11.0 SOILS, GEOLOGY, AND SEISMICITY

This chapter summarizes existing geologic conditions in the project area, describes applicable regulations, and evaluates project-related impacts associated with on-site geology, soils, seismic hazards, and slope stability. Mitigation measures are recommended as necessary to reduce significant geologic impacts. As described in Chapter 1.0, "Introduction," the proposed project would not result in the loss of any known mineral resources, nor would it impede or interfere with mineral extraction operations, and the project area is not delineated as a locally important recovery site. Therefore, implementation of the proposed project would have no effect with regard to mineral resources, and this topic will not be discussed further in this chapter.

11.1 ENVIRONMENTAL SETTING

11.1.1 PHYSIOGRAPHIC SETTING

The project area is located along the western slope of the Sierra Nevada Geomorphic Province. The Sierra Nevada Geomorphic Province is a tilted fault block nearly 400 miles long. Its east face is a high, rugged multiple scarp, in contrast with the gentle western slope, which disappears under sediments of the Great Valley. Deep river canyons are cut into the western slope. Their upper courses, especially in massive granites of the higher Sierra Nevada, are modified by glacial sculpturing, forming such scenic features as the Yosemite Valley. The high crest culminates in Mount Whitney, with an elevation of 14,495 feet above sea level near the eastern scarp. The metamorphic bedrock contains gold-bearing veins in the northwest trending Mother Lode. The northern Sierra Nevada boundary is marked where bedrock disappears under the Cenozoic volcanic cover of the Cascade Range (California Geological Survey 2002).

The western slope of the Sierra Nevada is underlain by a series of metamorphic rock assemblages that trend north-northwest to south-southeast between the Mesozoic granitics of the Sierra Nevada batholith on the east and the sediment-filled Sacramento Valley to the west. These metamorphic rocks were developed by convergent plate tectonics in the early Paleozoic to Late Jurassic (400–120 million years ago) and consist of three northerly trending units bounded by faults and classified on the basis of age and lithology: the Eastern, Central, and Western metamorphic terranes.

11.1.2 LOCAL GEOLOGY

The proposed trail alignment is located in the U.S. Geological Survey (USGS) Auburn and Greenwood 7.5-minute quadrangles and is approximately 14.2 miles from the confluence of the North Fork/Middle Fork American River confluence. The average gradient for most of the slopes along the proposed trail alignment is about 70% or flatter. Some segments, however, intersect slopes approaching 100% gradient. The proposed trail alignment would be approximately 200–400 feet above the river on the southern slope of the North Fork American River canyon.

Published geologic maps show the majority of the proposed trail alignment in a mixed-rock area described as a "mélange belt," composed of intermixed Mesozoic metasedimentary and metavolcanic rock with isolated bodies of limestone. The northeast section of the proposed trail alignment (from the Ponderosa Bridge to approximately 1 mile downstream) is mapped as Mesozoic metavolcanic flow rocks of the Logtown Ridge Formation (predominantly metamorphosed breccias, flows, and pyroclastic rocks) and Mesozoic metasedimentary rocks of the Mariposa Formation (predominantly slate, metagraywacke, and metaconglomerate) (Blackburn Consulting 2006, 2007).

The entire project area is mapped as predominantly hard, fractured, metavolcanic flow rocks. This rock structure strikes generally north-northwest, with fracture/foliation planes dipping steeply northeast. The lesser bands are mapped as northwesterly trending metavolcanic tuffs and metashale that cross sections of the proposed trail alignment. These bands tend to be intensely weathered/foliated and, in general, less competent than rock flow.

Isolated limestone bodies, typically hard and massive, are also mapped in the metavolcanic flow rock (Blackburn Consulting 2006, 2007).

11.1.3 RECREATIONAL GEOLOGIC FEATURES

Recreational geologic resources typically include volcanoes, surface hydrothermal features, or surface expression of geologic features unique enough to generate recreational interest in the general public (e.g., natural bridges, caves, features associated with glaciation, and geomorphic features such as waterfalls, cliffs, canyons, and badlands). Based on a review of available geological literature, topographic maps, and a field visit to the site, there are no known recreational geologic resources in the project area.

11.1.4 SOIL RESOURCES

Maps provided by the U.S. Soil Conservation Service (now called the Natural Resources Conservation Service) (SCS 1980) were reviewed to identify the distribution of soil types in the project area. Exhibit 11-1 provides a detailed map of the surficial soils in the project area. The physical and chemical characteristics of each soil type identified from the project site are presented below.

