4.6 GEOLOGY AND SOILS

The purpose of the Geology and Soils section is to evaluate whether the proposed project would expose people or structures to major geotechnical hazards or substantially contribute to erosion.

Analyses included in this section are derived, in part, from the *Water Supply Analysis for the Panorama Point Planned Development, Cottonwood, Shasta County, California (*Lawrence & Associates, 2008a). Given the relatively low sensitivity of the project site with respect to potential geologic and soil hazards, as well as existing standards adopted and enforced by Shasta County and other agencies, project implementation would not result in significant impacts with respect to geology and soils. No mitigation measures are necessary.

4.6.1 ENVIRONMENTAL SETTING

REGIONAL GEOLOGY

The geology of California is subdivided into 11 geomorphic provinces (California Department of Conservation, 2002). The project site is located in the Great Valley Province, also known as the Central Valley. The Great Valley Province is approximately 450 miles long, 50 miles in width, and reaches from just south of Redding to south of Bakersfield. The topography of the Great Valley Province is characterized by low rolling hills and flat bottom lands. A thick sequence of sedimentary rocks, ranging in age from Jurassic to recent, typifies the province.

The geologic units occurring in the site vicinity are, from youngest to oldest: recent stream deposits; the Pleistocene-age Red Bluff Formation; the Pliocene-age Tehama and Tuscan Formations; the Oligocene to late-Miocene-age Upper Princeton Gorge Formation; and the late-Jurassic to Cretaceous-age Great Valley Sequence or Chico Formation.

Recent stream deposits and dredger tailings are found in unnamed drainage channels and in the bed of Cottonwood Creek. These deposits consist of unconsolidated gravel and sand, which are typically underlain by silt and clay deposits.

The Red Bluff Formation typically consists of distinctly reddish, clayey gravel with some sand. The Red Bluff Formation caps the hills across the site and in the vicinity.

The Tehama Formation generally consists of interbedded clay, silt, sand, and gravel, or mixtures thereof, interpreted to be fluvial in origin. Gravels in the Tehama Formation sediments are composed mainly of greenstone, with lesser quantities of metamorphic rock fragments, chert, and occasional granitic rock fragments. These rock types are typically found in the Klamath Mountains and Coast Ranges to the west of the site, indicating that Tehama Formation sediments beneath the site are derived from these

areas. Most of the gravel clasts are rounded to sub-rounded, resembling present-day gravel in Cottonwood Creek.

Interfingering with the Tehama Formation is the Tuscan Formation. Sediment in the Tuscan Formation was derived from the volcanic terrains to the east of the Sacramento Valley, rather than the Coast Ranges. The Tuscan Formation consists of volcanic mudflows, ash beds, tuff breccias, and tuffaceous sandstones and conglomerates.

The Oligocene to late-Miocene-age Upper Princeton Gorge Formation consists of a mixture of marine sediment and non-marine sediment derived from erosion of the canyon walls. The fill is composed of sandstone, with interbeds of mudstone and occasional conglomeratic sandstone.

Underlying the Tertiary-age units in the western part of the basin is the Great Valley Sequence or Chico Formation. These units consist of well-consolidated to cemented, interbedded sandstone and shale.

LOCAL GEOLOGY

Likely geologic materials expected to be found at the Panorama Planned Development site are shown in Figure 4.6.1: Project Vicinity Geologic Materials. The uppermost 100 feet likely will consist mainly of interbedded clay/silt and sand/gravel beds, possibly becoming more gravelly towards the bottom of that interval. There will most likely be a clayey interval between about 100 and 120 feet below ground surface (bgs), with more interbedded clay and gravel below that. Below about 150 feet, there is likely to be a thick interval of mostly gravel to a depth of at least 300 feet bgs.

