3.6 Geology and Soils

This section assesses the proposed project's potential impacts related to the existing geological and soil conditions on the site, concentrating particularly on any potential hazards that could result from construction in the project area. Impacts related to the septic system proposed for the project are addressed in Section 3.8, *Hydrology and Water Quality*.

3.6.1 Existing Conditions

Environmental Setting

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

Regional Geology

The project area is located in the southern portion of the Cascade Range physiographic province, which extends from southern British Columbia to Lassen Peak (Norris and Webb 1990:152; California Geological Survey 2002:2). The Cascade Range province is characterized by—and named for—a north-south trending chain of large volcanoes. Many of the Cascade Range's best-known peaks, including Mt. Rainier and Mt. St. Helens, have been active in Recent or historical time. The Cascade Range province also includes some relatively flat lava plateaus, lava and cinder cones, plug domes, ash beds, and glacial deposits. The Pit River flows through the range, carving deep canyons on its way to the Sacramento River (Norris and Webb 1990:152–168).

The project area is located near the intersection of the Cascade Range province and several neighboring geomorphic provinces (California Geological Survey 2002:2).

- To the east, the Cascade Range province grades into the Modoc Plateau geomorphic province, a volcanic table land consisting of thick accumulations of lava flows and tuff beds. The boundary between the Cascade Range and the Modoc Plateau is indefinite, but is identified in a general way based on a transition from mountainous topography to high table land.
- Approximately 50 miles to the west, the province borders the Klamath Mountains geomorphic province. These mountains are characterized by rugged topography and prominent peaks and are considered a northern extension of the Sierra Nevada.
- Approximately 80 miles to the southeast, the Sierra Nevada geomorphic province disappears under the Cenozoic volcanic rocks of the Cascade Range. The Sierra Nevada is a tilted fault block nearly 400 miles long.
- Just 20 miles to the southwest, the Cascade Range province borders the Great Valley, a long alluvial plain in which sediment has been deposited continuously for nearly 160 million years.

The project area is located between two major volcanic cones of the Cascade Range (Figure 3.6-1). Lassen Peak is approximately 30 miles southeast of the project area and Mount Shasta is approximately 40 miles northwest. Both volcanoes have been active within the past 200 years: Lassen Peak last erupted in a series of events between 1914 and 1917, and Mount Shasta last erupted sometime around 1786 (U.S. Geological Survey 1992). The Pit River winds its way between these two cones on its way to the Sacramento River (California Geological Survey 2002:2). Extrusive igneous rocks underlie most of the region to the north, south, and east of the project area. These strata range in age from Pliocene (5.3–1.8 million years ago [mya]) to Pleistocene (1.5 mya to 11,000 years ago). Approximately 10–30 miles west of the project area, the regional geology is dominated by marine sedimentary and metasedimentary rocks. The dominant mapped unit in the region east of the project area is of Upper Cretaceous age (65–136 mya) (Jennings 1977).

The California Cascades are part of a seismically active area. Formation of the Cascades was associated with faulting, and Pre-Quaternary and older faults are common in the region (Jennings 1994; Norris and Webb 1990:156). Pleistocene faults are common in the project vicinity and are present in the project area (Jennings 1994.)

Seismic activity in the region continues in the Quaternary. Two recently active faults zoned by the state occur in the region: the Hat Creek fault zone and the McArthur fault (Sawyer 1995b, 1995c; Hart and Bryant 1997). According to USGS, two other faults in the region have been active within the past 15,000 years: the Mayfield fault (Bryant 1995) and the Rocky Ledge fault (Sawyer 1995a) (U.S. Geological Survey, Earthquake Hazards Program 2002) (Figure 3.6-2).

Small seismic events continue to be common. For example, in July 2007 a series of earthquakes, all less than magnitude 3, occurred in the project region, with an epicenter about 20 miles north of Burney (North State Briefs 2007). A sequence of earthquakes also occurred 8 miles northwest of Burney in December 2000. The strongest of these quakes was magnitude 4.6 (U.S. Geological Survey, Earthquake Hazards Program 2000).

