fault trenching), based on the professional judgment of licensed supervising personnel (California Professional Geologist or Certified Engineering Geologist). Where significant potential for damage due to surface fault rupture is identified, facilities siting and design will be modified to the extent feasible to avoid or reduce damage.

**Potential for damage to facilities caused by seismic groundshaking – less-than-significant impact**

As described in the “Affected Environment” section of this chapter, the project alignment is located in an area potentially subject to groundshaking caused by

earthquake activity on any of several faults. Available information indicates that groundshaking could be sufficient to damage project facilities. As with surface fault rupture, discussed above, the risk of service interruption would not alter substantially because of the project; service interruptions are therefore not discussed further. In addition, reconductoring alone would not substantially affect risks related to seismic groundshaking; this analysis therefore focuses on the new and upgraded facilities constructed under the proposed project, which would include a new power line crossing over the San Benito River (the Proposed River Crossing) and limited substation upgrades.

Some types of substation equipment are more susceptible to damage from earthquake shaking; PG&E has reviewed historical substation damage to determine the vulnerabilities of each type of equipment, including immediate visits to substations following past earthquakes. In recent years, PG&E personnel inspected substation damage in Los Angeles and Japan shortly after the Northridge and Kobe earthquakes. Damage has been found to vary dramatically with voltage. Damage was noted as extensive at 500 kV substations, significant at 230 kV substations, and minor at substations of 115 kV and below. The types of equipment most susceptible to damage from strong seismic ground shaking are transformer radiators and bushings, circuit breakers, circuit switchers, and disconnect switches. The proposed work at the substation does not include any seismic upgrades. The work is limited to relay changeouts and possibly also some limited conductor replacements; no foundation or structural work would take place.

Generally, overhead power lines can accommodate strong groundshaking;<sup>2</sup> and all new project facilities would be designed and constructed to meet or exceed relevant CPUC standards and, where applicable (and not in conflict with CPUC requirements), earthwork requirements of the current IBC. As discussed above, these codes include a wide variety of stipulations relevant to reducing earthquake-related risk, including foundation and structure design and structural tolerances. In addition, site-specific geotechnical studies would be performed by qualified personnel with appropriate expertise, and facilities design and construction would conform to all further recommendations of these investigations, which could expand on, modify, or increase the stringency of code requirements.

Adherence to CPUC and IBC standards and to recommendations of site-specific geotechnical investigations performed by qualified professionals would reduce the potential for damage to facilities consistent with the current engineering standard of care. Although risks cannot be entirely avoided, impacts will be less than significant.

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<sup>2</sup> This is reflected in wind loading design requirements for overhead lines generally being more stringent than requirements that address strong seismic ground shaking.

### **Potential for damage to project facilities caused by seismically induced liquefaction – less-than-significant impact**

Portions of the project alignment (particularly those in low-lying valley areas with thick, unconsolidated alluvial deposits and a shallow groundwater table) are likely subject to liquefaction and related types of seismically induced ground failure. This includes sections of the project alignment in the San Juan Valley, including the proposed San Benito River crossing. Parts of the river crossing section may also be at risk of lateral spreading, which occurs where liquefaction causes failure toward a free slope such as a streambank. Typically, areas at risk of lateral spreading are spanned by the existing and proposed alignment, but this will not be possible for the entirety of the river crossing.

However, as identified above, all new facilities will be designed and constructed to meet or exceed relevant CPUC standards. In addition, site-specific geotechnical studies will be performed by qualified personnel with appropriate expertise, and facilities design and construction will conform to all recommendations of these investigations. Additional design measures specific to this project also will be incorporated—for instance, the two poles located on either side of the San Benito River crossing will be designed specifically for these locations, reducing the potential for liquefaction to impact the alignment.

Adherence to CPUC standards and to recommendations of site-specific geotechnical investigations will reduce the potential for structural damage related to seismically induced ground failure consistent with the current engineering standard of care. Impacts are expected to be less than significant

### **Potential for loss of topsoil and/or accelerated soil erosion caused by construction activities – less-than-significant impact**

Most of the proposed construction activities will take place within PG&E's existing right-of-way, which has experienced repeated disturbance associated with construction and maintenance of the existing transmission line and is unlikely to preserve an intact topsoil layer. Even if topsoil is present, existing rights-of-way are dedicated to utilities use and do not represent an important topsoil resource; further disturbance by project activities would not result in significant loss of topsoil. The Proposed River Crossing will be constructed outside an existing right-of-way, and grading for construction likely will result in some loss of intact topsoil. Because the loss will be comparatively small and largely confined to the new right-of-way area, this impact is considered less than significant.