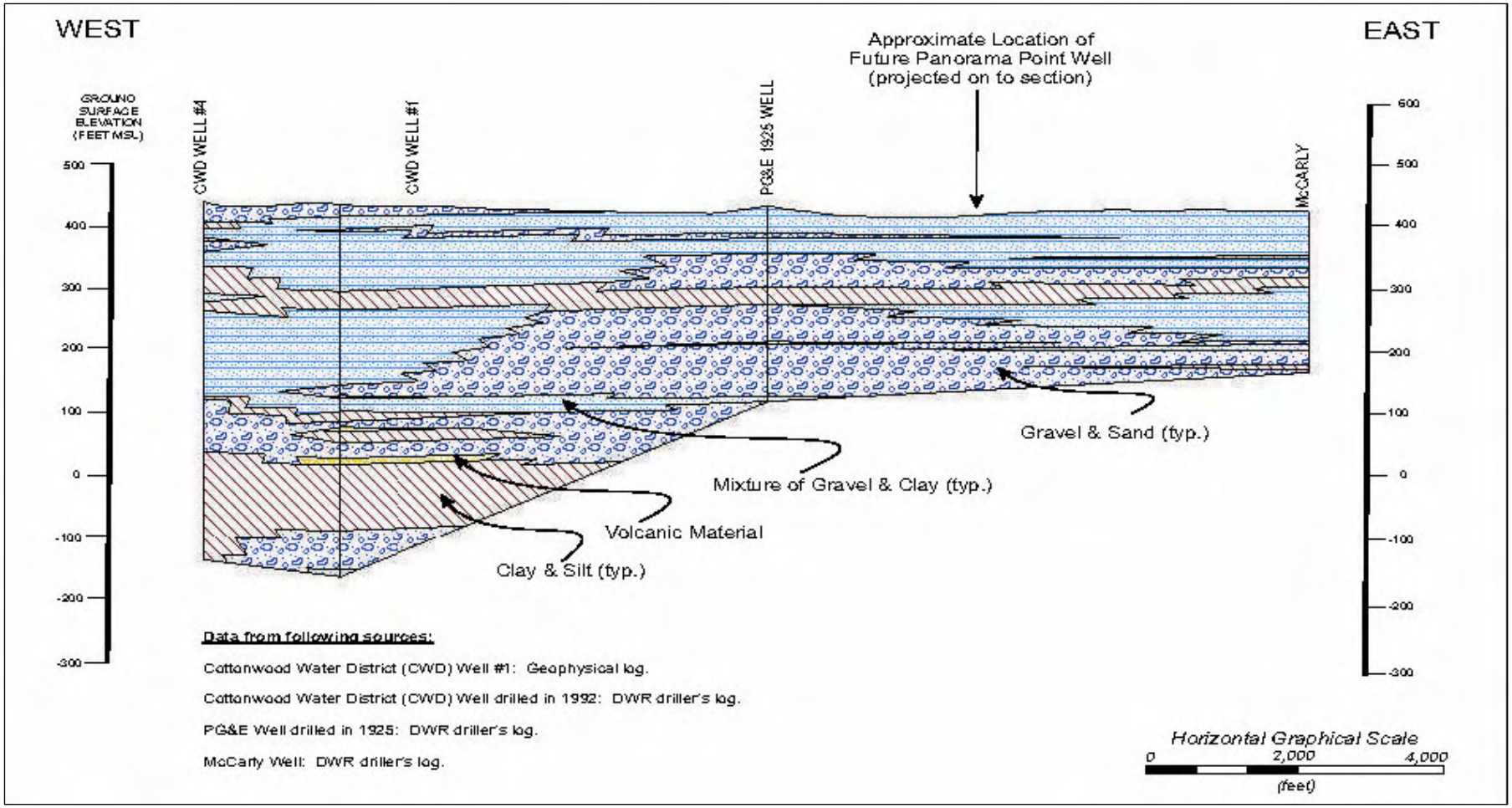

Figure 4.6.1
Project Vicinity Geologic Materials
(Source: Lawrence & Associates, 2008a)

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PROJECT SITE SOILS

Soils present within the project site are described in Table 4.6.1 and shown in Figure 4.6.2: Project Vicinity Soils.