Site Geology

The project area is located on a northwest-southeast trending ridge approximately 5,000 feet above sea level (Jennings 1994). Extrusive igneous rocks underlie the entire project area, which comprises two units. The project area and vicinity are underlain by a thick accumulation of nearly flat-lying lava flows. Strata exposed on the lower flanks of Hatchet Mountain are older basalts of Pliocene age. The upper portions of the ridge, including the project site itself, are situated on olivine basalt flows of Pleistocene age (Lydon et al. 1960).

Soils

According to mapping by the Natural Resources Conservation Service (2007a, 2007b), three soil units cover approximately 95% of the project area: the Obie-Mounthat Complex covers approximately 43%, followed by the Windy and McCarthy stony sandy loams and the Goulder gravelly sandy loam. Several other soils also occur in restricted portions of the project area (Figure 3.6-3). Soils at the project site itself belong to the Obie-Goulder-Mounthat unit.

Table 3.6-1 summarizes the properties of the soils in the project vicinity, including their relative areal coverage and key soil properties as they pertain to the proposed construction activity.

Geologic Hazards

Landslides and Mass Flows

Slope stability is a function of many factors, including rainfall, slope gradient, rock and soil type, slope aspect, vegetation, seismic conditions, and human activities. Although slope failure is not considered a major problem, landslides do occur throughout the county. In general, landslides have been more of an issue in the eastern and northern portions of the county, where some of

Table 3.6-1. Mapped Soils in the Hatchet Wind Project Area

Map Symbol and Soil Name	% of Project Area	General Description	Shrink-Swell Potential	Corrosivity to Concrete	Corrosivity to Uncoated Steel	Hazard of Erosion (off-road)	Suitability for Septic[a]
266-Obie-Mounthat Complex, 5–15% slopes	27	Moderately deep to deep, well drained soils formed from alluvium, andesitic debris flow and ash	Low	Moderate	Moderate	Slight	Poor
268-Obie-Mounthat Complex, 30–50% slopes	13		Low	High	Moderate	Moderate	Poor
267-Obie-Mounthat Complex, 15–30% slopes	3		Low	Low	Moderate	Moderate	Poor
WeD-Windy and McCarthy stony sandy loams, 0–30% slopes	27	Moderately deep to very deep, well drained soils formed in material weathered from andesitic mud flows	Low	Moderate	Moderate	Severe	Poor
WfE-Windy and McCarthy very stony sandy loams, 30–50% slopes	2.3		Low	Moderate	Moderate	Moderate	Poor
179-Goulder gravelly sandy loam, 15–30% slopes	23	Very deep, well drained soils that formed in tephra over andesitic lava	Low	High	Moderate	Severe	Poor
180-Goulder gravelly sandy loam, 30–50% slopes	1.4		Low	Moderate	Moderate	Moderate	Poor
173-Gaspar-Scarface Complex, moist, 15–30% slopes	2.0	Very deep, well drained soils formed in tephra	Low	Moderate	Moderate	Severe	Poor
CmD-Cohasset stony loam, 0–30% slopes	0.6	Deep and very deep, well drained soils that formed in material weathered from volcanic rock	Low	Moderate	Moderate	Moderate	Poor
174-Gaspar-Scarface complex, moist, 30-50% slopes	0.4	Very deep, well drained soils formed in tephra.	Low	Moderate	Moderate	Severe	Poor

Source: Natural Resources Conservation Service 2007.

[a] See Section 3.8, *Hydrology and Water Quality*, for more information on septic system suitability and potential impacts.

the geologic units most prone to failure include the Montgomery Creek, Tuscan, Chico, and Red Bluff Formations. None of these formations are found in the project area. (Shasta County 2004:5.1.03). Given the steepness of the slopes in the project area, there may be some potential for slope instability. USGS studies also suggest that the project area may be susceptible to debris flows and similar types of rapidly moving mass flows (Brabb et al. 1999). These types of flows pose the greatest concern in drainages and alluvial fan areas where canyons enter flatter valley floor topography.

Primary Seismic Hazards—Surface Fault Rupture and Groundshaking

The State of California considers two aspects of earthquake events *primary seismic hazards*: surface fault rupture (disruption along the surface trace of an active fault as the result seismic activity or fault creep) and seismic groundshaking (Figure 3.6-2).