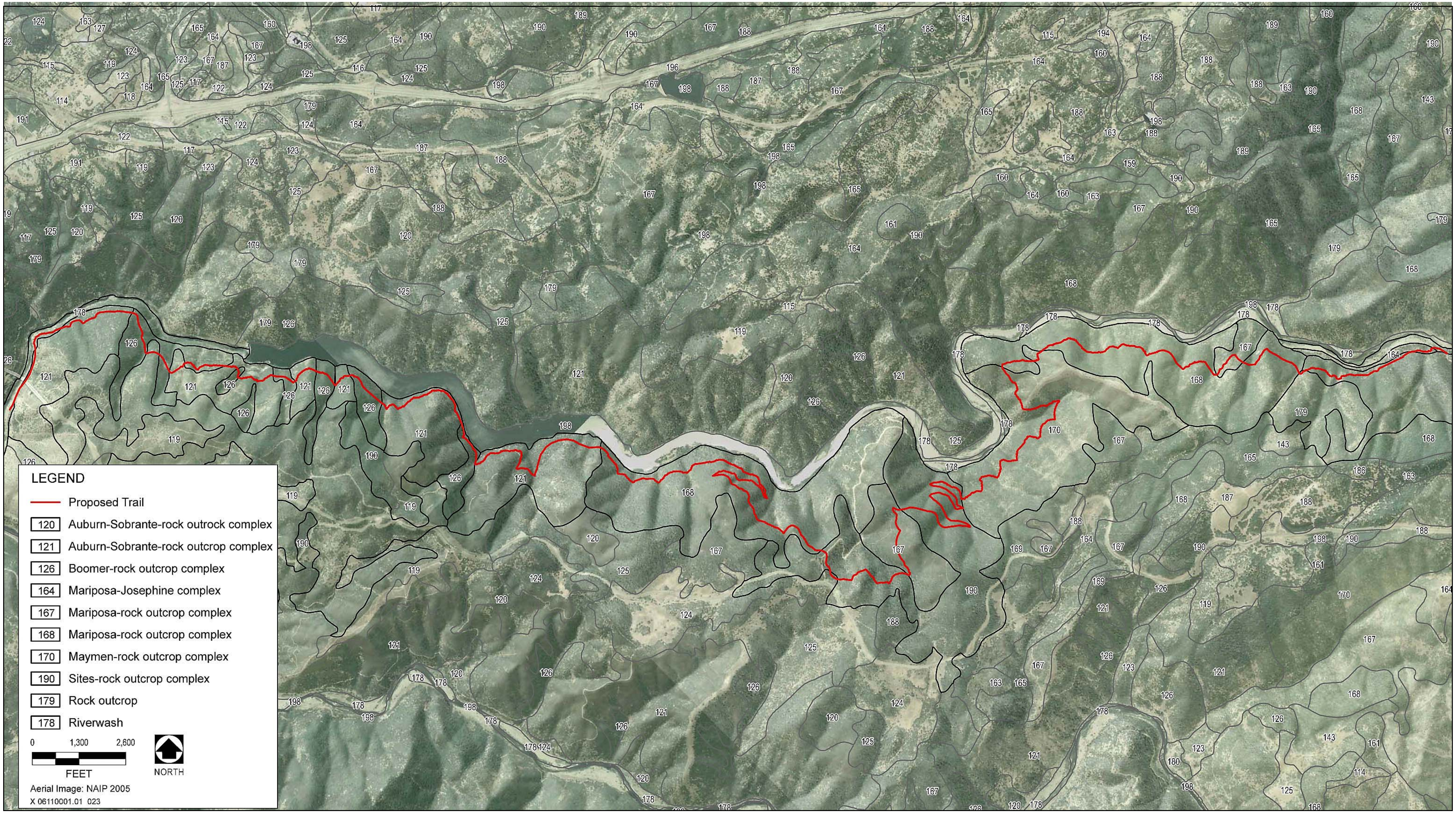
121 Auburn–Sobrante–Rock outcrop complex, 275% slopes—This soil is on undulating to very steep foothills. Rock outcrops are common. The soil forms in material weathered from metabasic or metasedimentary rock such as amphibolite schist, greenstone schist, or diabase at elevations of 125–3,000 feet. Soil is shallow over fractured, vertically tilted metabasic rock with rock outcrops. There are typically 4 inches of silt loam over 20 inches of silt loam subsoil. This soil is well drained, with slow to very rapid runoff and moderate permeability. This soil is used mostly for annual rangeland with small areas used for irrigated pasture. Rock is erosion resistant.

126 Boomer–Rock outcrop complex, 5–30% slopes—This soil forms over weathered metavolcanic (greenstone) bedrock at elevations of 500–5,000 feet. Soil is shallow over weathered schist and slate with rock outcrops. There are typically 10 inches of gravelly loam over 46 inches of gravelly clay loam subsoil. This soil is found on uplands; it is well drained, has slow to very rapid runoff, and has moderately slow permeability. This soil is used often for forestry and watersheds. Rock is erosion resistant.

164 Mariposa-Josephine complex, 5–30% slopes—The Mariposa-Josephine complex is encountered at elevations of 1,500–4,000 feet. Mariposa is common to ridges and south- and west-facing slopes, while Josephine is common to north- and east-facing slopes. Soil is shallow over weathered schist and slate with isolated rock outcrops. There are typically 6 inches of gravelly loam over 22 inches of gravelly clay loam subsoil. The complex is well drained with moderately slow permeability and moderate to high erosion hazard. Rock is erosion resistant.

167, 168 Mariposa–Rock outcrop complex, 50–70% slopes—This soil occurs on undulating to steep mountains at elevations of 1,600–5,600 feet. It is formed in material from metamorphosed sedimentary rocks. Soil is shallow over fractured, vertically tilted schist and slate with rock outcrops. There are typically 6 inches of gravelly loam over 28 inches of gravelly loam subsoil. This soil is well drained, has slow to very rapid runoff, and has moderate permeability. Timber production is the predominant use, with some grazing and deciduous fruit orchards. Rock is erosion resistant.