Table 4.6.1
Soil Units Occurring within the Study Area Boundary

Soil Name	Soil Type	Permeability	Slope (%)	Erosion Potential	Runoff Rate
Anderson (Ad)	Gravelly sandy loam	Rapid	8-30	None-slight	Slow
Moda (MhA)	Loam, seeped	Slow	0-3	None-slight	Slow
Newtown (NeC)	Gravelly loam	Slow	8-15	Moderate	Medium
Newtown (NeD)	Gravelly loam	Slow	15-30	Moderate-high	Medium-rapid
Newtown (NeE2)	Gravelly loam, eroded	Slow	30-50	High	Rapid
Perkins (PmA)	Gravelly loam	Slow	0-3	None-slight	Slow
Perkins (PoB)	Gravelly loam, moderately deep	Slow	3-8	Slight-moderate	Slow-medium
Perkins (PnA)	Gravelly loam, seeped	Slow	0-3	None-slight	Slow
Perkins (PlA)	Loam	Slow	0-3	None-slight	Slow
Red Bluff (RcA)	Gravelly loam, moderately deep	Slow	0-3	None-slight	Slow
Red Bluff (RcB)	Gravelly loam, moderately deep	Slow	3-8	Slight-moderate	Slow-medium
Redding (RdA)	Gravelly loam	Slow	0-3	None-slight	Slow
Wet alluvial land (W)	--	Slow	--	Slight	Slow

Source: U.S. Department of Agriculture, Natural Resources Conservation Service, 2008.

REGULATORY SETTING

An overview of existing and proposed *Shasta County General Plan* land use classifications and *Shasta County Zoning Plan* designations for the project site is provided in Section 3.4: Panorama Planned Development Regulatory Setting. A discussion of geology and soils-related state and local regulations, as well as objectives and policies in the *Shasta County General Plan* that are pertinent to the geology and soils analysis for the project, are included below.

State Regulations

California Building Standards Code. The County has adopted the California Building Standards Code (1994) (based on the Uniform Building Code), which establishes building requirements for all new structures. Therefore, the California Building Standards Code regulates the construction of structures associated with the proposed project. The project is located in Seismic Zone 3, as defined by the California Building Standards Code, which is defined as an area subject to potential damage from earthquakes corresponding to intensity VII and higher on the Modified Mercalli Intensity

