4.5 GEOLOGY AND SOILS

4.5.1 INTRODUCTION

This section addresses the potential for the Proposed Project to impact the geology and soils in and around the Proposed Project location. Following an overview of the environmental setting in **Subsection 4.5.2** and the relevant regulatory setting in **Subsection 4.5.3**, project-related impacts and recommended mitigation measures are presented in **Subsection 4.5.4**.

4.5.2 ENVIRONMENTAL SETTING

Regional Setting

The project site is located in the Great Valley geometric province of California, which lies between the Coast Ranges and Sierra Nevada provinces. The Great Valley province is underlain by an alluvial plain approximately 50 miles wide and 400 miles long, which is drained by the Sacramento and San Joaquin rivers (USGS, 2003). This region is typically underlain by sedimentary and metasedimentary alluvium which was formed by erosion of the two mountain ranges during the Mesozoic and Cenozoic eras. Mesozoic rocks include marine Cretaceous sandstone and shale, as well as metamorphosed clastic and volcanic rocks of the Franciscan assemblage. The Cenozoic rocks consist of strata of continental and marine origin, and Pliocene-Pleistocene volcanic rocks (City of Vacaville, 1998).

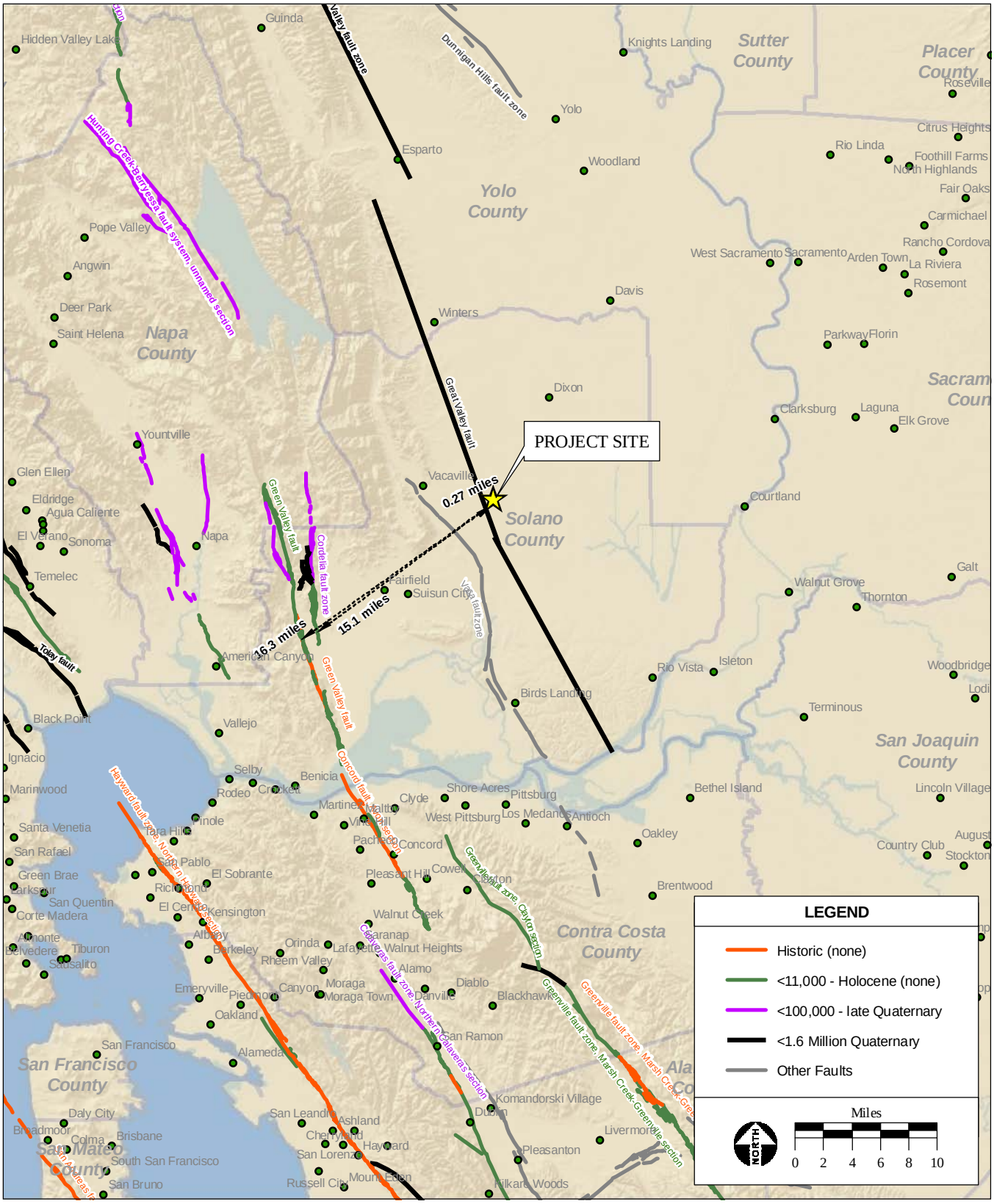
The western portion of Solano County is dominated by mountains and valleys while the southern and eastern portions are dominated by flat broad valleys, marshes, sloughs, and low-lying hills. These low lands are associated with the Sacramento River Alluvial Fan (Solano County, 2008).

