

4.7 GEOLOGY, SOILS, AND SEISMICITY

4.7.1 INTRODUCTION

This section addresses potential effects related to onsite geologic and seismic conditions within the Amoruso Ranch Specific Plan (ARSP or Proposed Project) project site, as well as potential effects to the off-site improvement areas described in **Section 2.9** of this Environmental Impact Report (EIR). Project site characteristics such as topography, regional and local geology, and soil types are described.

Reference materials include, in part, the following:

- *City of Roseville General Plan 2025*, as amended June 2015 (City of Roseville, 2015a)
- *Creekview Specific Plan Final EIR*, April 2011 (City of Roseville, 2011a)
- *Amoruso Ranch Specific Plan Area Mass Grading Plan*, August 7, 2014 (Kimley-Horn, 2014)

These documents listed above are available for review during normal business hours (Monday through Friday 8 a.m. to 5 p.m.) at:

City of Roseville Permit Center
311 Vernon Street
Roseville, CA 95678

In response to the Notice of Preparation (NOP; **Appendix C**), the City did not receive any comments pertaining to geologic and seismic conditions. Refer to **Appendix C** of this EIR to view the comments received on the Proposed Project in response to the NOP.

4.7.2 ENVIRONMENTAL SETTING

Topography

Regional Setting

The 694.4-acre project site is located within western Placer County in the Sacramento Valley. The major topographic feature in the Sacramento valley is a volcanic remnant, the Sutter Buttes, rising approximately 1,980 feet above the surrounding valley floor. The Sutter Buttes are located approximately 42 miles north of the City of Roseville (City). Other significant features are the Sierra Nevada Mountain Range to the east, and the Coast Mountain Range to the west. The west side of the City, where the Proposed Project is located, is generally regarded as a transitional zone between the flat, open terrain of the Central Valley to the west and the foothills of the Sierra Nevada Mountains to the east. The region consists of rolling topography with gentle slopes, and the area typically drains from east to west.

Existing Site Conditions

The project site consists of relatively flat topography with areas of gently rolling terrain with elevations ranging from 75 to 100 feet above mean sea level. Minor drainages flow from a slight rise in the northeastern quadrant of the property. University Creek, an intermittent drainage and tributary to Pleasant Grove Creek, flows from east to west through the southwest portion of the project site. It enters

the site from the southeast, leaves the site along the southern boundary, then re-enters the project site in the southwestern corner.

Geology

Regional Setting

The project site is situated within the Great Valley geomorphic province of California, near the boundary of the Sierra Nevada province to the east (CGS, 2002). The Great Valley province is an alluvial basin approximately 50 miles wide and 400 miles long, which is drained by the Sacramento and San Joaquin rivers (CGS, 2002). This region is typically underlain by alluvium that was derived from the erosion of the two mountain ranges during the Mesozoic and Cenozoic eras. The geologic formations on the east side of the Sacramento Valley and in the vicinity of the project site consist of alluvial (water deposited) sediments derived from erosion of the Sierra Nevada.

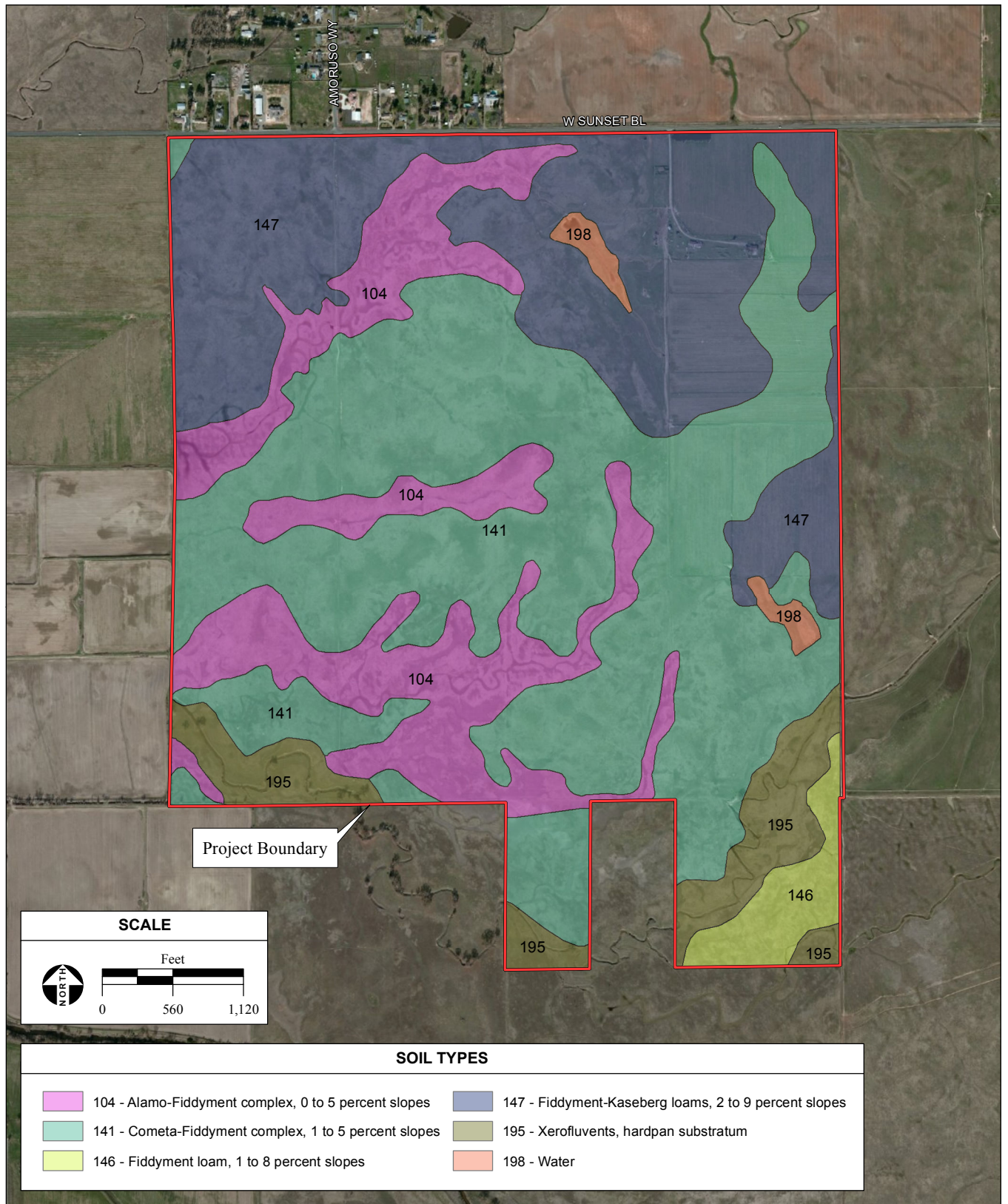
In the site vicinity, sediments composing the coalesced American River-Pleasant Grove Creek alluvial fan have been divided into four stratigraphic units, the Laguna Formation, the Turlock Lake Formation, the Riverbank Formation, and the Modesto Formation. Each of these stratigraphic units has yielded fossil remains at localities within the Central Valley (PaleoResource, 2014). Within the project site, the Riverbank formation has been found overlying the Turlock Lake formation. The Quaternary alluvium of the American River-Pleasant Grove alluvial fan assigned to the Riverbank and Modesto formations is lithologically indistinct from the underlying Turlock Lake and Laguna formations, but can be distinguished from them by stratigraphic position, degree of cementation and therefore topographic expression, amount of deformation, and age. The Laguna Formation is believed to be Pliocene to possibly early Pleistocene in age, while the age of the Turlock Lake Formation is early Pleistocene.