Surface Fault Rupture

As discussed above, several active[1] faults are located in the project region: the Hat Creek fault is located about 15 miles east of the project area, the McArthur fault is approximately 25 miles east of the project area, and the Mayfield fault is about 30 miles northeast of the project area. The Hat Creek and McArthur faults are zoned by the state (Hart and Bryant 1997). Other faults of likely Holocene age are mapped in the vicinity but are not—or not yet—zoned by the State of California; these include several smaller, unnamed faults located 30–35 miles from the project area to the east, northeast, and southeast (Jennings 1994). However, no active faults are located in or in the immediate vicinity of the project area. Accordingly, the potential for surface fault rupture to affect the project area is considered low.

Groundshaking

Unlike surface rupture, ground shaking is not confined to the trace of a fault, but rather propagates into surrounding areas during an earthquake. Thus, because the project area is located in a seismically active region, it is likely to continue to be affected by seismic groundshaking.

The overall risk of strong groundshaking in the project area is low to moderate. The California Geological Survey has classified the probabilistic seismic hazards for the state based on likely peak ground acceleration, which is a measure used to assess seismic groundshaking hazard. Based on a probabilistic seismic hazard map that depicts peak horizontal ground acceleration values exceeded at a 10% probability in 50 years (Cao et al. 2003), the peak horizontal ground acceleration for the proposed project is between 0.2 and 0.3 g (where 1*g* is equal to 1 gravity or an acceleration of 9.8 meters per second per second). This is a relatively low level of groundshaking for California. For comparison, the peak horizontal ground acceleration projected for much of the Central Valley is between 0.1 and 0.2 (a low risk of strong groundshaking); by contrast, peak horizontal ground acceleration projections for parts of the San Francisco Bay Area and southern California range from 0.4 to greater than 0.8; these figures constitute much higher groundshaking risks.

[1] See *Regulatory Setting* for a definition of *active* and a description of the Alquist-Priolo Earthquake Fault Zoning Act.

Secondary Seismic Hazards—Liquefaction, Seismically Induced Slope Failure, Ridgetop Shattering

Secondary seismic hazards include liquefaction, seismically induced landsliding, and ridgetop shattering.[2] *Liquefaction* is a phenomenon in which the strength and stiffness of a soil is reduced by earthquake shaking or other rapid loading. Poorly consolidated, water-saturated fine- and medium-grained sands located within 50 feet of the surface are typically considered the most susceptible to liquefaction. Soils and sediments that are not water-saturated and consist of coarser, finer, or less well-sorted materials are generally less susceptible to liquefaction (California Division of Mines and Geology 1997). *Seismically induced landsliding* refers to landslides triggered by earthquake shaking. *Ridgetop shattering* is an earthquake-related shattering of exposed bedrock materials along a ridgeline or other topographic high point.

The State of California has not yet mapped seismic hazards in Shasta County under the Seismic Hazards Mapping Program (California Geological Survey 2006). These hazards are addressed briefly below; this discussion is based on available information.

Areas at risk of liquefaction are typically flatlands with thick accumulations of sediment and shallow groundwater, such as portions of the Central Valley floodplains and parts of the San Francisco Bay Area's low-lying regions. The risk of liquefaction in the project area is probably fairly low because it is on a steep slope with a thin veneer of variably sandy and loamy soil overlying bedrock (although this is a reasonable assumption that is based on the geologic setting, it should be verified through preparation of a site-specific geotechnical report). However, given the steepness of the slope at the proposed project slite and the potential for moderate groundshaking, there may be some risk of earthquake-induced landsliding. Because of its steep slopes and thin soil cover, the project area may also be at risk of ridgetop shattering.

Volcanic Eruption

Three types of volcanic phenomena can endanger people and property: flowage, eruption of tephra, and emission of volcanic gases. These event types are described briefly below (Miller 1989).

- Flowage occurs when a volcano erupts and material is thrown into the air or onto the flanks of the volcano. Material may then flow down the flanks of the volcano or down the valleys adjacent to the volcano. This flow may take one or more forms, including lava flows, debris avalanches, pyroclastic flows (i.e., hot, dry rock fragments mixed with hot gas that move down the flanks), directed blasts (similar to pyroclastic flows but up to hundreds of meters thick and not controlled by topography), and floods (caused by the sudden melting of snow and ice at high elevations). Some types of flowage can occur with little or no warning.