170 Maymen–Rock outcrop complex, 5–100% slopes—The Maymen–Rock outcrop complex occurs at elevations of 1,200–3,500 feet and generally consists of 50% Maymen soil, 20% Rock outcrop, 25% Mariposa gravelly loam, and 5% Josephine loam. Soil is shallow, with rock outcrops. There are typically 2 inches of gravelly loam over 10 inches of gravelly loam subsoil. The Maymen is a shallow, gravelly loam that is somewhat excessively drained, and permeability is moderate. Timber production and residential development are limited on this complex because of the slope, shallowness, and rock outcroppings. Rock is erosion resistant.



Source: United States Department of Agriculture Soil Conservation Service 1977

Soil Types in the Project Area **Exhibit 11-1**

190 Sites–Rock outcrop complex, 15–30% slopes—This soil occurs on mountains at elevations of 600–5,000 feet. It is formed in material weathered from metabasic and metasedimentary rocks. This soil is well drained, has slow to very rapid runoff, and has moderately slow permeability. Soil is shallow, with rock outcrops. There are typically 16 inches of loam and clay over 50 inches of clay (weathered rock). Timber production is the predominant use, with some areas cleared and used for deciduous fruit orchards. Rock is erosion resistant.

SHRINK-SWELL POTENTIAL

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture; soils swell when wet and shrink when dry. If the shrink-swell potential is rated moderate to high, volume changes can eventually result in damage to subsurface structures if the structures are not designed and constructed appropriately to resist the changing soil conditions. Soils with high clay content tend to be most affected by shrink and swell. The potential for soil to undergo shrink and swell is greatly enhanced by the presence of a fluctuating, shallow groundwater table. Volume changes of expansive soils can result in the consolidation of soft clays after the water table drops or fill is placed.

NATURALLY OCCURRING ASBESTOS

Asbestiform minerals occur naturally in rock and soil as the result of natural geologic processes, often in veins near earthquake faults in the Coast Range and the foothills of the Sierra Nevada. Naturally occurring asbestos can take the form of long, thin, separable fibers. Natural weathering or human disturbance can break naturally occurring asbestos down to microscopic fibers, easily suspended in air.

There is no health threat if asbestos fibers in soil remain undisturbed and do not become airborne. When inhaled, however, these thin fibers irritate tissues and resist the body's natural defenses. Asbestos, a known carcinogen, causes cancers of the lung and the lining of internal organs, as well as asbestosis and other diseases that inhibit lung function.

The potential presence of and hazards posed by naturally occurring asbestos are discussed in greater detail in Section 9.1.3, "Existing Air Quality—Toxic Air Contaminants," in Chapter 9.0, "Air Quality."

11.1.5 REGIONAL SEISMICITY AND FAULT ZONES

The foothills of the Sierra Nevada are characterized by extremely low seismicity. The proposed trail alignment lies within the Foothills Fault System, which is bounded by the Melones Fault Zone about 20 miles east and by the Bear Mountain Fault Zone, the closest portion of which is about 4 miles southwest. Data compiled between 1808 and 1987 show that only 15 earthquakes between magnitude (M) 3.0 and 4.0 on the Richter scale were recorded along the Foothills Fault System between Mariposa and Oroville. Four notable historical earthquakes have been reported in the northern Sierra Nevada. Three seem to have been associated with the northern portion of the Melones Fault Zone near Downieville. The fourth was the M 5.7 Oroville earthquake of August 14, 1975, located about 45 miles northwest of the project area. Table 11-1 lists regional faults of relevance to the project area, and potential peak site accelerations from hypothetical earthquakes.

The Richter scale is a logarithmic scale that expresses the magnitude of an earthquake in terms of the amount of energy generated, with 1.5 indicating the smallest earthquake that can be felt, 4.5 an earthquake causing slight damage, and 8.5 a very damaging earthquake.

The Weimar Fault is mapped near the northeast portion of the project area. This fault is a Pre-Quaternary fault with no evidence of movement in the last 1.6 million years. Two other unnamed faults are mapped near the Weimar Fault and are also shown to be Pre-Quaternary in age.

Table 11-1 Regional Fault Activity		
Faults Active in the Vicinity of the Project Area	Distance from Project Site (miles)	Probable Maximum Magnitude[1]
Weimar	0.25	6.0
Bear Mountain	4	6.5
Melones	20	6.5
Dunnigan Hills	48	6.5
Coast Range (Sierran Block boundary)	60	7.0

[1] A measure of earthquake size calculated on the basis of seismic moment called Moment Magnitude (Mw).
Sources: Helley and Harwood 1987, Jennings 1994

Potential seismic hazards resulting from a nearby moderate to major earthquake can generally be classified as primary and secondary. The primary effect is fault ground rupture, also called surface faulting. Surface ground rupture along faults is generally limited to a linear zone a few meters wide. Common secondary seismic hazards include ground shaking, liquefaction, and subsidence. These hazards are discussed below.

SEISMIC GROUND SHAKING

The most important geologic hazard that could affect the project area is the risk to life and property from an earthquake generated by active and potentially active faults in the Foothill Fault System.

According to the California Building Standards Code (CBC), 1998 edition (described further in Section 11.2.2, “State Plans, Policies, Regulations, and Laws,” below), the project area is located in Seismic Zone 3. This location implies a minimum horizontal acceleration of 0.3 g (where “g” is the acceleration of gravity) for use in earthquake resistant design.