Existing Site Conditions

According to the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) soils maps, the project site contains five different soils (NRCS, 2015). **Figure 4.7-1** shows the location of the soils described below. The off-site improvement areas and Al Johnson Wildlife Area include soils consistent with the project site soils discussed below.

Alamo-Fiddymment Complex (No. 104)

This map unit consists of approximately 50 percent Alamo soil and 30 percent Fiddymment soil, with the remaining 20 percent composed of a mixture of San Joaquin sandy loam, Cometa sandy loam, and Kaseberg loam. The Alamo soil is poorly drained clay at a moderate depth over a hardpan. The Fiddymment soil is discussed below. The Alamo-Fiddymment complex is hydrologic soil group D, which is described as a soil with a very slow infiltration rate (high runoff potential) when thoroughly wet and a very slow rate of water transmission. The Alamo portion of the complex has a high shrink-swell potential, while the Fiddymment portion of the complex has a low to moderate shrink-swell potential. The complex has a slight risk of erosion hazard, a low risk of corrosion to concrete, and a high risk of corrosion to steel (NRCS, 2015).



SOURCE: NRCS Soils, 2006; Microsoft aerial photograph, 2/2/2012; AES, 2014

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Figure 4.7-1
Soil Types

Cometa-Fiddymment Complex (No. 141)

This map unit consists of approximately 35 percent Cometa soil and 35 percent Fiddymment soil with the remaining 30 percent composed of San Joaquin sandy loam, Kaseberg loam, Ramona sandy loam, and Alamo clay. The Cometa soil is a deep, well-drained claypan soil on low terraces and is formed as alluvium from predominantly granitic sources. The Fiddymment soil is discussed below. The Cometa-Fiddymment complex is also hydrologic soil group D, with a slight erosion hazard. The Cometa-Fiddymment complex ranges from low to high shrink-swell potential, has a moderate risk of corrosion of concrete, and has a moderate risk of corrosion to steel (NRCS, 2015).

Fiddymment loam (No. 146)

The Fiddymment soil is moderately deep silty and clayey loam over hardpan. The soils above the hardpan tend to be silts and clays to an approximate depth of 28 inches. The upper 12 inches of soil have a low shrink-swell potential, while the lower horizons (12 to 28 inches) have a high shrink-swell potential. This soil has a slight risk of erosion, a moderate risk of corrosion of concrete, and a low risk of corrosion to steel. This soil is in hydrologic soil group D (NRCS, 2015).

Fiddymment-Kaseberg loams (No. 147)

This map unit consists of approximately 50 percent Fiddymment soil and 30 percent Kaseberg soil. The Kaseberg soil is a well-drained soil that is shallow over hardpan. Fiddymment soil is discussed above. This soil has a moderate risk of corrosion of concrete and a low risk of corrosion to steel. The Fiddymment-Kaseberg loam is designated as hydrologic soil group C/D, which has a very slow to slow rate of infiltration with a layer that impedes downward water movement (NRCS, 2015). This soil has a slight risk of erosion, a moderate risk of erosion of concrete, and a low risk of corrosion to steel (NRCS, 2015).

Xerofluvents, hardpan substratum (No. 195)

This map unit consists of fairly poorly drained loamy alluvium in minor drainage ways and terraces. The Xerofluvents are located adjacent to the drainage that runs along the southern portion of the project site. This soil has a low risk of corrosion of concrete and a high risk of corrosion of steel. It is designated as hydrologic soil group C/D (NRCS, 2015). It has a low risk of erosion.

Geologic Constraints

Landslides and slope instability¹ are not known to occur in the vicinity of project site because of the flat topography and gently undulating terrain (City of Roseville, 2015a).

