3.6 Geology, Soils, and Seismicity

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporated*	*Less Than Significant Impact*	*No Impact*
6. GEOLOGY, SOILS, AND SEISMICITY— Would the project:				
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, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? (Refer to Division of Mines and Geology Special Publication 42.)	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☒	☐
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☒	☐
iv) Landslides?	☐	☒	☐	☐
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐
c) Be located on geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☐	☐	☒	☐
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) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?	☐	☐	☐	☒

3.6.1 Environmental Setting

Local Geology

The Project area is in the western foothills of the Sierra Nevada geomorphic province (CGS, 2002). The Sierra Nevada is composed of northwest-trending metamorphic, volcanic, and igneous rocks that stretch from Bakersfield to Lassen Peak, and includes the Sierra Nevada mountain range and a broad belt of western foothills. Deep river canyons are cut into the western slope of the province, and the metamorphic bedrock contains gold-bearing veins. Active faults along the eastern edge of the Sierra Nevada have accommodated the upthrusting and tilting of the entire Sierra Nevada block over the last 5 million years. This uplift has resulted in the gentle westward sloping terrain of the Sierra Nevada foothills.

Rocks in the Project area are deformed, metamorphosed remnants of Paleozoic and Mesozoic oceanic crust and volcanic islands added to the continent during subduction along the western coast of North America that were later intruded by plutonic rocks (rocks that cooled from magma underground) in various locations. This bedrock is generally located less than 3 feet below the ground surface along the Project alignment (Kleinfelder, 2011a). Gabbro (a mafic igneous rock with chemical composition similar to basalt, the magma that erupts on the seafloor) underlies the portion of the project alignment extending from the eastern end to the area south of Cameron Park (Kleinfelder, 2011a).

Naturally occurring asbestos generally occurs in ultramafic and serpentinite rocks, similar to those found along the Project alignment. "Asbestos" is a non-technical term applied to a group of minerals that form long, very thin mineral fibers. These fibers can become airborne when rocks or soils containing such minerals are disturbed by mining or earthwork activities, and are potentially hazardous if inhaled (Kleinfelder, 2011a). Reported asbestos occurrences have been mapped to the north and south of the Project alignment (Gosen and Clinkenbeard, 2011).

Soils

Overlying the geologic units described above is a layer of soil. In general, soil characteristics are strongly governed by slope, relief, climate, vegetation, and the rock type upon which they form. Soil types are important in describing engineering constraints such as erosion and runoff potential, corrosion risks, and various behaviors that affect structures, such as expansion and settlement.

Kleinfelder (2011a) mapped the geology of the Project area and sampled the soil along the Project alignment, determining that the Project alignment is underlain by bedrock with a soil cover ranging in thickness from 1 to 15 feet. Soils encountered in the well borings drilled as part of this investigation were generally shallow (1 to 3 feet below ground surface), and either consisted of fill or were naturally-formed. Clay and silt with variable amounts of sand and gravel make up the fill material. The naturally-formed soils range from clays and silts to sands and gravel. Soil survey data from the Natural Resources Conservation Service (NRCS) were reviewed for the Proponent's Environmental Assessment. Relevant physical properties of soils mapped by NRCS along the Project alignment are shown in **Table 3.6-1**, below.

Expansive Soils

Expansive soils contain significant amounts of clay particles that have the ability to give up water (shrink) or take on water (swell). When these soils swell, the change in volume can exert significant pressures on loads that are placed on them, such as building and structure foundations or underground utilities, and can result in structural distress and/or damage. Often, grading, site preparations, and backfill operations associated with subsurface structures can eliminate the potential for expansion. Expansive soils are defined in the California Building Code as those soils demonstrating certain distributions of particle sizes and that have an expansion index greater than 20. The other criterion requires that the soil has a plasticity index of 15 or greater, more than 10 percent of soil particles are silt or clay-sized, and 10 percent of the soil particles are smaller than 5 micrometers.

The geotechnical report prepared by Kleinfelder concluded that moderately to highly expansive soils exist along much of the Project alignment (Kleinfelder, 2011a). In the general area, the expansion potential of the soils along the Project alignment range from low to high, based on mapping by the Natural Resources Conservation Service (as shown in Table 3.6-1).