Ground motions can be estimated by probabilistic method at specified hazard levels. The intensity of ground shaking depends on the distance from the earthquake epicenter to the site, the magnitude of the earthquake, site soil conditions, and the characteristic of the source. The *Probabilistic Seismic Hazard Assessment for the State of California* (Petersen et al. 1996), published by USGS and the California Division of Mines and Geology (now known as the California Geological Survey), identifies the seismic hazard based on a review of these characteristics and historical seismicity throughout California. The results of these studies suggest there is a 10% probability that the peak horizontal acceleration experienced at the site would exceed 0.2 g in 50 years.

The CBC specifies more stringent design guidelines where a project would be located adjacent to a Class A or Class B fault as indicated on the California Probabilistic Seismic Hazard Maps (Cao et al. 2003). Faults with an “A” classification can produce large-magnitude events (M greater than 7.0), have a high rate of seismic activity (e.g., slip rates greater than 5 millimeters per year), and have well-constrained paleoseismic data (e.g., evidence of displacement within the last 700,000 years). Class B faults are those that lack paleoseismic data necessary to constrain the recurrence intervals of large-scale events. Faults with a “B” classification can produce an event of magnitude 6.5 or greater. A review of the available data indicates that no Class A or B faults are located within 20 miles of the project area.

GROUND FAILURE/LIQUEFACTION

Soil liquefaction occurs when ground shaking from an earthquake causes a sediment layer saturated with groundwater to lose strength and take on the characteristics of a fluid, thus becoming similar to quicksand. There are four types of ground failure or collapse of soil structures that commonly result from liquefaction: lateral spread, flow failure, ground oscillation, and loss of bearing strength. Age also is a factor in the potential of soils to liquefy; Holocene deposits (from approximately the last 11,000 years) are the most sensitive to liquefaction.

One consequence that may result from the occurrence of liquefaction is an associated surface expression. If the seismic event occurs over an extended duration, the liquefied soils may migrate toward the surface, resulting in ejection and subsequent sand boiling at the surface.

Liquefaction poses a hazard to engineered structures. Factors determining the liquefaction potential of a given site are soil type, the level and duration of possible seismic ground motions, the type and consistency of soils, and the depth to groundwater. Loose sands and peat deposits are susceptible to liquefaction. Liquefaction is particularly likely where land has been reclaimed from inundated areas by filling with loose sand. Clayey silts, silty clays, and clays deposited in freshwater environments are generally stable under the influence of seismic ground shaking.

The geotechnical engineering report prepared by Blackburn Consulting (2006, 2007) (Appendix B) determined that the project area is underlain by consolidated metavolcanic and metasedimentary rocks that are not susceptible to liquefaction. In addition, regional groundwater levels are expected to be greater than 50 feet in depth.

SUBSIDENCE AND LATERAL SPREADING

Land surface subsidence can be induced by both natural phenomena and human activity. Natural phenomena include subsidence resulting from tectonic deformations and seismically induced settlements; soil subsidence from consolidation, hydrocompaction, or rapid sedimentation; subsidence from oxidation or dewatering of organic-rich soils; and subsidence related to subsurface cavities. Subsidence related to human activity includes withdrawal of subsurface fluids or sediments. Pumping of water from subsurface water tables for residential, commercial, and agricultural uses causes more than 80% of the identified subsidence in the United States (Galloway et al. 1999).

Lateral spreading is the horizontal movement or spreading of soil toward an open face, such as a streambank, the open side of fill embankments, or the sides of levees. The potential for failure from lateral spreading is highest in areas where there is a high groundwater table, where there are relatively soft and recent alluvial deposits, and where creek banks are relatively high.

The project area is underlain by consolidated metavolcanic and metasedimentary rocks that are not susceptible to liquefaction. In addition, regional groundwater levels are expected to be greater than 50 feet in depth.

LANDSLIDING AND SLOPE STABILITY

As defined by the California Geological Survey, a landslide is the downslope movement of soil and rock material under the influence of gravity. The formation of landslides under natural conditions depends on several factors: the type of materials, structural properties of the materials, steepness of slopes, water and rainfall, vegetation type, proximity to areas undergoing active erosion, and earthquake-generated ground shaking.

The canyon sides of the American River watershed are prone to sliding or slumping because slopes exceed 30%. The rock units most likely to experience rockfalls and landslides are Valley Springs tuff, metavolcanic flows, mehrtren mudflow breccia (weathered), serpentine, and metasedimentary rocks.

Field review of the project area by Blackburn Consulting (2006, 2007) noted several areas of shallow instability and small landslides along the proposed trail alignment. These features were 1–3 feet thick and restricted to within surface soils underlying the bedrock interface.

TIDAL WAVES AND SEISMIC SEICHES

Earthquakes may affect open bodies of water in two ways: by creating seismic sea waves and by creating seiches. Seismic sea waves (often called “tidal waves”) are caused by abrupt ground movements (usually vertical) on the ocean floor in connection with a major earthquake. Because of the distance of the project area from the ocean (i.e., greater than 20 miles), seismic sea waves would not be a factor. A seiche is a sloshing of water in an enclosed or restricted water body such as a basin, river, or lake, caused by earthquake motion; the sloshing can occur for a few minutes or several hours. In 1868, for example, an earthquake along the Hayward Fault in the San Francisco Bay Area is known to have generated a seiche along the Sacramento River.