Subsidence

Subsidence is the sinking of the ground surface usually due to groundwater withdrawal or other subsurface collapse or extraction. The Roseville area is not known to have experienced significant subsidence or subsequent constraints to development due to subsidence (City of Roseville, 2015a).

¹ Slope instability refers to soil movement, such as landslides or soil creep, which may result in ground failure or affect the structural integrity of buildings and infrastructure.

Seismicity

Regional Faults

The project site is located between the seismically active Coast Range and the inactive Foothills fault zone in the Sierra Nevada. Regional faults in California include the Hayward fault zone (approximately 80 miles west), and the inactive Foothills fault zone that includes the Bear Mountains fault (approximately 19 miles east) and the Melones faults (approximately 33 miles east) (CGS, 2010a).

Local Faults

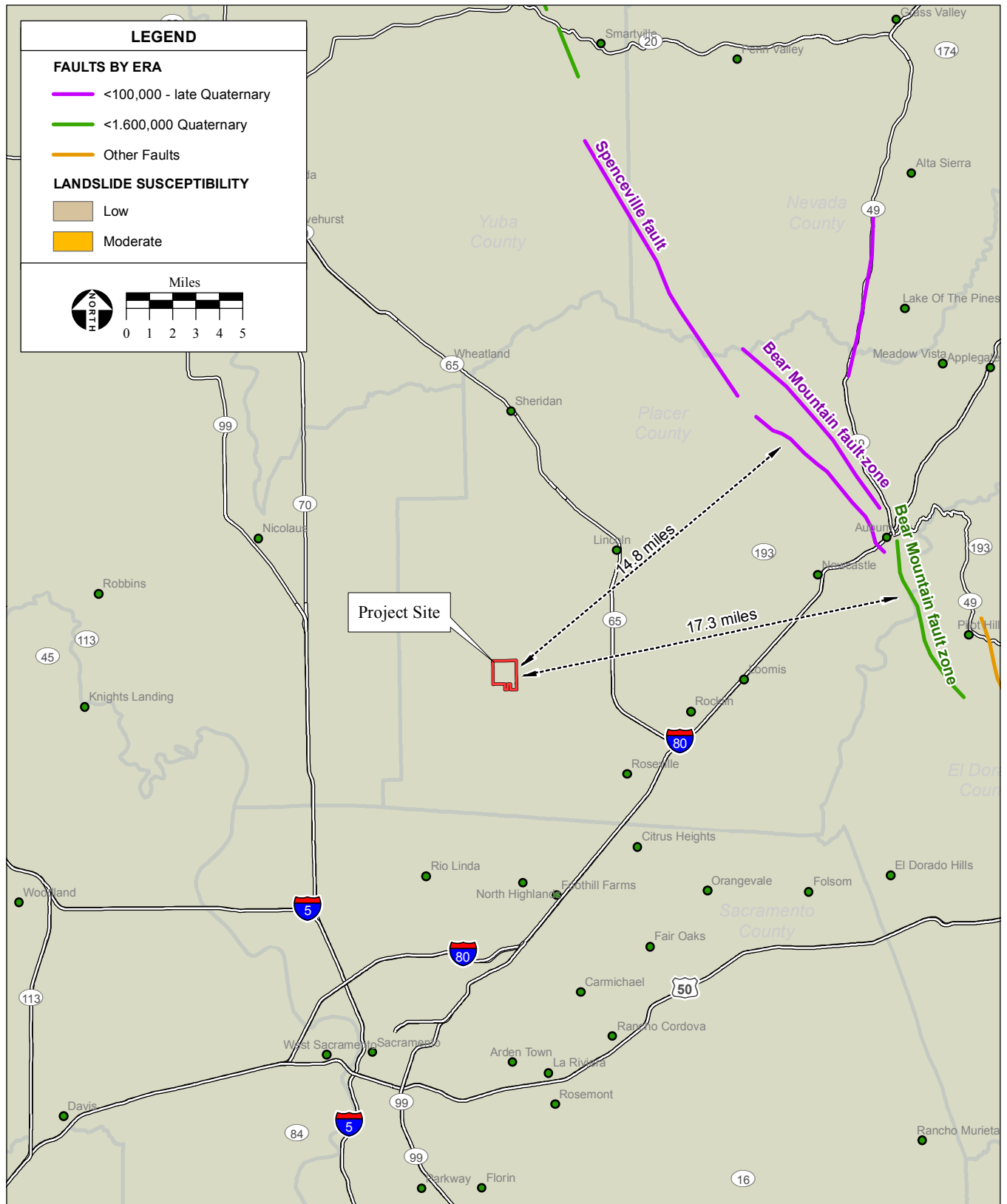
Although faults have been identified within the greater Sacramento area, no active faults are known to exist within Placer County. An active fault is a fault that shows displacement within the last 11,700 years (the Holocene epoch), and therefore, is considered more likely to generate a future earthquake than a fault that has not shown signs of recent activity. A fault that the California Geological Survey (CGS) determines to be sufficiently active and well-defined is zoned as an earthquake fault zone according to mandates of the Alquist-Priolo Earthquake Fault Zoning Act of 1972. These earthquake fault zone areas are located along active faults that are susceptible to the hazard of surface fault rupture. The project site is not located within an Alquist-Priolo Earthquake fault zone, and is not mapped as an area of having a risk of surface fault rupture (CGS, 2007).

There are no mapped active faults within Placer County; however, as shown on **Figure 4.7-2**, two inactive faults have been identified within 20 miles of the project site. These are the Spencerville fault system and the Bear Mountain fault zone. The Spencerville fault is located approximately 16 miles northeast of the project site, while the Bear Mountain fault zone is located in Auburn approximately 15 miles northeast of the project site.