TABLE 3.6-1
SOIL CHARACTERISTICS

Soil Map Unit Name	Shrink-Swell Potential[1]	Permeability[2]	Water Erosion Hazard[3]	Wind Erosion Hazard[4]	Drainage	Concrete Corrosivity	Limitations
Sacramento County Soils							
Argonaut-Auburn complex, 3 to 8 percent slopes	Moderate	Moderately high	Moderate	5	Well drained	Low	Shallow depth to bedrock; unstable excavation walls; high clay content;
Auburn-Argonaut-Rock outcrop complex, 8 to 30 percent slopes	Low	High	Moderate	5	Well drained	Low	Shallow depth to bedrock; unstable excavation walls; high clay content; slopes greater than 15 percent
Hicksville gravelly loam, 0 to 2 percent slopes, occasionally flooded	Moderate	Moderately high	Low	7	Moderately well drained	Low	Soil saturation at shallow depth; flooding
Lithic Xerorthents, 2 to 8 percent slopes	N/A	N/A	N/A	N/A	Excessively drained	N/A	N/A
Whiterock loam, 3 to 30 percent slopes	Low	High	Moderate	5	Somewhat excessively drained	Moderate	Shallow depth to bedrock; slopes greater than 15 percent
El Dorado County Soils							
Argonaut clay loam, 3 to 9 percent slopes	High	Moderately low	Moderate	6	Well drained	Low	High clay percentage; unstable excavation walls
Argonaut gravelly loam, 2 to 15 percent slopes	Moderate	Moderately high	Low	6	Well drained	Low	High clay percentage; unstable excavation walls; shallow depth to bedrock
Auburn extremely rocky silt loam, 3 to 70 percent slopes	Low	Moderately high	High	5	Well drained	Low	Shallow depth to bedrock; slopes greater than 15 percent
Auburn silt loam, 2 to 30 percent slopes	Low	Moderately high	High	5	Well drained	Low	Shallow depth to bedrock; slopes greater than 15 percent
Auburn very rocky silt loam, 2 to 30 percent slopes	Low	Moderately high	High	5	Well drained	Low	Shallow depth to bedrock; slopes greater than 15 percent
Loamy alluvial land	Low	Moderately high	Moderate	7	Moderately well drained	N/A	Saturation at shallow depth; flooding; unstable excavation walls
Placer diggings	Low	High	Low	6	N/A	N/A	More than 50 percent of soil contains cobbles greater than 3-inch diameter; slopes greater than 15 percent
Rescue clay, clayey variant	High	Moderately low	Low	4	Poorly drained	Low	Saturation at shallow depth; high clay percentage; unstable excavation walls

TABLE 3.6-1 (Continued)
SOIL CHARACTERISTICS

Soil Map Unit Name	Shrink-Swell Potential[1]	Permeability[2]	Water Erosion Hazard[3]	Wind Erosion Hazard[4]	Drainage	Concrete Corrosivity	Limitations
El Dorado County Soils (cont.)							
Rescue extremely stony sandy loam, 3 to 50 percent slopes, eroded	Low	Moderately high	Low	5	Well drained	Low	Slopes greater than 15 percent; unstable excavation walls
Rescue sandy loam, 2 to 9 percent slopes	Low	Moderately high	Moderate	3	Well drained	Low	Unstable excavation walls
Rescue very stony sandy loam, 15 to 30 percent slopes	Low	Moderately high	Low	5	Well drained	Low	Slopes greater than 15 percent; unstable excavation walls
Rescue very stony sandy loam, 3 to 15 percent slopes	Low	Moderately high	Low	5	Well drained	Low	Unstable excavation walls
Sobrante silt loam, 3 to 15 percent slopes	Moderate	High	Moderate	5	Well drained	Low	Shallow depth to bedrock; unstable excavation walls

NOTES:
[1] Based on percentage of linear extensibility.
[2] Based on standard saturated hydraulic conductivity (Ksat) class limits; Ksat refers to the ease with which pores in a saturated soil transmit water.
[3] Based on the erosion factor “Kw whole soil,” which is a measurement of relative soil susceptibility to sheet and rill erosion by water.
[4] The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible.

SOURCE: PG&E, 2013.

Soil Corrosivity

Corrosion is the deterioration of a metal, concrete, or other material through a reaction with its environment. The corrosivity of soils is commonly related to several key parameters, including soil resistivity, the presence of chlorides and sulfates, oxygen content, and pH. Typically, the most corrosive soils are those with the lowest pH and highest concentration of chlorides and sulfates. Wet/dry conditions can result in a concentration of chlorides and sulfates as well as movement in the soil, both of which tend to break down the protective corrosion films and coatings on the surfaces of building materials. High-sulfate soils are corrosive to concrete and may prevent complete curing, reducing its strength considerably. Low pH and/or low-resistivity soils can corrode buried or partially buried metal structures. Depending on the degree of corrosivity of the subsurface soils, concrete, reinforcing steel, and bare-metal structures exposed to these soils can deteriorate, eventually leading to structural failures.