  Flowage is one of the main hazards at both Lassen Peak and Mount Shasta because they are steep-sided volcanoes, are prone to large-volume eruptions, and have experienced this type of event during the last 10,000 years.

- Eruption of tephra occurs when a volcano erupts and fragments of lava and rock are blasted into the air, sometimes carried upward by the convecting column of hot gases. This airborne material is then deposited on and downwind of the volcano vent, forming pyroclastic, or ash fall, deposits. Close to a vent, the main hazards to life and property are high temperatures,

[2] Areas subject to secondary seismic hazards are mapped by the State of California pursuant to the Seismic Hazards Mapping Act of 1990.

burial, and impact of falling fragments. Farther from the vent, the main risk to life is damage to the respiratory system caused by inhaling ash. Although the risk from tephra decreases with distance from the vent, significant property damage can result even at great distance.

Lassen Peak and Mount Shasta are considered to have the potential for tephra eruptions.

- Emission of volcanic gases is associated with most eruptions. Most gas is composed of steam, carbon dioxide, sulfur, and chlorine compounds, along with lesser amounts of other compounds. Close to and sometimes downwind of a vent, volcanic gases can endanger people and property.

Based on patterns of eruptive activity during the Holocene, the project area is in a portion of northern California zoned as being subject to moderate tephra hazards (Miller 1989; U.S. Geological Survey 2000:8). The project area is not in an area zoned as a flowage hazard area.

Regulatory Setting

Federal Regulations

Clean Water Act Section 402[p]

Certain aspects of the federal Clean Water Act are relevant to erosion and sediment control measures during and after project earthwork. More specifically, 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 NPDES program. In California, the State Water Resources Control Board is responsible for implementing the NPDES program; pursuant to the state's Porter-Cologne Water Quality Control Act (see discussion in Chapter 8), it delegates implementation responsibility to the state's nine Regional Water Quality Control Boards.

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 Control Board (RWQCB) that has jurisdiction over the construction area, and to prepare a SWPPP stipulating best management practices (BMPs) that will be in place to avoid adverse effects on water quality.

Additional information on other aspects of the federal Clean Water Act is provided in Chapter 8 (*Water Resources*).

State Regulations and Policies

Alquist-Priolo Earthquake Fault Zoning Act

California's Alquist-Priolo Earthquake Fault Zoning Act (Public Resources Code Sec. 2621 et seq.), originally enacted in 1972 as the Alquist-Priolo Special Studies Zones Act and renamed in 1994, is intended to reduce the risk to life and property from surface fault rupture during earthquakes. The Alquist-Priolo Act prohibits the location of most types of structures intended for human occupancy[3] across the traces of active faults and strictly regulates construction in the corridors along active faults (i.e., *Earthquake Fault Zones*). It also defines criteria for identifying active faults, giving legal weight to terms such as *active*, and establishes a process for reviewing building proposals in and adjacent to Earthquake Fault Zones.

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 1997).

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, 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.

Volcanic Hazard–Related Policies

Under the Disaster Relief Plan (Public Law 93-288), USGS, through its Volcano Hazards Program (VHP), is responsible for issuing warnings of potential volcanic disasters to civil authorities and affected communities. The mission of the VHP is to enhance public safety and reduce losses from volcanic events through forecasts and warnings of volcanic hazards. The VHP monitors volcano unrest and eruption; prepares volcano hazard assessments; conducts research on volcanic processes; and provides forecasts, warnings, and volcano-hazard information. (U.S. Geological Survey 2006:1.)

The 5-year goals of the VHP for fiscal years 2004–2008 are listed below (U.S. Geological Survey 2006:2–3).

- 1.0 Complete National Volcano Early Warning System planning and install new, and develop existing, geophysical and geochemical monitoring networks on dangerous volcanoes commensurate with the threat each poses to ensure reliable, real-time information on critical parameters such as earthquake activity, ground deformation, and emission of volcanic gases.

[3] With reference to the Alquist-Priolo Act, a *structure for human occupancy* is defined as one "used or intended for supporting or sheltering any use or occupancy, which is expected to have a human occupancy rate of more than 2,000 person-hours per year" (California Code of Regulations, Title 14, Div. 2, Section 3601[e]).