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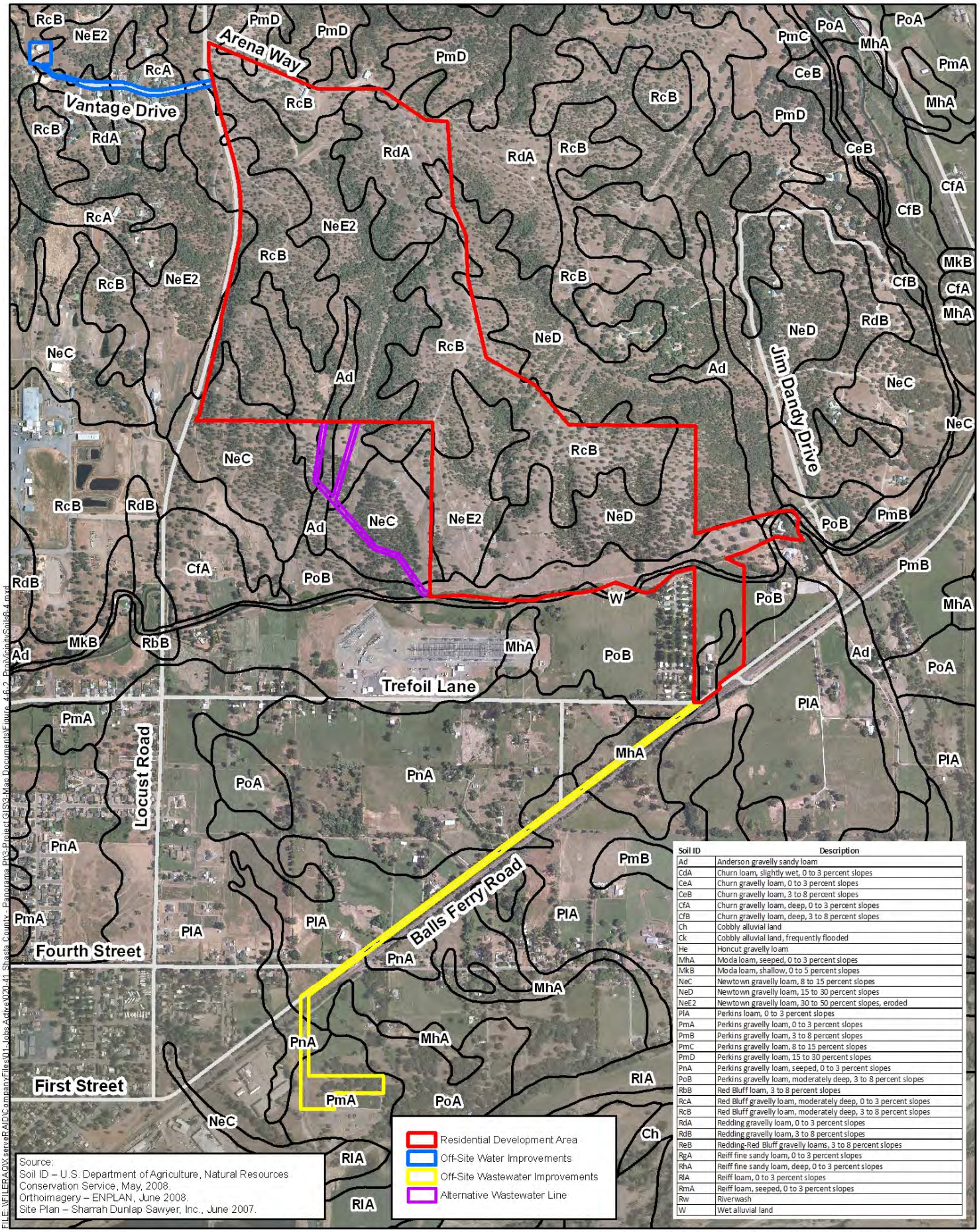

Soil ID	Description
Ad	Anderson gravelly sandy loam
CdA	Churn loam, slightly wet, 0 to 3 percent slopes
CeA	Churn gravelly loam, 0 to 3 percent slopes
CeB	Churn gravelly loam, 3 to 8 percent slopes
CfA	Churn gravelly loam, deep, 0 to 3 percent slopes
CfB	Churn gravelly loam, deep, 3 to 8 percent slopes
Ch	Cobbly alluvial land
Ck	Cobbly alluvial land, frequently flooded
He	Honcut gravelly loam
MhA	Moda loam, seeped, 0 to 3 percent slopes
MkB	Moda loam, shallow, 0 to 5 percent slopes
NeC	Newtown gravelly loam, 8 to 15 percent slopes
NeD	Newtown gravelly loam, 15 to 30 percent slopes
NeE2	Newtown gravelly loam, 30 to 50 percent slopes, eroded
PlA	Perkins loam, 0 to 3 percent slopes
PmA	Perkins gravelly loam, 0 to 3 percent slopes
PmB	Perkins gravelly loam, 3 to 8 percent slopes
PmC	Perkins gravelly loam, 8 to 15 percent slopes
PmD	Perkins gravelly loam, 15 to 30 percent slopes
PnA	Perkins gravelly loam, seeped, 0 to 3 percent slopes
PoB	Perkins gravelly loam, moderately deep, 3 to 8 percent slopes
RbB	Red Bluff loam, 3 to 8 percent slopes
RcA	Red Bluff gravelly loam, moderately deep, 0 to 3 percent slopes
RcB	Red Bluff gravelly loam, moderately deep, 3 to 8 percent slopes
RdA	Redding gravelly loam, 0 to 3 percent slopes
RdB	Redding gravelly loam, 3 to 8 percent slopes
ReB	Redding-Red Bluff gravelly loams, 3 to 8 percent slopes
RgA	Reiff fine sandy loam, 0 to 3 percent slopes
RhA	Reiff fine sandy loam, deep, 0 to 3 percent slopes
RlA	Reiff loam, 0 to 3 percent slopes
RmA	Reiff loam, seeped, 0 to 3 percent slopes
Rw	Riverwash
W	Wet alluvial land