Soil samples taken from the Project alignment during the geotechnical investigation conducted by Kleinfelder (2011a) were evaluated for soil corrosion factors. While not a regulation, and only recommended for use as general guidance, Caltrans has prepared corrosion guidelines that define the pH, chloride concentration, and sulfate concentration thresholds which are used by Caltrans to determine if a site is “corrosive” or “not corrosive” (Caltrans, 2012). The two samples analyzed are not corrosive to metals and concrete per the Caltrans criteria.

Erosion and Runoff

Erosion is a natural process whereby soil and highly weathered rock materials are worn away and transported, most commonly by wind or water. Soil erosion can become problematic when human intervention causes rapid soil loss and the development of erosional features (such as incised channels, rills, and gullies) that undermine roads, buildings, or utilities. Vegetation clearing and earth moving reduces soil structure and cohesion, resulting in abnormally high rates of erosion, referred to as accelerated erosion. This typically occurs during construction activity involving grading and soil moving activities (i.e., presence of soil stockpiles, earthen berms, etc.) that loosen soils and makes them more susceptible to wind and water erosion. Further, the operation of associated heavy machinery and vehicles over access roads, staging areas, and work areas can compact soils and decrease their capacity to absorb runoff, resulting in rills, gullies, and excessive sediment transport.

Natural rates of erosion can vary depending on slope, soil type, and vegetative cover (regional erosion rates are also dependent on tectonics and changes in relative sea level). Soils containing high amounts of silt are typically more easily eroded, while coarse-grained (sand and gravel) soils are generally less susceptible to erosion. The susceptibility of soils to water erosion along the Project alignment ranges from low (soils on gentle slopes with bigger particles) to high (relatively steep slopes with a shallow depth to bedrock). Susceptibility of soils to wind erosion generally is low, but increases to moderate levels for certain soils along the Project alignment.

Faults and Seismicity

The Project is located in an area of California that has not been seismically active over the past 11,000 years (Holocene time) except for one earthquake on the Cleveland Hills fault, located near

Lake Oroville, approximately 50 miles north of the Project area (Jennings and Bryant, 2010). Research conducted by the California Department of Water Resources (DWR) indicates that the magnitude 5.7 earthquake that occurred along the Cleveland Hills Fault on August 1, 1975, most likely resulted from reservoir-induced stress (PG&E, 2013). The northern portion of the Cleveland Hills Fault is the nearest active fault to the Project area zoned under the Alquist-Priolo Act; the Project area is not located in an Alquist-Priolo Earthquake Fault Zone (CGS, 2014). The nearest well-defined faults to the Project area are the Genoa and Cordelia faults, both over 60 miles away from the nearest point along the Project alignment. A major seismic event on either of these faults may cause ground shaking in the Project area. Quaternary faults near the Project alignment include the Rescue Fault and the Maidu Fault, both within the Bear Mountains Fault Zone (USGS and CGS, 2006); however, no Quaternary faults are known to traverse the Project alignment (Kleinfelder, 2011a). The most recent movement inferred along the Rescue Fault occurred around 130,000 years ago; the most recent evidence of displacement along the Maidu Fault is even older, around 1.6 million years ago (USGS and CGS, 2006).

Earthquake Hazards

Fault Rupture

Seismically induced ground rupture is defined as the physical displacement of surface deposits in response to an earthquake's seismic waves. The magnitude and nature of fault rupture can vary for different faults, or even along different strands of the same fault. Ground rupture is considered most likely along faults that have a record of displacement sometime in the past 11,000 years (the Holocene time). The Project alignment does not cross any Holocene faults. For this reason, the probability of surface rupture occurring along the Project alignment is low.

Ground Shaking

The primary tool that seismologists use to evaluate ground-shaking hazard and characterize statewide earthquake risks is a probabilistic seismic hazard assessment (PSHA). The PSHA for the State of California takes into consideration the range of possible earthquake sources and estimates their characteristic magnitudes to generate a probability map for ground-shaking. The PSHA maps depict values of peak ground acceleration (PGA) that have a 10 percent probability of being exceeded in 50 years (or a 1 in 475 chance). This probability level allows engineers to design structures for ground motions that have a 90 percent chance of NOT occurring in the next 50 years, making structures safer than if they were simply designed for the most likely events. The peak ground acceleration for the most vulnerable areas of the Project alignment (those closest to faults) would be about 0.128 g[6] (CGS, 2008). This PGA value is typically indicative of a moderate earthquake, capable of causing light to moderate damage; including movement of furniture; cracks in weak plaster, adobe, and poorly-built masonry buildings; and damage related to falling objects (ABAG, 2014). For comparison purposes, the maximum peak acceleration value recorded during the Loma Prieta earthquake of 1989 was in the vicinity of the epicenter, near Santa Cruz, at 0.64 g.