- 2.0 Conduct detailed geological field investigations of volcanoes and use GIS technology to enhance hazard assessments; hazard-zonation mapping; probabilistic eruption forecasting; and an overall understanding of volcanologic, magmatic, and hydrologic processes.
- 3.0 Conduct experiments and systematic studies to establish a sound theoretical and empirical basis for understanding volcano processes and related hydrothermal and surface flowage processes.
- 4.0 Utilize Interferometric Synthetic Aperture Radar (InSAR) data to systematically characterize the deformation field at hazardous volcanoes and volcanic regions. This goal will be achieved through partnerships with other USGS programs and other agencies.
- 5.0 Reduce volcano risk abroad through the Volcano Disaster Assistance Program (VDAP), an interagency partnership between USGS and USAID Office of Foreign Disaster Assistance (OFDA), by infrastructure development, technology transfer, and training in volcano monitoring, geological investigations, and hazard assessment in other countries.
- 6.0 Build and expand databases on volcanism in the U.S. and abroad, suitable for use in assessing potential volcanic activity and threat. Databases include historical information about volcanic unrest and eruptions, maps, geochemical and geophysical data, hazard analyses, and populations and infrastructure at risk.
- 7.0 Deliver effective products and services and provide timely access to VHP information.
- 8.0 Conduct strategic hiring and strengthen partnerships and communication with universities to maintain core capabilities, enhance scientific and technical coordination and exchange, and promote educational opportunities for students.

USGS and the State of California monitor volcanic activity at Mount Shasta and Lassen Peak (Shasta County 2004). Information about volcanic activity in the Cascade Range and volcanic hazard warnings can be accessed at http://volcano.wr.usgs.gov/cvo/current_updates.php.

Local Regulations

Shasta County General Plan

The Shasta County General Plan objectives are to protect all development from seismic hazards, unstable slopes, and other geologic hazards, such as volcanoes, erosion, and expansive soils, and to protect all waterways from adverse water quality impacts caused by development on highly erodible soils. The Shasta County General Plan seeks to achieve this goal by developing standards for the location of development relative to these hazards (Shasta County 2004).

Policies related to these objectives of the general plan are listed below.

SG-a Development proposals for critical or high density structures, as defined in the Uniform Building Code, located within a half mile of any fault identified as an Earthquake Fault Zone by the California Division of Mines and Geology shall include a geologic study of potential fault rupture. Geologic studies which are undertaken shall be performed by a registered geologist according to general guidelines of the California Division of Mines and Geology. Proposals for critical structures, as defined in the Uniform Building Code, within the study area shall include a site-specific seismic hazards evaluation, including ground motion criteria for the design of new buildings and structures.

SG-b In order to minimize development that would be endangered by landslides, geological investigations by a registered geologist or a geological engineer will be required on all subdivision and/or developments where the preliminary staff report indicates the possibility of landslides on or adjacent to the development. A landslide map shall be developed and maintained as these reports are accumulated for reference by the development sponsors.

SG-c Shasta County shall coordinate with State and Federal agencies monitoring volcanic activity and shall periodically review and update the Shasta County Emergency Plan with respect to volcanic hazards.

SG-d Shasta County shall develop and maintain standards for erosion and sediment control plans for new land use development. Special attention shall be given to erosion prone hillside areas, including those with extremely erodible soils types such as those evolved from decomposed granite.

SG-e When soil tests reveal the presence of expansive soils, engineering design measures designed to eliminate or mitigate their impacts shall be employed.

SG-f Shasta County shall pursue preparation of development standards based on topography and soil erosion potential in revising its land capability standards pursuant to Policy CO-h.

SG-g Shasta County should comply with the requirements of the Seismic Hazards Mapping Act, when the Seismic Hazards Maps for the County are completed and made available by the State Geologist. The Maps will include liquefaction hazard zones and earthquake-induced landslide hazard zones.

Shasta County Grading Permit

Shasta County requires a grading permit for projects that involve movement of earth materials in excess of 250 cubic yards or that disturb 10,000 square feet or more of surface area. To apply for the permit, the proponent usually must submit a grading and erosion control plan, vicinity and site maps, and other supplemental information. Standard conditions in the grading permit include a description of BMPs similar to those contained in a SWPPP. In addition, for earthmoving activities taking place between October 15 and May 1, a wet weather plan must be prepared by an erosion control specialist. The Shasta County Department of Resource Management, Environmental Health Division is responsible for ensuring compliance with the permit conditions and relevant ordinances. (Shasta County 2007.)