Site Topography

The project site was originally graded in 1958 during the construction of the Easterly Wastewater Treatment Plant's (EWWTP) North Plant. Elevations at the project site range from 60 to 65 feet above mean sea level (msl) (City of Vacaville, 1998). The surrounding topography is characterized by similar terrain and elevation.

Regional Seismicity and Fault Zones

The Alquist-Priolo Act defines active faults as those that have shown seismic activity during the Holocene period, approximately the past 11,000 years, while potentially active faults are those that have shown activity within the Quaternary period, or the past 1.8 million years (CGS, 2003). According to the United States Geological Survey (USGS) Earthquake Hazards Program (2007), the nearest fault is the potentially active Great Valley Fault Zone, located approximately 0.27 miles west of the project site. The Cordelia fault zone and the Green Valley fault, respectively 15.1 and 16.3 miles southewest of the project site, are the closest active faults to the site (**Figure 4.5-1**).



SOURCE: USGS Earthquake Hazards Program, 2007; AES, 2009

Figure 4.5-1
Fault Map

Seismic Shaking Intensity

A common measure of earthquake intensity and effects due to ground shaking is the Modified Mercalli Intensity (MMI) Scale. The range of MMI values and a description of intensity factors are displayed in **Table 4.5-1**. The MMI values for intensity range from I to XII, with intensity descriptions ranging from an event not felt by most people (I) to nearly total damage (XII). Between these two extreme ranges, intensities that range from IV to XI have the potential to cause moderate to significant structural damage.

The Richter Scale is a measure of magnitude of an earthquake's seismic energy release, with higher numerical values for stronger earthquakes and the effects associated with each level. The relationship between an earthquake's magnitude (Richter) and intensity (MMI) is shown in **Table 4.5-2**.

According to the California Geological Survey (CGS), a probabilistic seismic hazard map is a map that shows the potential hazards of earthquakes, which geologists and seismologists agree could occur in California. These maps are probabilistic due to the inherent uncertainties of the size, location and the resulting ground motion effects to a particular area of California. The seismic hazard maps are expressed in terms of the probability of exceeding a certain ground motion (how many times the acceleration of gravity). For example, if a location has a ten-percent probability of exceedance in 50 years map, then there is an annual probability of 1 in 475 of being exceeded each year (CGS, 2008). Engineers use these probability measurements to design buildings to withstand large ground motions; more than what is believed to occur during a 50-year interval, and effectively make buildings safer (CGS, 2008).