Feature and boundary locations depicted are approximate only. 07.16.09

Figure 4.6.2
Project Vicinity Soils

ENPLAN

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Scale. Such areas are subject to strict building regulations designed to enhance the ability of a structure to withstand potential earthquakes.

General Permit for Storm Water Discharges Associated with Construction Activity: 99-08-DWQ. The State of California Water Resources Control Board (SWRCB) requires that dischargers whose projects disturb one or more acres of soil or whose projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Permit for Storm Water Discharges Associated with Construction Activity. The development of the project site will disturb over one acre of soil; therefore, the project applicant will be required to obtain coverage under the Construction General Permit. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP must identify Best Management Practices (BMPs) to be used by the discharger to protect storm water runoff, as well as the placement of those BMPs. Additionally, the SWPPP must contain a visual monitoring program and a chemical monitoring program for "non-visible" pollutants, to be implemented if there is a failure of BMPs.

The SWRCB has drafted a new General Construction Permit, which is currently under consideration for approval. The new permit will substantially change the development and implementation requirements of a SWPPP. The project applicant may be subject to the new requirements depending upon the timing of permit approval and when project development begins.

Local Regulations

Shasta County Grading Ordinance. The Shasta County Grading Ordinance, included in the *Shasta County Zoning Plan* (Shasta County, 2003) sets forth regulations concerning grading, excavating, and filling. The Shasta County Grading Ordinance prohibits any grading of more than 250 cubic yards or 10,000 square feet of disturbance area without a grading permit from the County. The grading permit must include an approved grading plan provided by the project applicant, and it must set forth terms and conditions of grading operations that conform to the County's grading standards. The permit also requires the project applicant to provide a permanent erosion control plan that must be implemented upon completion of the project. Ongoing maintenance of erosion control measures is required for the duration of the project and for three years after completion of the project, unless the project is released earlier by the enforcing officer designated by the County Board of Supervisors.

Shasta County General Plan. The following policies and objectives included in the *Shasta County General Plan* apply to the proposed project:

Objectives

SG-1 Protection of all development from seismic hazards by developing standards for the location of development relative to these hazards; and protection of essential or critical structures, such as schools, public meeting facilities,

emergency services, and high-rise and high-density structures, by developing standards appropriate for such protection.

SG-2 Protection of development on unstable slopes by developing standards for the location of development relative to these hazards.

SG-3 Protection of development from other geologic hazards, such as volcanoes, erosion, and expansive soils.

SG-4 Protection of waterways from adverse water quality impacts caused by development on highly erodible soils.

Policies

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

4.6.2 THRESHOLDS OF SIGNIFICANCE

Criteria for determining the significance of impacts related to geology and soils were based on the Environmental Checklist Form in Appendix G of the State CEQA Guidelines (Cal. Code Regs., Title 14, Section 15000 et seq.). An impact related to geology and soils was considered significant if it would:

- Expose people or structures to substantial adverse effects including the risk of loss, injury, or death involving:
  - Rupture of a known earthquake fault.
  - Strong seismic ground shaking.
  - Seismic-related ground failure, including liquefaction.
  - Landslides.
- Result in substantial soil erosion or loss of topsoil.
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landsliding, lateral spreading, subsidence, liquefaction, or collapse.
- Be located on an expansive soil, as defined in Table 18-1-B of the Uniform Building Code, creating substantial risks to life or property.
- Have soils incapable of adequately supporting the use of septic tanks or alternative disposal systems where sewers are not available for the disposal of wastewater.