3.6.2 Impact Analysis

Methodology

Impacts related to geology, soils, and associated hazards were analyzed qualitatively, based on a review of soils and geologic information for the project area and on professional judgment. Analysis focused on the proposed project's potential to increase the risk of personal injury, loss of life, and damage to property, including new or upgraded facilities, as a result of existing geologic conditions in the action area. The analysis assumed that the applicant will comply with the requirements of the current UBC, County General Plan seismic safety standards, and the County grading ordinance.

Thresholds of Significance

For the purposes of this analysis, an impact was considered to be significant and to require mitigation if it would result in any of the following.

- Exposure of 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;
  - volcanic hazards, such as flowage, eruption of tephra, and emission of volcanic gases;
  - strong seismic groundshaking;
  - liquefaction and other related types of seismically induced ground failure; or
  - landslides.
- Substantial soil erosion or loss of topsoil.
- Location of structures on a geologic unit or soil that is unstable or that would become unstable as a result of construction, increasing the risk of on- or offsite landslide or slope failure.
- Location of structures on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (International Conference of Building Officials 1997), creating substantial risks to life or property.

Impacts and Mitigation Measures

Construction

Impact GEO-1: Potential to cause accelerated runoff, erosion, and sedimentation from grading activities (less than significant)

Erosion is the process by which soil material is detached and transported from one location to another by wind or water. Erosion occurs naturally in most systems but is often accelerated by human activities that disturb soil and vegetation. The rate at which natural erosion and accelerated erosion occur is largely a function of climate, soil cover, slope conditions, and inherent soil properties, such as texture and structure.

Most of the soils in the project area have a moderate to severe erosion hazard. Grading, excavation, removal of vegetation cover, and loading activities associated with construction activities could temporarily increase erosion and sedimentation. Construction activities could also result in soil compaction and wind erosion effects that could adversely affect soils and reduce the revegetation potential at the construction sites and staging areas.

This impact could be significant; however, compliance with the federal and local erosion-related regulations applicable to the project (i.e., the SWPPP that is developed for the site) would ensure that construction activities do not result in significant erosion. The SWPPP will be kept on site during construction activity and will be made available upon request to representatives of the Central Valley RWQCB (Central Valley Water Board) and Shasta County. One of the objectives of the SWPPP would be to identify, construct, and implement stormwater pollution prevention measures to reduce pollutants in stormwater discharges during and after construction. The SWPPP would also include details of how the sediment and erosion control practices, referred to as BMPs, would be implemented.

Moreover, compliance with the County's Grading Ordinance would further minimize any negative effects associated with erosion and sedimentation. Based on the extent of earth or soil to be disturbed and moved and how the grading activities are conducted on the project site, the ordinance determines the extent to which water quality issues must be addressed.

This impact would be less than significant. No mitigation is required.

Impact GEO-2: Location of structures on a geologic unit or soil that would become unstable as a result of the project (less than significant with mitigation)

Landsliding could potentially occur in the project area. The General Plan indicates that landsliding is known to occur in the county, and the proposed project would be constructed on steep slopes. If improperly implemented, construction activities such as excavation and fill placement to create building pads to support turbine foundations could exacerbate any existing slope instability, or could cause previously stable slopes to become unstable.

In addition, a large earthquake on a nearby fault could cause moderate ground shaking in the project area, potentially resulting in seismically induced landsliding, which in turn could increase the risk of structural loss, injury, or death.

Potential impacts related to landslides and slope stability are therefore considered significant. Implementation of Mitigation Measures GEO-1 and 2 would reduce this risk to a less-than-significant level.