Ground motion probabilities are dependent upon site specific soil conditions, which CGS Seismic Hazard Maps classified for three types of soils: firm rock, soft rock, and alluvium. According to the CGS Probabilistic Seismic Hazards Map, there is a 10 percent probability that the peak horizontal acceleration experienced at the site would exceed 0.482 gravity (g) from a seismic event in 50 years (CGS, 2008). The ground-shaking probabilities have associated average peak acceleration rates that correspond to MMI rating between VIII and IX (**Table 4.5-1**). Earthquakes of these intensity values could cause slight damage in specially designed buildings and considerable damage to buildings of ordinary design. If affected building structures are of a poor design or outdated, then the damage from such an earthquake could be substantial.

Liquefaction, Slope Instability and Surface Rupture Potential

Liquefaction is the sudden loss of soil strength caused by seismic forces acting on water-saturated, granular soil, leading to a "quicksand" condition generating various types of ground failure. Estimating the potential for liquefaction must account for soil types, soil density, and groundwater table depth, and the duration and intensity of ground-shaking. Liquefaction can occur during seismic events with a MMI intensity value of VII or higher. Soils comprised of sand and sandy loams that are in areas with high groundwater tables or high rainfall are subject to liquefaction. The project site is located in an area classified as having a moderate liquefaction potential (Solano County, 2008).

TABLE 4.5-1. MODIFIED MERCALLI INTENSITY SCALE

Intensity Value	Intensity Description	Average Peak Acceleration
I.	Not felt except by a very few persons under especially favorable circumstances.	< 0.0015*g*
II.	Felt only by a few persons at rest, especially on upper floors on buildings. Delicately suspended objects may swing.	< 0.0015*g*
III.	Felt quite noticeably indoors, especially on upper floors of buildings, but many persons do not recognize it as an earthquake. Standing cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.	< 0.0015*g*
IV.	During the day felt indoor by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably.	0.015*g*-0.02*g*
V.	Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.	0.03*g*-0.04*g*
VI.	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.	0.06*g*-0.07*g*
VII.	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving cars.	0.10*g*-0.15*g*
VIII.	Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, and walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving cars disturbed.	0.25*g*-0.30*g*
IX.	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.	0.50*g*-0.55*g*
X.	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.	> 0.60*g*
XI.	Few, if any, masonry structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.	> 0.60*g*
XII.	Damage total. Practically all works of construction are damaged greatly or destroyed. Waves seen on ground surface. Lines of sight and level are distorted. Objects are thrown upward into the air.	> 0.60*g*

Note: [a] *g* is gravity = 9.8 meters per second squared.
Source: Bolt, 1988.

TABLE 4.5-2. APPROXIMATE RELATIONSHIP BETWEEN EARTHQUAKE MAGNITUDE AND INTENSITY

Richter Scale Magnitude	Maximum Expected Intensity (MMI) Scale	Distance Felt (Approximate Miles)
3.0 – 3.9	I – III	15
4.0 – 4.9	IV – V	30
5.0 – 5.9	VI – VII	70
6.0 – 6.9	VII – VIII	125
7.0 – 7.9	IX - X	250
Source: California Office of Emergency Services, 2005		

Subsidence and Settlement

Seismic settlement is the compaction of soil materials caused by ground-shaking or the extraction of underground fluids (water, oil, gas). Settlement can be caused by liquefaction or densification of silts and loose sands as a result of seismic loading. Such settlement may range from a few inches to several feet, and be controlled in part by bedrock surfaces (which prevent settlement) and old lake, slough, swamp, or stream beds which settle readily. Static settlement can occur through increased loading of the surface or subsurface materials, such as that imposed by foundations for structures. Dewatering for excavation and foundation construction can cause settlement of drying subsurface materials if water formed part of the support for the surface soils.