Seismic Hazard Probability

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 4.7-1**. 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. Seismic hazard is the likelihood that an earthquake will exceed a threshold level of ground shaking or motion intensity within a 50-year period. For example, if a location has a ten percent probability of exceedance in 50 years, then there is an annual probability of 1 in 475 that an earthquake will exceed the threshold level of motion (DOC, 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 State of California Department of Conservation (DOC), there is a 2 percent probability that the peak horizontal acceleration experienced at the site would exceed 0.260 gravity (g) from a seismic event in 50 years, which means that the area has an earthquake hazard rating of between IV and V (refer to **Table 4.7-1**) (DOC, 2008).



SOURCE: USGS Earthquake Hazards Program, 2007; AES, 2014

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Figure 4.7-2
Regional Faults

TABLE 4.7-1
MODIFIED MERCALLI INTENSITY SCALE

Intensity Value	Intensity Description	Average Peak Acceleration
I.	Not felt except by a very few persons under especially favorable circumstances.	< 0.0015g
II.	Felt only by a few persons at rest, especially on upper floors on buildings. Delicately suspended objects may swing.	< 0.0015g
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.	< 0.0015g
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.	0.015g-0.02g
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.	0.03g-0.04g
VI.	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.	0.06g-0.07g
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.	0.10g-0.15g
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.	0.25g-0.30g
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.	0.50g-0.55g
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.	> 0.60g
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.	> 0.60g
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.	> 0.60g
Note: g = gravity = 9.8 meters per second per second. Source: Bolt, 1988.		

To estimate the probability of future earthquake events, United States Geological Survey (USGS) considered potential sources of an event on the fault systems in California using the 2008 USGS-National Seismic Hazard Mapping Project (NSHMP). Based on a combined probability of the fault systems and

background earthquakes of the region, there is a 25 percent chance of a magnitude 5.0 or larger earthquake occurring within 50 kilometers of the project site by the year 2064 (USGS, 2009).

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 4.7-2**.

TABLE 4.7-2
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: USGS, 2013a.		

Liquefaction

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. The City's geographic location, soil characteristics, and topography, combined, minimize the risk of liquefaction. According to the City's General Plan, “based on project-specific analysis and past experience, liquefaction has not been a significant problem within the City.” However, a site-specific geotechnical study would be needed to characterize liquefaction potential. The geo-technical study would be required as part of the building permit process and would be prepared prior to site development to ensure buildings, roadways, and utility infrastructure are appropriately designed.

Soil Characteristics

Soils in the project vicinity are generally characterized as alluvial deposits derived from erosion of the Sierra Nevada Mountain Range to the east that accumulate in the Great Valley basin. Soil limitations can include slow or very slow permeability, limited ability to support a load, high shrink-swell potential, and moderate depth to hardpan. Soil characteristics of relevance to the project site include the following:

- *Permeability:* The ability of a soil to transmit water or air. Permeability is considered in the design and construction of soil drainage systems, where the rate of water movement under saturated conditions affects the behavior of water movement through the soil.
- *Shrink-Swell Potential:* The potential for volume change in a soil due to a loss or gain in moisture. If the shrink-swell potential is rated moderate to high, damage to buildings, roads, and other structures can occur.

- *Runoff*: The volume of rainwater directly leaving an area in surface drainage, as opposed to the volume that seeps out as groundwater.
- *Erosion*: the susceptibility of a soil to water (rainfall) or wind transport.

As discussed above, all of the soils in the project site have a low erosion hazard as mapped by the NRCS. The Fiddymment, Cometa, and Kaseberg complexes are all well drained soils, while the Alamo portion of the Alamo-Fiddymment complex is poorly drained, and Xerofluvents are somewhat poorly drained. All of the soils are hydrologic group C or D, which corresponds to soils with slow infiltration rate, and therefore a higher rate of runoff. The two dominant soil units mapped in the project site are hydrologic group D (ENGEO, 2012).

Soil characteristics and engineering properties that could constrain development in the project site were identified by the NRCS, as described in **Table 4.7-3**. The table indicates the nature of the constraint (wetness or tendency to flood, high shrink-swell or expansion potential, etc.) and summarizes the level of constraint (slight, moderate, high, severe) for four types of construction activities expected to occur in the project site. These activities are excavation and support for structures with shallow foundations; excavation and foundation support for dwellings without basements and small commercial buildings; construction of local roads and streets; and the construction of grassed waterways.

Soil Constraints

Runoff and Drainage

All of the surface soils identified in the project site exhibit slow to very slow permeability. These soils transmit water very slowly and must be considered in the grading plan to avoid ponding and drainage issues.

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. As discussed above, all of the soils within the project site have a slight risk of erosion (NRCS, 2015). Only areas along drainages may have moderate erosion potential due to direct exposure to moving water.

Expansive Soils

Expansive soils are largely comprised of clays, which greatly increase in volume when water is absorbed and shrink when dried; this action is called “shrink-swell potential.” Expansive soils are of concern because building foundations may rise during the rainy season and fall during the dry season in response to the clay's action; this can cause structural distortion. The soils on the project site range from low to high shrink-swell capacity. The Alamo portion of the Alamo-Fiddymment complex has high shrink swell potential, and the Fiddymment soils found throughout the project site have a claypan layer approximately 12 to 28 inches deep that has a high shrink swell potential (NRCS, 2015).