Mitigation Measure GEO-1: Implement recommendations of site-specific geotechnical investigation prepared by state-licensed personnel

As part of the project design process, the Shasta County Department of Resource Management will ensure that the applicant retains appropriately qualified state-licensed professionals (G.E. and C.E.G.) to conduct site-specific geotechnical and engineering geologic investigations consistent with all currently applicable standards of professional geotechnical engineering and engineering geologic practice. The purpose of the investigations will be to provide a geologic basis for the development of appropriate project design. Investigations will address bedrock and Quaternary geology; geologic structure, including primary and secondary seismic hazards as defined by the State of California; soils; slope stability; previous history of excavation and fill placement; earthwork recommendations; and any other topics identified by Shasta County Department of Resource Management, the design engineer(s), the geotechnical engineer, or the engineering geologist as relevant. The results of the study will be presented to the Shasta County Department of Resource Management in the form of a geotechnical and engineering geology report (soils report). The report will include design and/or construction requirements to address any geologic conditions or hazards identified as posing substantial risk to life, safety, or property (including the project), as well as recommendations to ensure that project construction and operation do not exacerbate any existing geologic hazards. The applicant will be responsible for ensuring that project design and construction adheres to all recommendations of the report.

Mitigation Measure GEO-2: Ensure that the site-specific geotechnical investigation addresses landslide risks

The applicant will ensure that the site-specific geotechnical report prepared for the project evaluates landslide risks, including seismically induced landsliding, in the project area and, where appropriate, identifies mitigation to address these hazards. Any mitigation will be consistent with the current standard of care for geotechnical engineering and engineering geology, and all applicable building codes and standards. The applicant will be responsible for ensuring that all recommendations of the site-specific geotechnical report are implemented.

Operations

Impact GEO-3: Potential exposure of people or structures to surface rupture of a known earthquake fault (less than significant)

Based on currently available knowledge, there are no known active faults in the project area. Impacts related to surface fault rupture are therefore expected to be less than significant. No mitigation is required.

Impact GEO-4: Potential exposure of people or structures to strong seismic ground shaking or liquefaction hazards (less than significant)

A large earthquake on a nearby fault could cause moderate ground shaking in the project area, potentially resulting in liquefaction and associated ground failure, such as lateral spreading or differential settlement, which in turn could increase the risk of structural loss, injury, or death. However, as part of the design process described above, the project applicant will be required to implement UBC Seismic Hazard Zone 3 and County General Plan standards into the project design for applicable features to minimize the potential effects of ground shaking hazards on associated project features. Structures will be designed to meet the regulations and standards associated with UBC Seismic Hazard Zone 3 hazards. This impact is considered less than significant. No mitigation is required.

Impact GEO-5: Potential structural damage as a result of development on expansive soils (less than significant)

Expansive soils have the potential to compromise the structural integrity of proposed new facilities (e.g., roadways, buildings, and other associated features). However, as shown in Table 3.6-1, all of the soil map units in the project area have been identified as having low shrink-swell potential. This impact is considered less than significant.

Impact GEO-6: Location of structures on a ridge potentially prone to ridgetop shattering (less than significant with mitigation)

The project area is located along a bedrock ridgeline in an area with the potential for moderate groundshaking. Therefore, it may be at risk of ridgetop shattering in an earthquake of sufficient magnitude. Depending on the level of associated surface disruption, substantial damage to project facilities could result, potentially rising to the level of a significant impact. Implementation of Mitigation Measure GEO-2 would reduce this impact to a less-than-significant level.

Mitigation Measure GEO-3: Ensure that the site-specific geotechnical investigation addresses ridgetop shattering risks

The proponent will ensure that the site-specific geotechnical report prepared for the project includes an evaluation of the potential for ridgetop shattering to affect project facilities and, if appropriate, identifies mitigation to address these hazards. Any mitigation will be consistent with the current standard of care for geotechnical engineering and engineering geology, and all applicable building codes and standards. The applicant will be responsible for ensuring that all recommendations of the site-specific geotechnical report are implemented.

Impact GEO-7: Exposure of people or structures to volcanic hazards (less than significant)

The project area is located in a volcanically active area, near two volcanoes that have erupted in historical time. The main volcanic hazard at the project site is tephra (ash) fall. The 6–10 people working at the site could be exposed to this hazard. However, staffing for project operation and maintenance is expected to come from the proponent's existing work force; any additional hires would likely be drawn from the local population already living in the Shasta County area and subject to its volcanic hazards. Consequently, the project is not expected to increase the overall number of people exposed to volcanic hazards and would not materially increase the level of exposure of people already living and working in the county. Impacts related to volcanic hazards exposure would thus be less than significant despite the area's ambient risks. No mitigation is required.