Surface Fault Rupture

Surface ground rupture along faults is generally limited to a linear zone a few meters wide. Because no active faults have been mapped across the project site by the California Geological Survey or USGS, nor is the project site located within an Alquist-Priolo Earthquake Special Study Zone, fault ground rupture does not represent a hazard at the project site

Soil Resources

Soil Types

Soil types and their distribution in the project area, depicted in **Figure 4.5-2**, were identified through a review of maps provided by the Natural Resources Conservation Service (NRCS). With the exception of urbanized areas where soils typically consist of engineered fill, the NRCS soil characteristics describe native, undisturbed soils. Descriptions of the soil units mapped for the study area are provided below (NRCS, 2009).

SOURCE: West Yost Associates, 2009; DigitalGlobe aerial photograph, 6/2007; USDA NRCS Soils Data, 2001-2007; AES 2009

Figure 4.5-2
Soils Map

Capay silty clay loam, 0%-2% Slopes (Ca)

This is a deep, moderately well drained soil which generally occurs at elevations between 10 and 130 feet above sea level (asl). Included in this unit are small areas of Rincon, Yolo, and Brentwood soils. These soils comprise approximately 15 percent of the total acreage. The typical profile of this soil is 0-21 inches below surface level (bsl) of silty clay loam, 21-50 inches bsl of clay, and 50-80 inches bsl of clay loam. This soil is characterized as having a slight hazard of erosion, a high shrink-swell potential, and being moderately corrosive to concrete. The Ca soil unit has been assigned to hydrologic group D, which corresponds to having a slow infiltration rate when thoroughly wet. The NRCS farmland classification identifies this soil unit as being prime farmland if irrigated.

Capay Clay, 0%-2% Slopes (Cc)

This soil unit has very similar characteristics to Ca. Cc is also a moderately well drained soil associated with hydrologic group D which has a slight hazard of erosion, a high shrink-swell potential, is moderately corrosive to concrete, and is classified as prime farmland if irrigated. The Cc differs from Ca in its minor components and soil profile. Small areas of Clear lake components are included in the Cc soil unit. These soils comprise approximately 15 percent of the total acreage. Its typical profile includes 0-50 inches bsl of clay and 50-62 inches bsl of clay loam. This soil unit is listed on the National Hydric Soils list as a soil that is poorly drained and has a water table at less than or equal to 1.0 feet from the surface during the growing season.

San Ysidro sandy loam, 0% - 2% Slopes (SeA)

SeA is a moderately well drained soil which generally occurs at elevations between 30 and 100 feet asl. Included in this unit are small areas of Antioch and San Ysidro, thick surface soils. These soils comprise approximately 15 percent of the total acreage. The typical profile of this soil is 0-14 inches bsl of sandy loam, 14-28 inches bsl of clay loam, 28-54 inches bsl of sandy clay loam, and 54-68 inches bsl of stratified sandy loam to clay loam. Similar to the Cc and Ca soil units, SeA has a slight hazard of erosion, a high shrink-swell potential, is moderately corrosive to concrete, and is associated with hydrologic group D. However, this soil is not considered prime farmland under any condition.

Yolo loam, 0% - 2% Slopes (Yo)

This is a well drained soil which generally occurs at elevations between 20 and 150 feet asl. Included in this unit are Reiff, Brentwood, and Sycamore soil types. These soils comprise approximately 15 percent of the total acreage. The typical profile of this soil contains only loam to a depth of approximately 60 inches. Yo is characterized a having a slight hazard of erosion, a moderate shrink-swell potential, and a low risk of corroding concrete. This soil has been assigned to hydrologic group B, which corresponds to soils which have a moderate infiltration rate when thoroughly wet. The NRCS farmland classification identifies this soil unit as being prime farmland.

Yolo loam, clay substratum, 0% - 2% Slopes (Yr)

Yr has very similar characteristics to Yo. Yr is also a well drained soil which has a slight hazard of erosion, has a low risk of being corrosive to concrete, has a moderate shrink-swell potential, is associated with hydrologic group B, and is classified as prime farmland. The Yr differs from Yo in its minor

components and soil profile. Small areas of Reiff, Yolo, Sycamore, and Brentwood components are included in the Cc soil unit. These soils comprise approximately 15 percent of the total acreage. Its typical profile includes 0-45 inches of loam and 45-60 inches of clay.