TABLE 4.7-3
SITE SOIL CHARACTERISTICS

Soil Name and Map Symbol	Physical Properties	Shallow Excavations	Dwellings, Small Commercial Buildings	Local Roads and Streets	Grassed Waterways (protects against erosion)
Alamo-Fiddymment Complex (No. 104)	Very slow permeability, high shrink-swell potential, slow runoff, slight erosion hazard	Severe to moderate (wetness, shallow depth to rock, clayey, cemented pan)	Severe (wetness, shrink-swell)	Severe (wetness, shrink-swell, low strength)	Wetness, cemented pan, slow percolation, erodes easily, depth to rock
Cometa-Fiddymment Complex (No. 141)	Very slow permeability, low to high shrink-swell potential, slow runoff, slight erosion hazard	Moderate to severe (depth to rock, shrink-swell, clayey)	Severe (low strength, shrink-swell)	Severe (shrink-swell, low strength)	Slow percolation, erodes easily, depth to rock
Fiddymment loam (No. 146)	Very slow permeability, low to high shrink-swell potential, slow to medium runoff, slight to moderate erosion hazard	Moderate (depth to rock, clayey, cemented pan)	Severe (shrink-swell)	Severe (shrink-swell, low strength)	Erodes easily, depth to rock
Fiddymment-Kasberg loams (No. 147)	Very slow to moderate permeability, low to high shrink-swell potential, slow to medium runoff, slight to moderate erosion hazard	Moderate to severe (depth to rock, clayey, cemented pan)	Severe (shrink-swell, depth to rock)	Severe (shrink-swell, low strength, cemented pan, depth to rock)	Erodes easily, depth to rock
Xerofluvents, hardpan substratum (No. 195)	Moderate slow permeability, slight erosion potential, slow runoff, slight erosion hazard	Severe (floods, wetness)	Severe (floods, wetness)	Moderate (floods, wetness)	Cemented pan

Source: NRCS, 2015.

Corrosive Soils

The risk of soil corrosion refers to soil-induced electrochemical or chemical action that may corrode or weaken concrete or steel. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. According to the NRCS, Alamo-Fiddymment complex and Xerofluvents have a low risk of corrosion of concrete, while Cometa-Fiddymment complex, Fiddymment loam, and Fiddymment-Kaseberg loams have a moderate potential to corrode concrete. Fiddymment loam and Fiddymment-Kaseberg loams have a low risk

of corrosion of steel, while the Cometa-Fiddymment complex has a moderate potential to corrode steel. Both the Alamo-Fiddymment complex and Xerofluents have a high risk of corrosion of steel (NRCS, 2015).

Agricultural Soils

There are six farmland designations established by the DOC: Prime Farmland, Farmland of Statewide Importance, Unique Farmland, Farmland of Local Importance, Grazing Land, and Other. These classifications combine the actual farming use of the land with the technical soil ratings that determine a land area's suitability for farming. This section focuses on soil suitability; refer to **Section 4.1, Land Use and Agriculture**, for a discussion of the agricultural use of the land and impacts to designated farmland.

Soils which qualify as Prime Farmland are high quality and have sufficient moisture content to produce sustained yields. No soils within the project site are qualified for Prime Farmland, although the Xerofluents (which make up approximately 6.7 percent of the project site) qualify for Farmland of Statewide Importance. Soils qualifying as Farmland of Statewide Importance are similar to soils qualifying as Prime Farmland, but have minor shortcoming such as less ability to store soil moisture. Most of the soils in the project site are designated with land capability class III and IV, which correspond to soils that have severe to very severe limitations that restrict the crops that can be planted on them, and that require careful management or special conservation practices (NRCS, 2015). None of the land in the project site is actually designated as Farmland of Statewide Importance because although qualifying soils are present, the use of the land is not consistent with that farmland category. See **Section 4.1, Land Use and Agriculture**, for additional discussion of farmland in the project site.

Mineral Resources

CGS classifies the project site as MRZ-4, "areas of no known mineral occurrence where geologic information does not rule out either the presence or absence of significant mineral resources" (DOC, 1995). It is not designated as an area of gold, aggregate, clay, or granite production (DOC, 1995). Furthermore, there are no active or inactive mines within the project site as identified by the USGS Mineral Resources Data System (USGS, 2013b).

4.7.3 REGULATORY SETTING

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 in 1972 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.

Seismic Hazards Mapping Act

The California Seismic Hazards Mapping Act of 1990 (Public Resources Code [PRC] 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 (NPDES)

The State Water Resources Control Board (SWRCB) administers regulations and permitting for the United States. Environmental Protection Agency (EPA; 55 CFR 47990) for pollution generated from stormwater under the National Pollutant Discharge Elimination System (NPDES). There are nine Regional Water Quality Control Boards (RWQCBs) that implement the SWRCB's jurisdiction. The NPDES Stormwater Program requires that any construction or demolition activities, including but not limited to clearing, grading, grubbing, or excavation, that results in a ground disturbance of 1.0 acre is subject to the SWRCB's NPDES General Permit No. 2009-0009-DW, amended by 2010-0014-DWQ and 2012-0006-DWQ, for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Construction General Permit). The project site is within the jurisdiction of the Central Valley RWQCB (CVRWQCB). The Construction General Permit requires that the implementation of Best Management Practices (BMPs) be employed year-round to reduce sedimentation and discharge of pollutants into surface waters. Compliance with the Construction General Permit conditions requires the preparation of a Stormwater Pollution Prevention Plan (SWPPP) that addresses BMPs for control of erosion and sediment during construction activities. These elements are further explained within **Section 4.13, Hydrology and Water Quality**.

California Building Standards Code (CBC)

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 18 regulates soils and foundations. The CBC also applies to building design and construction in the state and is based on the federal International Building Code (IBC) 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.