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6 PGA is expressed as the percentage of the acceleration due to gravity (g), which is approximately 980 centimeters per second squared. In terms of automobile accelerations, one "g" of acceleration is equivalent to the motion of a car traveling 328 feet from rest in 4.5 seconds.

Liquefaction and Lateral Spreading

Soil liquefaction is caused by pressure waves moving through the ground due to earthquakes. Research and historical data indicate that loose granular soils and non-plastic silts that are saturated by relatively shallow groundwater (generally less than 50 feet) are susceptible to liquefaction. Liquefaction causes soil to lose strength and “liquefy,” triggering structural distress or failure due to the dynamic settlement of the ground or a loss of strength in the soils underneath structures. Liquefaction in a subsurface layer can in turn cause lateral spreading of the ground surface, which usually takes place along weak shear zones that have formed within the liquefiable soil layer. Lateral spreading has generally been observed to take place in the direction of a free face (e.g. a retaining wall or slope).

The CGS has not mapped any portion of the Project alignment as a Seismic Hazard Zone. Seismic Hazard Zones are regulatory zones that encompass areas prone to liquefaction and earthquake-induced landslides. This indicates that the risk for liquefaction along the Project alignment is low.

To confirm the level of liquefaction risk, the geotechnical investigation was reviewed for relevant information. A hydrologic analysis was not conducted as part of the geotechnical investigation. Most of the bores drilled as part of the geotechnical investigation used technology that precluded accurately measuring groundwater. However, regional groundwater in the area is generally deep and contained within fractures in the bedrock, and few production wells are present in terrain like that of the Project area (Kleinfelder, 2011a). The fact that groundwater does not appear to be perennially present in soils overlying bedrock along the Project alignment decreases the potential for liquefaction to occur in the area. Soils are also generally thin over the bedrock along the Project alignment. In addition, soils along the Project alignment that are well drained and are underlain by crystalline bedrock generally have low susceptibility to liquefaction.

One exception to this general finding regarding groundwater is the site of Tower 31/231, which is located in a wetland area (shown on Figure 2-3; to be accessed by helicopter). Depth to bedrock at this site was about 5 feet (Kleinfelder, 2011b). Potential for liquefaction may be higher at this site than at others along the Project alignment.

Slope Failure

Slope failures, commonly referred to as landslides, include many phenomena that involve the downslope displacement and movement of material, triggered either by static (i.e., gravity) or dynamic (i.e., earthquake) forces. Exposed rock slopes undergo rockfalls, rockslides, or rock avalanches, while soil slopes experience soil slumps, rapid debris flows, and deep-seated rotational slides. Slope stability can depend on a number of complex variables, including the geology, structure, and amount of groundwater, as well as external processes such as climate, topography, slope geometry, and human activity. The factors that contribute to slope movements include those that decrease the resistance in the slope materials and those that increase the stresses on the slope. Landslides can occur on slopes of 15 percent or less, but the probability is greater on steeper slopes that exhibit old landslide features such as scarps, slanted vegetation, and transverse ridges.

The Project alignment extends through rolling hills with gently to moderately steep topography. A soils/geologic hazard reconnaissance study and a geologic mapping investigation both concluded that the potential for landslides along the alignment is low (Kleinfelder, 2011a).

3.6.2 Regulatory Setting

State

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. In accordance with this act, the State geologist established regulatory zones, called “earthquake fault zones,” around the surface traces of active faults and published maps showing these zones. Within these zones, buildings for human occupancy cannot be constructed across the surface trace of active faults. Each earthquake fault zone extends approximately 200 to 500 feet on either side of the mapped fault trace, because many active faults are complex and consist of more than one branch. There is the potential for ground surface rupture along any of the branches.

California Building Code

The California Building Code (CBC), which is codified in Title 24 of the California Code of Regulations, Part 2, was promulgated to safeguard the public health, safety, and general welfare by establishing minimum standards related to structural strength, egress facilities, and general building stability. The purpose of the CBC is to regulate and control the design, construction, quality of materials, use/occupancy, location, and maintenance of all buildings and structures within its jurisdiction.

The 2013 CBC is based on the 2009 International Building Code. In addition, the CBC contains necessary California amendments that are based on the American Society of Civil Engineers (ASCE) Minimum Design Standards 7-05. ASCE 7-05 provides requirements for general structural design and includes means for determining earthquake loads as well as other loads (flood, snow, wind, etc.) for inclusion in building codes. The provisions of the CBC apply to the construction, alteration, movement, replacement, and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures throughout California.