On all substrate types, surface disturbance during construction will result from construction of new access roads and, to a limited extent, use of existing access roads that are not paved. The amount of surface disturbance is related to slope steepness, which tends to dictate the extent of grading required to provide safe access road grades. In addition, slope steepness greatly influences how rainfall runoff may cause soil erosion and contribute to sediment loading. However, as noted in Section 4.8, "Hydrology and Water Quality," PG&E will prepare a

SWPPP that identifies measures to control erosion (see APM HYDRO-1 [Prepare and implement a Storm Water Pollution Prevention Plan]). The SWPPP will evaluate the slope steepness and soil types for the pole locations and access routes. The SWPPP also will stipulate construction and maintenance procedures that include BMPs, limitation of sidehill fills, drainage control, surface treatments, and revegetation standards. Implementation of these measures will reduce the soil erosion potential to acceptable levels; impacts related to accelerated soil erosion will be less than significant.

**Potential for damage to project facilities caused by slope failure; potential for project activities to increase slope failure hazard – less-than-significant impacts**

Portions of the project alignment are located in areas subject to landslide hazards, potentially including seismically induced landslides. Landslides and other types of slope failure have the potential to undermine foundations, cause distortion and distress to structures, and displace or destroy project components. To ensure that these concerns are addressed, design-level geotechnical studies will be performed as necessary to evaluate the localized potential for slope instability along proposed power line routes and in the vicinity of other project facilities, and will identify appropriate design and construction measures to avoid or reduce hazards. Adherence to good grading practices—as stipulated in CPUC general orders, the IBC, and Cal-OSHA regulations followed by all California construction projects—will ensure that construction activities do not create new areas of instability. Temporary construction slopes and existing natural or constructed slopes that could be affected by construction activities will be evaluated for stability. In developing grading plans and construction procedures for access roads and power poles, the stability of both temporary and permanent cut, fill, and otherwise affected slopes will be evaluated. Construction grading plans will be designed to limit the potential for slope instability, maintain adequate drainage of improved areas, and minimize the potential for erosion and flooding during construction. During construction, slopes affected by construction operations will be monitored and maintained in a stable condition. Construction activities likely to result in slope or excavation instability will be suspended during and immediately following periods of heavy precipitation, when slopes are more susceptible to failure. For construction requiring excavations, such as foundations, appropriate support and protection measures will be implemented to maintain the stability of excavations and to protect surrounding structures and utilities. Where excavations are located adjacent to structures, utilities, or other features that may be adversely affected by potential ground movements, bracing, underpinning, or other methods of temporary support for the affected facilities will be designed and implemented.

Over the longer term, proper design will allow power lines to span large unstable areas. In cases of shallow sliding, slope creep, or raveling, specially designed deep foundations may be used to anchor the overlying structure to underlying competent material. As appropriate, unstable slopes will be stabilized by excavating and removing unstable material, regrading unstable slopes to improve surface drainage and limit infiltration, installing subsurface drainage systems,

and/or constructing improvements to mechanically restrain slope movement. To the extent feasible, towers and poles will be located away from very steep hillsides, debris flow source areas, the mouths of steep sidehill drainages, and the mouths of canyons that drain steep terrain.

Incorporation of these standard engineering and construction practices will ensure that people and structures are not exposed to undue slope instability hazards. Impacts related to slope instability are expected to be less than significant.

#### **Potential for damage to project facilities caused by construction on expansive soils – less-than-significant impact**

Portions of the project alignment are situated on soils with moderate to high expansion potential. If improperly designed or installed, project facilities in these areas could be subject to damage related to shrink-swell behavior. However, as identified above, facilities design and construction will comply with CPUC design standards and will incorporate recommendations of detailed site-specific geotechnical studies where these are considered necessary by CPUC. Depending on the nature of the facilities and the characteristics of the substrate at the work site, such standards and recommendations could require a variety of mitigation approaches, including specialized foundation design; over-excavation and placement of clean, nonexpansive engineered fill prior to construction; and/or other measures to reduce concerns related to expansive soils, consistent with the prevailing engineering standard of care for civil works. Consequently, impacts related to expansive soils are expected to be less than significant.

#### **Potential for damage to project facilities caused by construction on corrosive soils – less-than-significant impact**

Portions of the project alignment are situated on potentially corrosive soils. If improperly designed or installed, project facilities in these areas could be subject to damage related to corrosion of uncoated steel and/or concrete. However, as discussed above for expansive soils hazards, facilities design and construction will comply with CPUC design standards and will incorporate recommendations of detailed site-specific geotechnical studies where these are considered necessary by the CPUC. With these requirements in place, impacts related to corrosive soils are expected to be less than significant.

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