Chapter 18 of the CBC regulates soils and foundations, and regulates the preparation of a preliminary soil report, geohazard report, and geotechnical reports. Chapter 18 also regulates analysis of expansive soils and the determination of the depth to groundwater table. There are varying seismic design categories that require analysis of slope instability, liquefaction, total and differential settlement, surface displacement due to faulting or seismically induced lateral spreading or lateral flow, and lateral earth pressures on retaining walls. It also requires addressing mitigation measures to consider in structural design, which may include ground stabilization, selection of appropriate foundation type and depths, selection of appropriate structural systems to accommodate anticipated displacements, or any combination of these measures. The potential for liquefaction and soil strength loss must be evaluated for site-specific peak ground acceleration, earthquake magnitude, and source characteristics consistent with the maximum considered earthquake ground motions. Peak ground acceleration must be determined as specified in CBC Chapter 18.

Finally, Appendix Chapter J of the 2013 CBC regulates grading activities, including drainage and erosion control and construction on unstable soils, such as expansive soils and areas subject to liquefaction.

City of Roseville

The City of Roseville Municipal Code adopted the 2013 CBC to ensure that buildings are designed and sited to protect against geologic hazards and unstable soil conditions.

Chapter 16.20 of the City's Municipal Code (Grading Ordinance) regulates stockpiling and grading through requirements for a grading permit for any grading activities that result in the movement of 50 cubic yards of material.

The Development Services Department, which includes the Building, Engineering – Land Development, Code Enforcement, and Planning divisions, maintains policies and guidelines relating to grading, erosion control, inspection, and permitting. These policies and guidelines, known as the City of Roseville Design and Construction Standards (adopted in March 2007, updated in January 2013, and amended in January 2014), require development of a grading plan to reduce potential impacts associated with the

development of structures on expansive soils, changes in topography and soil erosion due to grading, slope instability, and increased erosion along stream channels.

Design and Construction Standards

Section 111 of the City's Design and Construction Standards pertains to grading improvements on construction sites, and ensures that all grading is completed in accordance with the approved building plans, Design and Construction Standards, the CBC, the City of Roseville Grading Ordinance, the SWRCB Construction General Permit, the City of Roseville Stormwater Ordinance, and the latest edition of the California Department of Transportation (Caltrans) Standard Specifications.

Implementation of Section 111 of the City's Design and Construction Standards (adopted by Resolution March 2007) would ensure that exposure of people and structures to seismic hazards, development of structures on expansive soils, topographic changes and soil erosion due to grading, and slope instability and increased erosion along stream channels due to grading would be less than significant by requiring development of a Grading Plan to include a description of the site, an erosion and sedimentation control plan, and mitigation monitoring requirements. The City's authority for regulating grading is provided by Chapter 1 of the CBC. The City's Design and Construction Standards require that a grading permit be obtained from the City prior to beginning any grading work. This is necessary to ensure that the proposed grading is compatible with adjacent property topography and is constructed in a safe manner.

The City of Roseville requires the preparation of site specific geotechnical studies as part of the building permit process. Per Section 111-3 of the City's Design and Construction Standards, all grading improvements shall be installed in accordance with provisions in the CBC, recommendations of site specific geotechnical reports and geotechnical engineer. The technical information that must be compiled for these studies, which addresses both seismic hazards and soil conditions, is specified in the CBC. Implementation of the recommendations within the site specific geotechnical evaluation would ensure that impacts associated with exposure of people and structures to seismic hazards, development of structures on expansive soils, grading activities increasing slope instability and increased erosion along stream channel, and soil recommendations to address potential slope and foundation instability, stream bank protection and slope evaluation, expansive soils, and differential settlement reduce impacts to a less-than-significant level.

Section 111-3 Installation – This section requires construction sites to have required erosion and sediment control measures in place between October 1 and April 30 (the State Construction General Permit requires BMPs year-round). All projects adjacent to creeks, wetland, vernal pools, drainage ditches, and stormwater drain inlets shall have adequate sediment control measures in place prior to ground disturbance regardless of time of year. If construction is in progress, the Contractor shall ensure that the construction site is prepared prior to the onset of any storm.

Section 111-5 Soil Testing Procedures and Frequencies – This section requires that field density testing for earthwork and backfill will be performed by either the owner's Independent Testing Laboratory (ITL) or the City's Geotechnical Engineering Consultant, at the discretion of the City Engineer as follows:

- Private property: Building areas including 10 feet outside the exterior building lines shall be tested by the property owner's Geotechnical Engineer with proper written pad certifications submitted to City Building Official prior to foundation placement
- Public Right-of-Way: All grading operations, which involve revision to existing contours for the purpose of accepting right-of-way improvements, shall require written and stamped certification from a licensed California Geotechnical Engineer.
- Test method: In place nuclear density, ASTM D2922 to check conformance to requirements of Geotechnical Report, project plans, specifications and Section 71 of the standards. In addition to testing, the field technicians shall observe all backfill operations to ensure methods consistent with those that achieved minimum required compaction results are used throughout the backfill process. The field technician shall record these observations in their Daily Field Reports (DFRs).

Minimum report requirements include the following:

- DFRs: All testing and observation shall be recorded in a DFR. The DFR shall include all field density testing; test tables, and/or plans shall show the field recorded dry density, moisture content, reference laboratory compaction test used and any moisture offset used based on supplemental laboratory testing.

As stated in the CBC, a written construction permit shall be obtained from the enforcing agency prior to the erection, construction, reconstruction, installation, moving, or alteration of any building or structure.

4.7.4 IMPACTS

Method of Analysis

Potential impacts to geology and soils were analyzed through the review and evaluation of available documents. The impact analysis focuses primarily on geological impacts related to soil erosion, soil stability, and nearby seismic activity. The evaluation is based on review of project plans, including grading plans; federal, state, and local regulations and guidelines; and relevant specific and general plans. NRCS information about project site soils was reviewed to identify constraints present on the project site. Additionally, USGS fault maps were consulted to identify potential faults and seismic hazards from a regional perspective.