11.2 REGULATORY SETTING

11.2.1 FEDERAL PLANS, POLICIES, REGULATIONS, AND LAWS

FEDERAL EARTHQUAKE HAZARDS REDUCTION ACT

In October 1997, the U.S. Congress passed the Earthquake Hazards Reduction Act to “reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards and reduction program.” To accomplish this, the act established the National Earthquake Hazards Reduction Program (NEHRP). This program was significantly amended in November 1990 by the National Earthquake Hazards Reduction Program Act (NEHRPA), which refined the description of agency responsibilities and program goals and objectives.

NEHRP’s mission includes improved understanding, characterization, and prediction of hazards and vulnerabilities; improved building codes and land use practices; risk reduction through postearthquake investigations and education; development and improvement of design and construction techniques; improved mitigation capacity; and accelerated application of research results. The NEHRPA designates the Federal Emergency Management Agency (FEMA) as the lead agency of the program and assigns it several planning, coordinating, and reporting responsibilities. Other NEHRPA agencies include the National Institute of Standards and Technology, National Science Foundation, and USGS.

11.2.2 STATE PLANS, POLICIES, REGULATIONS, AND LAWS

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

In California, the State Water Resources Control Board (SWRCB) administers the U.S. Environmental Protection Agency regulations (Title 55, Section 47990 of the Code of Federal Regulations [i.e., 55 CFR 47990]) that require the permitting of stormwater-generated pollution under the National Pollutant Discharge Elimination System (NPDES). The issuance of NPDES permits is carried out through regional water quality control boards (RWQCBs). Pursuant to the federal regulations, an operator must obtain a General Permit under the NPDES Stormwater Program for all construction activities with ground disturbance of 1 acre or more. The General Permit requires projects to implement best management practices (BMPs) to reduce pollutant loads into the waters of the state, and to implement measures to reduce sediment and erosion control. In addition, a storm water pollution prevention plan (SWPPP) must be prepared. The SWPPP addresses water pollution control during construction. SWPPPs require that all stormwater discharges associated with construction activity be free of site pollutants wherever clearing, grading, and excavation results in soil disturbances.

CALIFORNIA BUILDING STANDARDS CODE

The State of California provides minimum standards for building design through the CBC (Title 24 of the California Code of Regulations). Where no other building codes apply, Chapter 29 of the CBC regulates excavation, foundations, and retaining walls. The CBC also applies to building design and construction in the state and is based on the federal Uniform Building Code (UBC), which is used widely throughout the country and generally adopted on a state-by-state or district-by-district basis. The CBC has been modified for California conditions with numerous more detailed and/or more stringent regulations.

The state earthquake protection law (California Health and Safety Code Section 19100 et seq.) requires that structures be designed to resist stresses produced by lateral forces caused by wind and earthquakes. Specific minimum seismic safety and structural design requirements are set forth in Chapter 16 of the CBC. The CBC identifies seismic factors that must be considered in structural design.

Chapter 18 of the CBC regulates the excavation of foundations and retaining walls, and Appendix Chapter A33 regulates grading activities, including drainage and erosion control, and construction on unstable soils, such as expansive soils and liquefaction areas.

CALIFORNIA SEISMIC HAZARDS MAPPING ACT

The California Seismic Hazards Mapping Act of 1990 (Public Resources Code Sections 2690–2699.6) addresses seismic hazards other than surface rupture, such as liquefaction and induced landslides. The Seismic Hazards Mapping Act specifies that the lead agency for a project may withhold development permits until geologic or soils investigations are conducted for specific sites and mitigation measures are incorporated into plans to reduce hazards associated with seismicity and unstable soils.

ALQUIST-PRIOLO FAULT ZONING ACT

The Alquist-Priolo Earthquake Fault Zoning Act (Public Resources Code Sections 2621–2630) was passed by the California Legislature in 1972 to mitigate the hazard of surface faulting to structures. The main purpose of the act is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The act addresses only the hazard of surface fault rupture and is not directed toward other earthquake hazards. Local agencies must regulate most development in fault zones established by the State Geologist. Before a project can be permitted in a designated Alquist-Priolo Earthquake Fault Zone, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults.

11.2.3 LOCAL PLANS, POLICIES, REGULATIONS, AND ORDINANCES

PLACER COUNTY GRADING ORDINANCE

The grading and erosion prevention ordinance of Placer County (referred to herein as the Placer County Grading Ordinance) (Article 15.48 of the Placer County Code) regulates grading on property within the unincorporated area of Placer County for the following purposes:

- to safeguard life, limb, health, property, and public welfare;
- to avoid pollution of watercourses with hazardous materials, nutrients, sediments, or other earthen materials generated on or caused by surface runoff on or across the permit area; and
- to ensure that the intended use of a graded site is consistent with the *Placer County General Plan*, any adopted specific plans, applicable Placer County (County) ordinances (e.g., the zoning ordinance, flood damage prevention ordinance, and environmental review ordinance), and applicable chapters of the CBC.

PLACER COUNTY GENERAL PLAN

The following are the relevant goals and policies identified by the *Placer County General Plan* (Placer County 1994) for soils, geology, and seismicity.

- **GOAL 8.A:** To minimize the loss of life, injury, and property damage due to seismic and geological hazards.

- **Policy 8.A.1.** The County shall require the preparation of a soils engineering and geologic-seismic analysis prior to permitting development in areas prone to geological or seismic hazards (i.e., groundshaking, landslides, liquefaction, critically expansive soils, avalanche).