The earthquake design requirements take into account the occupancy category of the structure, site class, soil classifications, and various seismic coefficients, all of which are used to determine a Seismic Design Category (SDC) for a project. The SDC is a classification system that combines the occupancy categories with the level of expected ground motions at the site, and ranges from SDC A (very small seismic vulnerability) to SDC E/F (very high seismic vulnerability and near a major fault). Design specifications are then determined according to the SDC.

The updated CBC no longer cites the 1997 UBC Table 18-1-B for identifying expansive soils although the significance criteria in Appendix G of the CEQA Guidelines still refers to this table. This analysis relies on the updated CBC section as provided below.

1803.5.3 Expansive Soil. In areas likely to have expansive soil, the building official shall require soil tests to determine where such soils do exist. Soils meeting all four of the following provisions shall be considered expansive, except that tests to show compliance with Items 1, 2 and 3 shall not be required if the test prescribed in Item 4 is conducted:

1. Plasticity index (PI) of 15 or greater, determined in accordance with ASTM D 4318
2. More than 10 percent of the soil particles pass a No. 200 sieve (75 micrometers), determined in accordance with ASTM D 422
3. More than 10 percent of the soil particles are less than 5 micrometers in size, determined in accordance with ASTM D 422
4. Expansion index greater than 20, determined in accordance with ASTM D 4829

California Code of Regulations Title 8 (Cal/OHSA)

Subchapter 4 of Title 8 of the California Code of Regulations contains Construction Safety Orders that establish minimum safety standards whenever employment exists in connection with the construction, alteration, painting, repairing, construction maintenance, renovation, removal, or wrecking of any fixed structure or its parts. Safety requirements during excavation, such as sloping and benching or support systems, are also enumerated in these Orders.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act was developed to protect the public from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and from other hazards caused by earthquakes. This act requires the State Geologist to delineate “zones of required investigation” (i.e., seismic hazard zones) where site investigations are required to determine the need for mitigation of potential liquefaction and/or earthquake-induced landslide ground displacements.

National Pollutant Discharge Elimination System Program, CWA Section 402

Under the CWA Section 402, the National Pollutant Discharge Elimination System (NPDES) controls water pollution by regulating point sources of pollution to waters of the United States. The California State Water Resources Control Board (SWRCB) administers the NPDES permit program in California.

Projects that disturb one or more acres of soil must obtain coverage under the state’s NPDES General Permit for Discharges of Storm Water Associated with Construction Activity. A stormwater pollution prevention plan (SWPPP) must be developed and implemented for each project covered by the general permit. The SWPPP provides specific construction-related BMPs to prevent soil erosion and loss of topsoil. A SWPPP must be prepared before construction begins. The required components and best management practices commonly included in a SWPPP are described in greater detail in Section 3.9, *Hydrology and Water Quality.*

Local

General plans and local ordinances that contain regulations applicable to geologic, soil, and seismic hazards are identified below.

El Dorado County General Plan

The *Conservation and Open Space Element of the El Dorado County General Plan* discusses significant natural resources in the County, including geology and soils, and establishes goals, objectives, and policies related to these topics. Relevant policies from the El Dorado County General Plan include:

> ***Policy 7.1.2.2*****:** Discretionary and ministerial projects that require earthwork and grading, including cut and fill for roads, shall be required to minimize erosion and sedimentation, conform to natural contours, maintain natural drainage patterns, minimize impervious surfaces, and maximize the retention of natural vegetation. Specific standards for minimizing erosion and sedimentation shall be incorporated into the Zoning Ordinance.

> ***Policy 7.1.2.3*****:** Enforce Grading Ordinance provisions for erosion control on all development projects and adopt provisions for ongoing, applicant-funded monitoring of project grading.

Engineering and Construction Codes and Standards

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.

3.6.3 Applicant Proposed Measures

PG&E proposes to implement the following two measures related to geology and soils, which are analyzed as part of the Project.

APM GEO-1: Minimization of Construction in Soft or Loose Soils

Where soft or loose soils are encountered during project construction, appropriate measures will be implemented to avoid, accommodate, replace, or improve such soils. Depending on site-specific conditions and permit requirements, these measures may include:

- locating construction facilities and operations away from areas of soft and loose soil;
- over-excavating soft or loose soils and replacing them with engineered backfill materials;

- increasing the density and strength of soft or loose soils through mechanical vibration and/or compaction;
- installing material over access roads such as aggregate rock, steel plates, or timber mats; and
- treating soft or loose soils in place with binding or cementing agents.