Soil Erosion

Soil erosion is the removal and transportation of soil materials from the ground surface that results in deposition in a remote location. Common mechanisms of soil erosion include natural occurrences, such as wind and storm water runoff, as well as human activities that may include changes to drainage patterns and the removal of vegetation. Factors that influence the rate of soil erosion include the physical properties of the soil, topography and slopes, rainfall and peak rainfall intensity. Erosion and potential project-related impacts due to erosion are discussed in more detail within **Section 4.7** (Hydrology and Water Quality).

Mineral Resources

In compliance with the California Surface Mining and Reclamation Act (SMARA), the California Division of Mines and Geology (CDMG) has established the classification system shown in **Table 4.5-3** to denote both the location and significance of key extractive mineral resources.

TABLE 4.5-3. CALIFORNIA DIVISION OF MINES AND GEOLOGY MINERAL LAND CLASSIFICATION SYSTEM

Classification	Description
MRZ-1	Areas where adequate information indicates that no significant mineral deposits are present or where it is judged that little likelihood exists for their presence
MRZ-2	Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists
MRZ-3	Areas containing mineral deposits, the significance of which cannot be evaluated from existing data
MRZ-4	Areas where available data are inadequate for placement in any other mineral resource zone
Note: MRZ = Mineral Resource Zone Source: DOC, 2009a	

Under SMARA, the State Mining and Geology Board may designate certain mineral deposits as being regionally significant to satisfy future needs. The Board's decision to designate an area is based on a classification report prepared by CDMG and on input from agencies and the public. Known mineral resource zones in Solano County consist of an area located northeast of Vallejo, south and southeast of Green Valley, areas south and east of Travis Air Force Base, and pockets located within both Vacaville and Fairfield (Solano County, 2008). Two mines are located within five miles of the project site: 1) the Green Stone Quarry, approximately 4.52 miles southwest of the site, produces stone and 2) the Q Ranch Pit, approximately 3.87 miles northwest of the site, produces sand and gravel. No known mineral resources occur on the project site.

4.5.3 Regulatory Context

Federal

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, program goals, and objectives. NEHRP's mission includes improved understanding, characterization, and prediction of hazards and vulnerabilities; improvement of building codes and land use practices; risk reduction through post earthquake investigations and education; development and improvement of design and construction techniques; improvement of 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.

State

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was passed by the California Legislature to mitigate the hazard of surface faulting to structures. The act's main purpose 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 Fault Study Zone, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults.

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.

National Pollutant Discharge Elimination System Permit (NPDES)

The State Water Resources Control Board (State Water Board) administers regulations and permitting for the U.S. Environmental Protection Agency (55 CFR 47990) for pollution generated from stormwater under

the NPDES. There are nine Regional Water Quality Control Boards (RWQCBs) that implement the State Water Board's jurisdiction and require that an operator of any construction activities with ground disturbances of 1.0 acre or more obtain a General Permit through the NPDES Stormwater Program. The project site is within the jurisdiction of the Central Valley RWQCB (CVRWQCB). The General Permit requires that the implementations of Best Management Practices (BMPs) be employed to reduce sedimentation into surface waters and control erosion. The preparation of a Storm Water Pollution Protection Plan (SWPPP) addresses control of water pollution that includes the effects of sediments in the water during construction activities. These elements are further explained within **Section 4.7**, Hydrology and Water Quality.

California Building Standards Code

The State of California provides minimum standard for building design through the California Building Standards Code (CBC) (California Code of Regulations, Title 24). Where no other building codes apply, Chapter 29 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) used widely throughout the country (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.

California Surface Mining and Reclamation Act

SMARA was enacted by the California Legislature to regulate activities related to mineral resource extraction. The act requires the prevention of adverse environmental effects caused by mining, the reclamation of mined lands for alternative land uses, and the elimination of hazards to public health and safety from the effects of mining activities. At the same time, SMARA encourages both the conservation and the production of extractive mineral resources, requiring the State Geologist to identify and attach levels of significance to the state's varied extractive resource deposits. Under SMARA, the mining industry in California must plan adequately for the reclamation of mined sites for beneficial uses and provide financial assurances to guarantee that the approved reclamation will actually be implemented. The requirements of SMARA must be implemented by the local lead agency with permitting responsibility for the proposed mining project.