Thresholds of Significance

For purposes of this analysis, the following thresholds of significance, as derived from Appendix G of the California Environmental Quality Act (CEQA) Guidelines, have been used to determine whether implementation of the Proposed Project would result in significant geology, soils, and seismicity impacts.

Based on Appendix G of the State CEQA Guidelines, an impact is considered significant if implementation of the Proposed Project would do any of the following:

- Expose people or structures to substantial risk of loss, injury or death due to major geologic hazards, such as rupture of a known earthquake fault, seismic ground shaking, seismic-related ground failure including liquefaction, slope failure or landslides;
- Place structures on soils that are likely to collapse or subside, or be located on expansive soils that could damage foundations or structures creating substantial risks to life or property; or
- Result in substantial soil erosion or loss of topsoil.

Impacts due to septic systems were screened out of the analysis and will not be discussed further because wastewater generated by the Proposed Project will be directed to the Pleasant Grove Wastewater Treatment Plant (PGWWTP) for treatment. Refer to **Section 4.12.3, Public Utilities - Wastewater**, for a discussion of impacts to PGWWTP.

Impacts

IMPACT 4.7-1	SOIL EROSION FROM GRADING ACTIVITIES
Applicable Policies and Regulations	Roseville Design and Construction Standards Roseville Grading Ordinance 2013 California Building Standards Code National Pollutant Discharge Elimination System
Significance with Policies and Regulations	Less than Significant
Mitigation Measures	None Required
Significance After Mitigation	Less than Significant

Soil erosion is the result of naturally occurring physical and chemical forces that break down, remove, and transport 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. Erosion poses a hazard because it removes soils, which can undermine roads and buildings and produce unstable slopes, and it results in deposition of soil in reservoirs, lakes, drainages, and on roads.

Development within the project site would require grading and leveling the site to accommodate the residential, commercial, roads, and other uses as described in **Section 2.0, Project Description**. It is estimated that 481 acres² of the 694.4-acre project site would be graded to accommodate the new development proposed under the ARSP. Grading activities are necessary to prepare the project site for infrastructure and structures and would result in a general leveling of the gently rolling topography. No unique topographic features would be removed and the major drainage channel of University Creek would remain in open space. Although development of the Proposed Project would permanently alter the topography of the project site through site preparation (grading and trenching) and by construction of the

² Includes areas within the 694.4-acre project site proposed for development, not including the 48.9-acre Placer Parkway, 20-acre Urban Reserve parcel, and 144.2 acres of open space.

Proposed Project components, 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.

Construction activities, including grading, clearing, and landscaping, 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 during the time when soils remained exposed. 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, and a grading permit will be required prior to site development, which would identify how and where soil would be moved and stored onsite. Any grading or land clearing on the off-site improvement areas would also be subject to the grading permits described herein. The permit application and grading plan would be reviewed for compliance with construction standards designed to minimize erosion. Site-specific information from a geotechnical evaluation would be required to more fully identify and address other erosion hazards, if any. The City requires the grading permit and site-specific geotechnical study as a condition of project approval and issuance of building permits. Specifics of the grading plan could include, but not be limited to, sediment retention basins and energy dissipaters that would both reduce the power of erosion runoff entering stream channels, and retain the majority of suspended sediment.

As stated, a grading permit is required prior to site development, and all development must meet the requirements of Section 111-3 of the City's Construction Standards for field testing and the recommendations of the Geotechnical Studies and Geotechnical Engineers. In addition, site development would be required to comply with the SWRCB NPDES General Permit for Discharges of Storm Water Runoff Associated with Construction Activity (General Permit). The SWRCB requires that all construction sites have adequate control measures to reduce the discharge of sediment and other pollutants to streams to ensure compliance with Section 303 of the Clean Water Act (CWA). The developer would be required to comply with the policies and regulations of the City and State, which would reduce impacts due to soil erosion to **less-than-significant** levels.

IMPACT 4.7-2	DEVELOPMENT OF STRUCTURES ON EXPANSIVE SOILS OR ON SOILS WITH OTHER LIMITATIONS
Applicable Policies and Regulations	Roseville Design and Construction Standards Roseville Zoning Ordinance 2013 California Building Standards Code
Significance with Policies and Regulations	Less than Significant
Mitigation Measures	None Required
Significance After Mitigation	Less than Significant

The NRCS indicates that the soils on the project site range from low to high shrink-swell capacity. The physical forces resulting from the shrink-swell processes of soils can exert pressure on foundations and infrastructure lines which, in turn, could result in pipeline and foundation damage. Other soil constraints in the project site include low soil strength, slow permeability and wetness, and corrosivity to steel and concrete. Slow permeability can cause drainage problems.

Despite these characteristics, the soil conditions in the project site do not pose significant constraints to residential or commercial construction or infrastructure placement, as they are similar to the existing urban areas within the City and vicinity. Standard engineering practices and compliance with the CBC and City's Design and Construction Standards III-3 (Soil Testing and recommendations from geotechnical report) would ensure that the impacts are minimized. As indicated above, site-specific geotechnical evaluation must be submitted by project developers as part of the building permit process. The geotechnical evaluation routinely required by the City would identify locations where special construction and design methods would be needed and would include recommendations for alleviating constraints due to high shrink-swell, corrosion, or other potential soils constraints in both the project site and the off-site improvement areas. The developer would be required to comply with the recommendations set forth in the geotechnical evaluation, pursuant to the City's building permit process. Therefore, this impact would be **less than significant**.