APM GEO-2: Reduction of Slope Instability during Construction

Existing natural or temporarily constructed slopes affected by construction or operations will be evaluated for stability by qualified construction staff at the beginning of each construction day that employees may be exposed to the areas immediately upslope or downslope from the area of concern can be reasonably anticipated. In developing grading and construction procedures for access roads, the stability of both temporary and permanent cut, fill, and otherwise affected slopes will be analyzed. Construction slopes and grading will be designed to limit the potential for slope instability and minimize the potential for erosion and flooding during construction. During construction, slopes affected by construction activities will be monitored by qualified construction staff and maintained in a stable condition. Construction activities likely to result in slope instability will be suspended, as necessary, during and immediately following periods of heavy precipitation when unstable slopes are more susceptible to failure.

Additionally, PG&E has proposed the following measure for impacts to hydrology and water quality, which affects soil erosion and is thus included here:

APM HYDRO-1: Stormwater Pollution Prevention Plan (SWPPP)

PG&E will file a Notice of Intent (NOI) with the SWRCB for coverage under the General Construction Storm Water Permit and will prepare and implement an SWPPP in accordance with General Order No. 2009-0009-DWQ, which typically includes measures such as placement of straw wattles or silt fencing, flagging, mulching, seeding and other means to help stabilize disturbed areas and reduce erosion and sedimentation. Further details of the Permit requirements are in *Section 3.9, Hydrology and Water Quality*.

3.6.4 Environmental Impacts and Mitigation Measures

This impact analysis considers the potential geology, soils, and seismicity impacts associated with the construction, operation, and maintenance of the Project. The Project includes reconductoring, replacement of existing poles, modification of existing steel towers, and modification of existing substations along the Missouri Flat-Gold Hill Line. Substation expansion is not part of the Project and no changes to existing operation and maintenance activities are expected once construction is completed. For these reasons, substation components of this Project would have no impact with respect to geology, soils, or seismicity hazards and impacts. The following discussion focusses on impacts from construction and operation activities associated with the proposed reconductoring, replacement of poles, and tower modification.

ai) Whether the Project would 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 (refer to Division of Mines and Geology Special Publication 42): *NO IMPACT.*

The Project does not cross any Alquist-Priolo earthquake fault zones, and the nearest locations of fault movement within the last 11,000 years are all more than 50 miles away from the Project. The Project would not expose people or structures to substantial adverse effects involving fault rupture.

aii) Whether the Project would expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking: *LESS THAN SIGNIFICANT.*

As described in Section 3.6.1, *Environmental Setting*, structures built along the Project alignment could experience light to moderate damage due to seismic shaking. However, the new risk of damage to structures built or upgraded as part of the Project would be low, for multiple reasons. First, the Project would be constructed within existing PG&E right-of-way and most poles would be placed at approximately the same or similar locations as the existing structures. Second, wind loading design requirements for poles and towers are typically more stringent than requirements that address strong seismic ground shaking; therefore, overhead power lines can accommodate strong ground shaking without incurring significant damage. Third, PG&E would adhere to CPUC General Order 95, which provides general standards for design and construction of overhead electric power and distribution lines, as well as earthwork and foundation design requirements of the IBC where they are not superseded by CPUC regulations. Site characterization, investigation, and project design requirements and standards of the IBC and CPUC would reduce the potential for damage to facilities consistent with current engineering standards of care. Because existing poles would be replaced with new poles built according to modern, up-to-date building codes, the ground shaking risk to people or structures associated with the Project would be less than significant.

aiii) Whether the Project would expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure, including liquefaction: *LESS THAN SIGNIFICANT*.

As noted in Section 3.6.1, *Environmental Setting*, the potential for seismic-related ground failure along the Project alignment is low, based on information gathered about soil texture, groundwater, and depth to bedrock. The Project would replace existing poles along the Missouri Flat-Gold Hill line, and would not expose additional structures to seismic-related ground failure. With the implementation of soil engineering measures described in the geotechnical report, such as the use of well-compacted non-expansive engineered fill containing a mix of soil particle sizes, liquefaction susceptibility of soils supporting Project structures would be reduced further. Therefore the extent to which the Project would expose people or structures to seismic-related ground failure would be less than significant.

aiv) Whether the Project would expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving landslides: *LESS THAN SIGIFICANT WITH MITIGATION INCORPORATED*.