Local

City of Vacaville General Plan (1990)

The following General Plan guiding and implementation policies associated with geologic hazards are applicable to the Proposed Project.

Guiding Policies

9.1-G 1 Investigate and mitigate geologic and seismic hazards or locate development away from such hazards in order to preserve life and protect property.

Implementation Policies:

9.1-I 2 Analyze proposed development sites at the earliest stage of the detailed planning process to determine geologic suitability. The analysis should include the structural engineering for the actual site and possible impacts of the project on adjacent lands.

9.1-I 4 To the extent practicable, do not allow critical facilities, structures involving high occupancies, and public facilities to be sited in areas of high damage susceptibility. Where such location is deemed essential to the public welfare, these structures will be sited, designed and constructed with due consideration of the potential for earthquake damage due to ground shaking, associated ground deformation, seismically triggered flooding, liquefaction and landslide.

9.1-I 9 Require preparation of a soils report prior to issuing a building permit, except where the Building Official determines that a report is not needed.

9.1-I 10 Limit cut slopes to 2:1 (50 percent slope) except where an engineering geologist can establish that a steeper slope would perform satisfactorily over the long term. Where practicable, require more gentle slopes than the 2:1 standard. Encourage use of retaining walls, rock-filled crib walls, or stepped-in buildings as alternatives to high cut slopes.

9.1-I 11 Require contour rounding and revegetation to preserve natural qualities of sloping terrains and mitigate the artificial appearance of engineered slopes, and control erosion.

4.5.4 Impacts and Mitigation Measures

Method of Analysis

This section identifies any impacts to geology and soils that could occur from construction, operation, and/or maintenance of the Proposed Project. Impacts to and from geological resources were analyzed based on an examination of the project site, published information regarding geological hazards of the project area, field studies, and comparison of these factors to the significance criteria listed below. If significant impacts are likely to occur, mitigation measures are included to increase the compatibility and safety of the Proposed Project and to reduce impacts to less-than-significant levels. Impacts that were determined to be less than significant in the Initial Study do not warrant further analysis and are not discussed within this EIR.

Thresholds of Significance

Criteria for determining the significance of impacts to geology and soils have been developed based on Appendix G of the California Environmental Quality Act's (CEQA) *Guidelines*. Impacts to geology and soils would be considered significant if the Proposed 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 Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault;
  - Strong seismic ground shaking;
  - Seismic-related ground failure, including liquefaction;
  - Landslides.
- Result in substantial soil erosion or the loss of topsoil.
- Be located in a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- of off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.
- Be located on expansive soil.
- 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.
- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state.
- Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.

Effects Found Not to be Significant

The Initial Study (**Appendix B**) concluded that the Proposed Project would not expose people or structures to landslides or result in the loss of mineral resources. Additionally, the Proposed Project does propose the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater. These effects are therefore not considered within this EIR.

Project Specific Impacts and Mitigation Measures

Impact

4.5-1 Earth-moving activities associated with construction of the Proposed Project have the potential to result in accelerated runoff, erosion and sedimentation.

Construction of the Proposed Project would involve demolition, grading, clearing, and landscaping activities. Construction would result in the temporary disturbance of soil and would expose disturbed areas to potential storm events, which could generate accelerated runoff, localized erosion, and sedimentation. In addition, construction activities could expose soil to wind erosion effects that could adversely affect both on-site and nearby soils and the re-vegetation potential of the area. However, soils at the project site are characterized as having only slight erosion hazards. Upon completion of the project, structures, roadways, and landscaping or revegetated areas would eventually cover soils exposed during construction, and no long-term erodible soils would be created as a result of the Proposed Project.