- **Policy 8.A.4.** The County shall ensure that areas of slope instability are adequately investigated and that any development in these areas incorporates appropriate design provisions to prevent landsliding.

- **Policy 8.A.5.** In landslide hazard areas, the County shall prohibit avoidable alteration of land in a manner that could increase the hazard, including concentration of water through drainage, irrigation, or septic systems; removal of vegetative cover; and steepening of slopes and undercutting the bases of slopes.

- **Policy 8.A.6.** The County shall require the preparation of drainage plans for development in hillside areas that direct runoff and drainage away from unstable slopes.

- **Policy 8.A.9.** The County shall require that the location and/or design of any new buildings, facilities, or other development in areas subject to earthquake activity minimize exposure to danger from fault rupture or creep.

- **Policy 8.A.10.** The County shall require that new structures permitted in areas of high liquefaction potential be sited, designed, and constructed to minimize the dangers from damage due to earthquake-induced liquefaction.

- **Policy 8.A.11.** The County shall limit development in areas of steep or unstable slopes to minimize hazards caused by landslides or liquefaction.

WEIMAR-APPLEGATE-CLIPPER GAP GENERAL PLAN

The *Weimar-Applegate-Clipper Gap General Plan* contains the following goal and policy relevant to soils, geology, and seismicity in the project area.

- **GOAL:** To protect the lives and property of the citizens of the Weimar-Applegate-Clipper Gap area from unacceptable risk resulting from seismic and geologic hazards.

- **Policy 2.** Maintain strict enforcement of seismic safety standards for new construction contained in the Uniform Building Code.

FORESTHILL GENERAL PLAN

The *Foresthill General Plan* contains the following goal and policy relevant to soils, geology, and seismicity in the project area.

- **GOAL:** To protect the lives and property of the citizens of the Weimar-Applegate-Clipper Gap area from unacceptable risk resulting from seismic and geologic hazards.

- **Policy 2.** Maintain strict enforcement of seismic safety standards for new construction contained in the Uniform Building Code.

FORESTHILL DIVIDE COMMUNITY PLAN

The *Foresthill Divide Community Plan* (Community Plan), which is currently in draft form, covers the project area. The Community Plan contains the following goals and policies relevant to soils, geology, and seismicity in the project area.

- **GOAL 4.A.8:** Promote the conservation of soils as a valuable natural resource.
- **Policy 4.A.8-2.** The County shall require slope analysis maps during the environmental review process, or at the first available opportunity of project review, to judge future grading activity, building location impacts, and road construction impacts.
- **Policy 4.A.8-4.** Require the use of feasible and practical BMPs to minimize the effects of construction, logging, mining, recreation or other activities that could result in soil loss from dust generation and water runoff.
- **Policy 4.A.9-1.** The County shall require the preparation of a soils engineering and geologic-seismic analysis prior to permitting development in areas prone to geological or seismic hazards (i.e., ground shaking, landslides, liquefaction, critically expansive soils, avalanche).
- **Policy 4.A.9-2.** The County shall require submission of a preliminary soils report, prepared by a registered civil engineer and based upon adequate test borings, for every major subdivision and for each individual lot where critically expansive soils have been identified or are expected to exist.
- **Policy 4.A.9-4.** The County shall ensure that areas of slope instability are adequately investigated and that any development in these areas incorporates appropriate design provisions to prevent landsliding.
- **Policy 4.A.9-5.** In landslide hazard areas, the County shall prohibit avoidable alteration of land in a manner that could increase the hazard, including concentration of water through drainage, irrigation, or septic systems; removal of vegetative cover; and steepening of slopes and undercutting the bases of slopes.
- **Policy 4.A.9-6.** The County shall require the preparation of drainage plans for development in hillside areas that direct runoff and drainage away from unstable slopes.
- **Policy 4.A.9-11.** The County shall limit development in areas of steep (in excess of 30%) or unstable slopes, or slope breaks to minimize hazards caused by landslides, liquefaction, construction undercutting or vegetation loss.

11.3 IMPACTS

11.3.1 ANALYSIS METHODOLOGY

Evaluation of potential impacts on soils, geology, and seismicity was based on a review of documents pertaining to the project area, including the *Placer County General Plan*, *Placer County Trails Master Plan*, *Weimar-Applegate-Clipper Gap General Plan*, *Foresthill General Plan*, the Community Plan, the *Auburn State Recreation Area Interim Resource Management Plan*, and the geotechnical report prepared by Blackburn Consulting (2007); field review of the proposed trail alignment; review of geologic maps; and review of published and unpublished geologic literature. Impacts related to soils, geology, and seismicity that would result from implementation of the proposed project were identified by comparing existing data and environmental documents.

11.3.2 THRESHOLDS OF SIGNIFICANCE

CEQA THRESHOLDS

Based on the Placer County California Environmental Quality Act (CEQA) Checklist and the State CEQA Guidelines, the proposed project would result in a potentially significant impact on soils, geology, and seismicity if it would cause:

- unstable earth conditions or changes in geologic substructure;
- significant disruptions, displacements, compaction, or overcrowding of the soil;
- substantial change in topography or ground surface relief features;
- distruction, covering, or modifications of any unique geologic or physical feature;
- any significant increase in wind or water erosion of soils either on or off the site;
- changes in deposition or erosion or changes in siltation that may modify the channel of a river, stream, or lake; or
- exposure of people or property to geologic and geomorphological (i.e., avalanches) hazards such as earthquakes, landslides, mudslides, ground failure, or similar hazards.