The Project would be constructed in hilly areas that could be subject to landslide hazards, although none have been mapped there by the CGS. Grading and excavations associated with new access roads, construction laydown areas, and tower and pole footings, if improperly performed, could create unstable conditions, or worsen existing landslide risks. Cuts into hillsides could remove material that is needed to support the upland material, and road or staging area fills could slough, slump, or ravel if they result in over-steepened slopes. Landslide evaluations performed for the Project generally concluded the transmission alignment would cross areas of low to moderate landslide hazard (Kleinfelder, 2011a). The Project includes APM GEO-2, which would decrease the likelihood of landsliding by monitoring slopes affected by construction activities and maintaining these slopes in a stable condition. This measure also includes the condition that construction activities likely to result in slope instability would be suspended as necessary during and immediately following periods of heavy precipitation. These activities would reduce landsliding potential. In addition, adherence to sound grading practices (e.g. bracing or underpinning of excavated faces), as stipulated in the CPUC General Order 95, the IBC, and OSHA regulations followed by all California construction projects, would generally ensure that construction activities would not create new areas of instability.

In the long run, the Project would be unlikely to experience an increase in exposure to landslide hazards because it would occur within PG&E's ROW and most poles and towers would be placed in the same or similar location as the existing structures. Although the amount of grading required by the Project is not anticipated to require formal grading plan, if such plans become necessary, the following mitigation measure would ensure the appropriate level of design review to reduce the impact to less than significant.

> **Mitigation Measure 3.6-1:** If grading plans are required, designs will be signed by a professional engineer and submitted to CPUC for approval within a reasonable timeframe prior to construction initiation.
>
> **Significance after Mitigation:** Less than Significant.

b) Whether the Project would result in substantial soil erosion or the loss of topsoil: *LESS THAN SIGNIFICANT*.

Excavation and grading activities planned during construction would increase exposure of soil to erosive forces. Project activities that would expose soil include the limited grading expected in the work areas associated with towers and poles, the helicopter landing zone, access roads, and pull sites; and undergrounding of the distribution line in El Dorado Hills. Intense rain or wind events in such areas could result in substantial soil erosion into adjacent waterways, and possibly propagation of small rills or gullies. In cases such as this (i.e., constructed-related impacts), increased runoff or entrainment of sediment in runoff is just as much a concern as soil erosion. As noted in the Project Description, excavated material would be stored in small, temporary stockpiles located away or downgradient from waterways.

The Project would require a total of approximately 29 acres of soil disturbance distributed along the entire alignment. Due to the extent of soil disturbance, coverage under the California State Water Resources Control Board (SWRCB) General Permit for Storm Water Discharges Associated with Construction Activity Order Number 2009-0009-DWQ (General Permit) would be required (additional discussion of the SWPPP is included in Section 3.9, *Hydrology and Water Quality*). Development and implementation of a stormwater pollution prevention plan (SWPPP) is necessary to obtain coverage under this permit. A SWPPP incorporates sediment control best management practices (BMPs) designed to limit the amount of soil eroded by water. Examples of typical construction BMPs include scheduling or limiting activities to certain times of the year; installing sediment barriers such as silt fence and fiber rolls along the perimeter of the construction area; maintaining equipment and vehicles used for construction; tracking controls, such as stabilizing entrances to the construction site, and developing and implementing a spill prevention and cleanup plan. PG&E has included preparation of a SWPPP in the Project as APM HYDRO-1, described above, and a qualified SWPPP practitioner would implement and monitor the best management practices identified in the SWPPP. In addition to measures required during construction, a SWPPP also requires implementation of post-construction BMPs that would restore the work sites to their original condition, minimizing long-term erosion problems and the impacts of loss of topsoil.

Soil disturbance during Project construction would also expose soil to wind erosion. The amount of material eroded by wind increases when soil is relatively dry, broken into smaller particles, and when wind velocity and turbulence are higher. Removal of vegetation can also increase the susceptibility of soil to wind erosion. During construction the risk of soil erosion due to wind can be decreased by dividing the project into many smaller phases of clearing and grading and by covering disturbed soils as completely as possible. PG&E has included measures to reduce the entrainment of soil in the atmosphere as part of the Project. These two measures, APM AQ-1 and APM AQ-3, are described in detail in Section 3.3, *Air Quality*. To supplement these two measures and reduce the risk of dust emission to less than significant levels, Mitigation Measures 3.3-1 and 3.3-2 have also been included in Section 3.3. These measures would minimize the risk of soil loss due to wind erosion during Project construction activities.

After Project construction is completed, disturbed areas would be returned to approximately pre-Project conditions, unless otherwise requested by the landowner. With the implementation of a SWPPP, APM AQ-1, APM AQ-3, and Mitigation Measures 3.3-1 and 3.3-2, the amount of soil erosion caused by the Project would be less than significant.

c) Whether the Project would be located on geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse: *LESS THAN SIGNIFICANT*.