IMPACT 4.7-3	LOSS OF TOPSOIL DUE TO CONVERSION OF AGRICULTURAL LAND TO URBAN USES
Applicable Policies and Regulations	None Available
Significance with Policies and Regulations	Less than Significant
Mitigation Measures	None Required
Significance After Mitigation	Less than Significant

Development of the Proposed Project would result in the conversion of approximately 694.4 acres of agricultural land that is used for grazing activities and some irrigated crops. As discussed above, no soils within the project site qualify as Prime Farmland, although the Xerofluvents located along the stream corridor qualify as Farmland of Statewide Importance. Most of the soils in the project site are designated with land capability class III and IV, which corresponds to soils that have severe to very severe limitations that restrict the crops that can be planted on them, and that require careful management or special conservation practices; these soils do not qualify for farmland classification (NRCS, 2015).

Areas along stream channels, which generally contain higher-quality topsoil, would remain in open space and would not be substantially disturbed by project development, so there would be no loss of high quality topsoil or soils which qualify for farmland designation. Please refer to Impacts 4.1-3 and 4.1-5 in **Section 4.1, Land Use and Agriculture**, for a discussion of loss of agricultural land. Therefore, this impact would be **less than significant**.

IMPACT 4.7-4	EXPOSURE OF PEOPLE AND STRUCTURES TO SEISMIC HAZARDS
Applicable Policies and Regulations	Roseville Design and Construction Standards 2013 California Building Standards Code
Significance with Policies and Regulations	Less than Significant
Mitigation Measures	None Required
Significance After Mitigation	Less than Significant

Placer County does not contain any known active faults, and according to the USGS, there is only a 25 percent chance of a magnitude 5.0 or larger earthquake occurring within 50 kilometers of the project site by the year 2064. As discussed above, this is a low seismic risk for the State of California, a very seismically active area. To reduce the risk of seismic-related safety hazards to acceptable levels, the current CBC creates design standards to mitigate for seismic risk in all areas of California. The City of Roseville standard conditions of approval require that at the time of tentative map approval, construction

4.7 Geology, Soils, and Seismicity

must be in accordance with the 2013 CBC and local building standards, as administered by the City's Building Department and Design and Construction Standards (III-3 Geotechnical Engineer recommendations). Therefore, compliance with these standard conditions will reduce the risk of seismic-related safety hazards and structural damage to pipelines, roads, residential homes etc, from ground shaking. Regular monitoring and enforcement of the CBC requirements regarding seismic and geologic safety by the City through the building permit and plan check processes will ensure that new development and construction meet all seismic and geologic safety standards, thereby protecting the public by reducing the risk of building damage or collapse. In addition, the City's Design and Construction Standards require grading permits, which require preparation of an erosion and sedimentation control plan and mitigation monitoring requirements, which further reduce the risk of exposure of people and structures to seismic hazards. Exposure of people and structures within the project site to seismic hazards is a **less-than significant** impact.

IMPACT 4.7-5	CUMULATIVE GEOLOGY AND SOILS IMPACTS
Applicable Policies and Regulations	Roseville Design and Construction Standards Roseville Zoning Ordinance 2013 California Building Standards Code
Significance with Policies and Regulations	Less than Significant
Mitigation Measures	None Required
Significance After Mitigation	Less than Significant

The context for evaluation of potential cumulative impacts on geology, soils, and seismicity is based on development in the region, including projected build out under the City of Roseville's adopted General Plan and approved or potential projects in the City, as well as additional foreseeable growth in west Placer County. However, the geologic analysis of cumulative impacts is generally site-specific, rather than cumulative in nature because each development site has unique geologic considerations that would be subject to site development, grading and construction standards.

Cumulative development in the Roseville area and western Placer County would increase the number of people living, working, and traveling through the region who would be exposed to seismic hazards or hazards associated with soil constraints (e.g., expansive soils). Although seismic risk in the City of Roseville is low, the potential effects from a large seismic event from regional faults could affect a large geographic area. That said, soil conditions that could affect development are site-specific, and the magnitude of these cumulative seismic and soils impacts would be reduced to less-than-significant levels with implementation of the CBC requirements that would be incorporated into project design and subject to review in conjunction with building permits. The Proposed Project's contribution to these cumulative impacts would not be considerable because all project structures would similarly comply with the CBC. A **less than significant** cumulative impact would result.

Cumulative development in the Roseville area would involve grading activities that would remove surface vegetation, alter topography, and potentially expose soils to greater erosion potential. The magnitude of this impact would be greatest during construction, particularly if development were to occur simultaneously with proposed developments immediately adjacent to the project boundaries, including the Placer Parkway regional transportation project, Placer Ranch area, and/or Creekview Specific Plan. However, implementation of Placer County and City of Roseville grading standards and use of NPDES Construction General Permit-mandated BMPs during construction would ensure the project's contribution would not be cumulatively considerable, and the cumulative impact is **less than significant**. Moreover, upon development of the project site and other projects where undeveloped land is converted to urban uses, exposed soil would be covered with impervious surfaces that would reduce erosion potential over the long term.

Cumulative development in the Roseville area, particularly in areas where soils which may qualify for a farmland designation would be converted to urban uses, would result in loss of topsoil. However, the Proposed Project's contribution to the loss of topsoil would not be cumulatively considerable because this area does not have the potential to produce significant amounts of erodible topsoil. As described previously in this EIR, the project site soils are predominately clay and hardpan which are not easily eroded, and none of the soils in the proposed development areas qualify for a farmland designation. The Proposed Project's impact would be **less than significant**.

With adherence to the City's Municipal Code and CBC requirements, no mitigation measures are required.

4.7.5 MITIGATION MEASURES

None Required.