ISSUES NOT ANALYZED FURTHER

The proposed project would have no impact associated with the following issues, and these issues will not be analyzed further in this chapter:

- **Fault Ground Rupture:** No known active faults cross the project area, and the project area is not located in an Alquist-Priolo Earthquake Fault Zone; therefore, fault ground rupture is unlikely.
- **Ground Failure/Liquefaction:** The project area is underlain by consolidated metavolcanic and metasedimentary rocks that are not susceptible to liquefaction. In addition, regional groundwater levels are expected to be greater than 50 feet in depth. Therefore, the potential for liquefaction is low.
- **Subsidence and Lateral Spreading:** Subsidence can result from tectonic deformations and seismically induced settlements; soil subsidence from consolidation, hydrocompaction, or rapid sedimentation; subsidence from oxidation or dewatering of organic-rich soils, and subsidence related to subsurface cavities. The potential for failure from lateral spreading is highest in areas where there is a high groundwater table, where there are relatively soft and recent alluvial deposits, and where creek banks are relatively high. The project area is underlain by consolidated metavolcanic and metasedimentary rocks that are not susceptible to liquefaction. In addition, as mentioned above, regional groundwater levels are expected to be greater than 50 feet in depth. Therefore, the risk of subsidence and lateral spreading is considered low.
- **Tsunami:** The potential for a tsunami in the project area is considered negligible because of the distance from the ocean, where tsunamis originate.
- **Seiche:** The potential for damaging seiches is considered very low to negligible because of the absence of a deep, large open body of water adjacent to or in the project area.
- **Expansive Soils:** The soils along the proposed trail alignment have a low to moderate shrink-swell potential and are therefore not considered too expansive.

- **Septic Systems:** The proposed project does not include and would not use septic tanks or alternative wastewater disposal systems.

- **Mineral Resources:** As mentioned at the beginning of this chapter, the proposed project would have no effect on mineral resources because it would not result in the loss of any known mineral resources and would not impede or interfere with mineral extraction operations, and because the project area is not delineated as a locally important recovery site.

11.3.3 IMPACT ANALYSIS

IMPACT 11-1	Construction-Related Erosion Hazards. *Based on soil types and topography, the excavation and grading of soil could result in erosion during project construction, particularly during periods of strong winds or storm events.*
Significance	*Potentially Significant*
Mitigation Proposed	*Mitigation Measure 11-1: Obtain Authorization for Construction and Operation Activities with the Central Valley RWQCB and Implement Erosion and Sediment Control Measures as Required*
Residual Significance	*Less Than Significant*

Soils in the project area are of Auburn–Sobrante–Rock outcrop complex, Boomer–Rock outcrop complex, Mariposa-Josephine complex, Mariposa–Rock outcrop complex, Maymen–Rock outcrop complex, and Sites–Rock outcrop complex. These soil types have been characterized as having moderate to very high erosion hazards. Moreover, the steep slopes along the proposed trail alignment would increase the potential for wind erosion during grading activities or water erosion during a storm event. Project construction activities would involve excavation and grading of soil. These activities could result in localized erosion during the construction period. Construction activities would remove any vegetative cover and could expose disturbed areas to wind and storm events. Therefore, this impact is considered potentially significant.

IMPACT 11-2	Risks to People from Naturally Occurring Asbestos. *Disturbance of naturally occurring asbestos fibers could create a health hazard. However, the project area is not located in an area that is likely to contain naturally occurring asbestos.*
Significance	*Less than Significant*
Mitigation Proposed	*None Warranted*
Residual Significance	*Less than Significant*

See Impact 9-3, "Exposure of Sensitive Receptors to Toxic Air Contaminant Emissions or Asbestos," in Chapter 9.0, "Air Quality," for further discussion.

IMPACT 11-3 **Risks to People and Structures Caused by Strong Seismic Ground Shaking.** *The foothills of the Sierra Nevada are characterized by extremely low seismicity. However, four notable earthquakes have been reported in the northern Sierra Nevada. In addition, the area does have the potential to be affected by shock waves resulting from earthquakes in western and eastern Placer County, and in more distant areas that display greater seismic activity. Ground shaking could cause structural damage to permanent improvements proposed as part of the project.*

Significance *Potentially Significant*

Mitigation Proposed *Mitigation Measure 11-2: Implement Recommended Measures to Reduce the Potential for Exposure to Seismic Hazards*

Residual Significance *Less Than Significant*

The proposed project involves the development of a multiple-use trail and bridge crossings. No structures for human occupancy would be placed across any fault trace identified by the California Geological Survey fault evaluation report, or within 50 feet of such a trace. Structures would be limited to small bridges over streams.

The foothills of the Sierra Nevada are characterized by extremely low seismicity. The intensity of ground shaking would depend on the magnitude of the earthquake, the distance from the epicenter, and the duration of shaking. The damage sustained and the degree of hazard depends on the seismic hazards of each specific site, the type of structure and its building materials, and construction quality. The Weimar Fault is mapped near the northeast portion of the project area. This fault is a Pre-Quaternary fault with no evidence of movement in the last 1.6 million years. Two other unnamed faults are mapped near the Weimar Fault and are also shown to be Pre-Quaternary in age. However, four notable earthquakes have been reported in the northern Sierra Nevada. In addition, the area does have the potential to be affected by shock waves resulting from earthquakes in western and eastern Placer County, as well as more distant areas that display greater seismic activity. The potential exists for earthquakes to occur in the vicinity of the project area in the future. Although the project area would not likely experience a fault rupture, ground shaking could cause structural damage to permanent improvements, such as bridge crossings, proposed as part of the project. Therefore, this impact is considered potentially significant.