The geologic and soil units described in the Environmental Setting, above, are not unstable. Landsliding impacts, and the ability of Project structures to withstand liquefaction are discussed in impacts aiii) and aiv). No groundwater, petroleum, or natural gas withdrawals take place in the Project vicinity, nor are these activities proposed as part of the Project (see *Sections 3.9, Hydrology and Water Quality, and 3.11, Mineral Resources).* Potential for ground subsidence along the Project alignment or due to the Project is therefore low. Regardless, the potential adverse effects of instability of site soils during the construction and operation and maintenance phases of the Project would be adequately addressed through the compaction and grading requirements of the CBC and any more stringent or specific recommendations provided by PG&E's Project-specific geotechnical report. Typical building practices included in the report that would improve soil stability are: moisture conditioning of the soil to achieve maximum stability, ensuring deleterious materials are removed from soil prior to being placed or moved on-site, and/or over-excavating existing soils and placing structural foundations on a mat of artificial fill compacted to appropriate design specifications. These types of measures, which are standard in the engineering practice and required through building and construction codes, ensure that small ground movements such as long-term soil consolidation or movements due to subsidence or collapsible soils do not damage or deteriorate building foundations and/or other structural components of the Project.

d) Whether the Project would be located on expansive soil, as defined in Section 1803.5.3 (formerly Table 18-1-B of the Uniform Building Code), creating substantial risks to life or property: *LESS THAN SIGNIFICANT*.

Portions of the Project are situated on soils with moderate to high expansion potential (Kleinfelder, 2011a). If improperly designed or installed, expansive soils could cause damage to foundations over a long period of time, usually the result of inadequate soil and foundation engineering or the placement of structures directly on expansive soils. The soil conditions present in the study area are not particularly unique in comparison to other areas nor do they represent a significant impediment to the Project. Facility design and construction would comply with CPUC design standards and would employ standard engineering and building practices common to construction projects throughout California. For example, non-expansive engineered fill would be used to support structures along the Project alignment, and specialized foundation design methods would be employed, as proposed in the geotechnical report (Kleinfelder, 2011a and 2013). Consequently, impacts related to expansive soils would be less than significant.

e) Whether the Project would have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater: *NO IMPACT*.

The Project would not include the use of septic tanks or alternative wastewater systems. For this reason, the Project would not pose an environmental or public health hazard by building septic tanks or alternative wastewater disposal systems in soils incapable or adequately supporting such systems.

References

Association of Bay Area Governments (ABAG), 2014. Modified Mercalli Intensity Scale. [http://quake.abag.ca.gov/shaking/mmi/]. Accessed March 12, 2014.

California Department of Transportation (Caltrans), 2012. Corrosion Guidelines Version 2.0. November 2012.

California Geological Survey (CGS), 2002. California Geomorphic Provinces : Note 36. Revised December 2002.

CGS, 2008. *Ground Motion Interpolator*. [http://www.quake.ca.gov/gmaps/PSHA/psha_ interpolator.html]. Accessed February 28, 2014.

CGS, 2014. Search for Regulatory Maps. [http://www.quake.ca.gov/gmaps/WH/regulatorymaps.htm]. Accessed February 28, 2014.

Gosen, B.S., and J.P. Clinkenbeard, 2011. Reported Historic Asbestos Mines, Historic Asbestos Prospects, and Other Natural Occurrences of Asbestos in California. California Geological Survey Map Sheet 59. USGS Open-File Report 2011-1188.

Jennings, C., and W. Bryant, 2010. Fault activity map of California: California Geological Survey Geologic Data Map No. 6., map scale 1:750,000.

Kleinfelder, 2011a. *Geotechnical Investigation Report Pacific Gas and Electric Company Missouri Flat – Gold Hill 115-kV Transmission Line Reconductoring Project : Sacramento and El Dorado Counties, California*. September 12, 2011.

Kleinfelder. 2011b. *Addendum 1 to Geotechnical Investigation Report Tower 31/231 Foundation Evaluation Pacific Gas and Electric Company Missouri Flat – Gold Hill 115-kV Transmission Line Reconductoring Project: Sacramento and El Dorado Counties, California*. December 14, 2011.

Kleinfelder, 2013. *Supplemental Geotechnical Investigation Report Pacific Gas and Electric Company Missouri Flat – Gold Hill 115-kV Transmission Line Reconductoring Project : Sacramento and El Dorado Counties, California*. April 12, 2013.

PG&E, 2013. *Proponent's Environmental Assessment for the Application of Pacific Gas and Electric Company for a Permit to Construct the Missouri Flat-Gold Hill 115 kV Power Line Reconductoring Project*, filed August 23, 2013.

U.S. Geological Survey and California Geological Survey (USGS and CGS), 2006, Quaternary fault and fold database for the United States. [http//earthquakes.usgs.gov/regional/qfaults]/. Accessed February 27, 2014.