Implementation of **Mitigation Measure 4.5-1** would require construction contractors to install erosion and sediment control measures. After implementation of these measures, potential impacts would be reduced to less than significant. **Less than Significant with Mitigation**.

> **Mitigation Measure 4.5-1**: Implement **Mitigation Measure 4.7-1a** (Hydrology and Water Quality) to identify and implement erosion control BMPs within the SWPPP prepared for construction activities. Implementation of these BMPs would ensure that temporary and short-term construction-related erosion impacts under the Proposed Project would be reduced to a less-than-significant level.

Impact

4.5-2 The Proposed Project has the potential to result in structural damage and injury from seismic activity and related geologic hazards.

The nearest mapped active fault to the project site is the Great Valley fault located approximately 0.27 miles to the southwest. Although potential damage to people or structures from seismic ground shaking could be a concern, compliance with the CBC would require the site's seismic-design response spectrum to be established and incorporated into the design of all new structures. Structures and utilities would be designed to withstand seismic forces per CBC requirements. These construction standards would minimize the seismic ground shaking effects on developed structures.

It is anticipated that a moderate amount of on-site soils may be used as engineered fill. If this fill material is determined to be unsuitable for use on-site, soils from other sources from construction sites in the project vicinity would be utilized, as described in **Section 3.4.3**. Fill materials would

be tested to ensure their stability for use on the project site, and placement of fill would be monitored to ensure compliance with all state and local requirements.

As mentioned in **Subsection 4.5.2**, the project site is not located within an Alquist-Priolo Fault Zone and is therefore not susceptible to surface rupture. However, the project site does have the potential for liquefaction. This is considered a potentially significant impact. A geologic suitability analysis would be completed to address the structural engineering for the actual site and possible impacts of the project on adjacent lands prior to construction. Therefore, the project design would reduce all potential impacts to a less than significant level. **Less than Significant**.

Impact

4.5-3 The Proposed Project has the potential for structural damage and injury from construction on expansive soils.

The project site contains Capay Clay soil series, Capay Silty Loam series, and San Ysidro sandy loam series which have high shrink-swell potential, and two Yolo Loam series which have moderate shrink-swell potential. The soils which have moderate shrink-swell potential are located on portion of the plant referred to as the North Plant, which would be demolished under the Proposed Project. The remainder of the project site is dominated by the soils which have a high shrink-swell potential. The majority of the project components would be constructed in areas of the South Plant that are already developed. New proposed structures would have the same design considerations, in regards to expansive soils, as the recently completed South Plant. The following mitigation measure would require the City to ensure that all structures within the Proposed Project are designed to withstand settlement impacts resulting from unstable soil conditions onsite. **Less than Significant with Mitigation**.

> **Mitigation Measures 4.5-3.** Prior to final design and construction, the City shall conduct a soil/geotechnical engineering study in the previously unconstructed portion of the project site to determine the extent of high shrink-swell soils. Recommendations from this study shall be incorporated into the final design and construction methods for the project according to accepted engineering practices.

Cumulative Impacts and Mitigation Measures

Impact

4.5-4 Development of the Proposed Project in combination with future projects in the City of Vacaville could result in cumulative effects associated with geology and soils.

Implementation of the Proposed Project and other potential cumulative projects in the region, including growth resulting from build-out of the City's General Plan and proposed development of the power plant adjacent to the project site, could result in increased erosion and soil hazards and could expose additional structures and people to seismic hazards. Potential soil and seismic hazards from cumulative development could represent a significant cumulative impact if projects

do not incorporate grading/erosion plans and are not developed to the latest building standards incorporating recommendations from site-specific geotechnical reports prepared for these projects. The City would implement mitigation measures specifically designed to avoid, reduce, or mitigate potential impacts associated with geology and soils. Therefore, after mitigation, cumulative impacts would be considered less than significant. **Less than Significant with Mitigation**.

Mitigation Measure 4.5-4. Implement **Mitigation Measures 4.5-1** and **4.5-3**.