IMPACT 11-4 **Risks to People and Structures Caused by Landsliding.** *Field review of the proposed trail alignment noted several areas of shallow slope instability and/or small landslide areas. Although landsliding does not appear to be a current problem for the project area, stable conditions may be changed by slope alterations from cuts or fills, and by changes to drainage patterns.*

Significance *Potentially Significant*

Mitigation Proposed *Mitigation Measure 11-2: Implement Recommended Measures to Reduce the Potential for Exposure to Seismic Hazards*

Residual Significance *Less Than Significant*

Geologic maps of the project area and vicinity show no deep-seated, large-scale landslides along the proposed trail alignment. Field review of the proposed trail alignment noted several areas of shallow slope instability and/or small landslide areas, which are described in detail in the geotechnical report performed for the proposed project by Blackburn Consulting (2006, 2007) (Appendix B). These features are 1–3 feet thick and are restricted to within the surface soils overlying the bedrock. Construction activities could affect these areas, and stable conditions may be changed by slope alterations from cuts or fills, and changes to drainage patterns. The largest landslide areas (Site H and I identified in the geotechnical report) would be avoided with the revised trail alignment as shown in Exhibit 3-2. Several of the areas of shallow slope instability and/or small landslide areas identified in the geotechnical report may require modified construction techniques or slight realignments of the proposed trail alignment. Seasonal slide debris in some areas of the trail may require construction of features such as gabion walls, rock walls, or mechanically stabilized earth walls to provide greater slope stability. This impact is considered potentially significant.

11.4 MITIGATION MEASURES

Mitigation Measure 11-1: Obtain Authorization for Construction and Operation Activities with the Central Valley RWQCB and Implement Erosion and Sediment Control Measures as Required.

Mitigation Measure 11-1 applies to Impact 11-1.

The County and/or the California Department of Parks and Recreation (State Parks) shall design a drainage system for erosion control that incorporates the use of BMPs. Erosion and stormwater control shall be designed and implemented in accordance with the latest edition of the erosion and sediment control guidelines for developing areas of the Sierra Nevada foothills and mountains (HSRCOD 1991). BMPs for erosion and siltation prevention, as described in Chapter 3.0, “Project Description,” of this document and developed in the trail plan, would be implemented along the trail. Because of the small size of the staging areas and the implementation of these design features, the proposed project is not anticipated to have significant effects on water quality.

The County shall comply with the terms and conditions set forth in the Section 401 water quality certification obtained from the Central Valley RWQCB. Because of alignment changes and new drainages affected since the issuance of the 401 certification, this permit will be resubmitted following the filing of the Notice of Determination and any new conditions attached to that permit will be incorporated into the project.

As required under the NPDES stormwater permit for general construction activities, the County shall prepare and submit the appropriate notices of intent and shall prepare any other necessary engineering plans and specifications for pollution prevention and control. The County will prepared a SWPPP that identifies and specifies the use of erosion and sediment control BMPs, means of waste disposal, implementation of approved local plans, nonstormwater management controls, permanent postconstruction BMPs, and inspection and maintenance responsibilities. The SWPPP shall also specify the pollutants that are likely to be used during construction that could be present in stormwater drainage and nonstormwater discharges. A sampling and monitoring program shall be included in the SWPPP that meets the requirements of SWRCB Order 99-08-DWQ to ensure that the BMPs are effective.

Construction techniques shall be identified that would reduce the potential for runoff, and the plan shall identify the erosion and sedimentation control measures to be implemented. The SWPPP shall also specify spill prevention and contingency measures, identify the types of materials used for equipment operation, and identify measures to prevent or clean up spills of hazardous materials used for equipment operation and hazardous waste. Emergency procedures for responding to spills shall also be identified. BMPs identified in the SWPPP shall be used in all subsequent site development activities. The SWPPP shall identify personnel training requirements and procedures that would be used to ensure that workers are aware of permit requirements and proper installation and performance inspection methods for BMPs specified in the SWPPP. The SWPPP shall also identify the appropriate personnel responsible for supervisory duties related to implementation of the SWPPP. All construction contractors shall retain a copy of the approved SWPPP on the construction site.

Mitigation Measure 11-2: Implement Recommended Measures to Reduce the Potential for Exposure to Seismic Hazards.

Mitigation Measure 11-2 applies to Impacts 11-3 and 11-4.

A geotechnical report for the proposed project has been prepared (Blackburn Consulting 2006, 2007) (Appendix C) that evaluates the potential for various geologic and seismic-related hazards. During project design and construction, all measures outlined in the geotechnical report for the proposed project (Blackburn Consulting 2006, 2007) (Appendix C) and, if necessary, supplemental site-specific geotechnical recommendations shall be implemented to ensure that the proposed trail alignment and bridge crossings are safe. It is the responsibility of the County to provide for engineering inspection and certification that earthwork has been performed in conformity with recommendations contained in the report.