4.6.3 ENVIRONMENTAL IMPACTS AND MITIGATION

Impact GEO-4.6-1 Seismic-Related Impacts *(Less-than-Significant Impact)*

RUPTURE OF A KNOWN EARTHQUAKE FAULT

Fault rupture can occur along fault systems during seismic events (earthquakes). If the rupture extends to the surface, movement on a fault is visible as a surface rupture. The occurrence of a fault rupture depends on several factors, including location of the epicenter in relation to the project site, and the characteristics of the earthquake, such as intensity and duration. The hazards associated with fault rupture generally occur in the immediate vicinity of the fault system. Cottonwood, and the Sacramento Valley in general, are not characterized by an abundance of active faulting. The site is not located within an Alquist-Priolo Earthquake Fault Zone (California Division of Mines and Geology, 1994 and 1997) designated by the State of California. Surface rupture is not considered a significant hazard in the project vicinity.

STRONG SEISMIC GROUND-SHAKING

Strong earthquakes generated along a fault system generally create ground shaking, which lessens with distance from the epicenter. In general, the area affected by ground shaking would depend on the characteristics of the earthquake and location of the epicenter. According to the *Shasta County General Plan*, Shasta County has a low level of historic seismic activity compared to other areas throughout California. Shasta County has adopted the *California Building Standards Code* (based on the *Uniform Building Code*), which establishes building requirements for all new structures based on predicted earthquake intensities. The project site is located in the *Uniform Building Code* Seismic Zone 3, described as an area of "moderate seismicity." Given the *Uniform Building Code* requirements, seismic ground-shaking is not considered to be a significant hazard.

SEISMIC-RELATED GROUND FAILURE, LIQUEFACTION, AND/OR LANDSLIDES

All of these processes involve a displacement of the ground surface due to loss of strength or failure of the underlying materials during earthquake shaking.

Seismically Induced Landslides. Landslides occur throughout Shasta County; however, landslides are more prevalent in the eastern and northern portions of Shasta County and are commonly related to the sedimentary and volcanic rocks in these vicinities. As discussed in the *Shasta County General Plan,* seismically induced land sliding is not considered a significant hazard in the project vicinity.

Liquefaction. Liquefaction potential is determined from a variety of factors, including: soil type, soil density, depth to the groundwater table, and the duration and intensity of ground mobilization as a result of increased pore water pressure induced by significant ground shaking. Structures or levees found on or above potentially liquefiable soils may experience settling and loss of foundation support.

Soils most susceptible are saturated, Holocene-age, and loose clean sand and silty sand. Liquefaction is most likely to occur in deposits of water-saturated alluvium, in stream channel deposits (especially where the groundwater table is high), and in areas of substantial artificial fill. Areas in Shasta County with the highest potential for liquefaction are located along the Sacramento River and its tributaries. The project site is not located near the Sacramento River or a tributary to the Sacramento River. Given the site conditions and *Uniform Building Code* requirements, liquefaction is not considered to be a significant hazard.

Lateral Spreading and Slope Stability. Lateral spreading can be described as liquefaction-induced lateral displacement on gently sloping grounds, with or without incised depressions. According to the *Shasta County General Plan*, the project site is not located in an area recognized by Shasta County to be prone to liquefaction (Shasta County, 2004). With application of *Uniform Building Code* standards, lateral spreading and slope stability are not considered to be significant hazards.

No mitigation measure is necessary for this less-than-significant impact.

Impact GEO-4.6-2 Substantial Soil Erosion or Loss of Topsoil *(Less-than-Significant Impact)*

Soil disturbance associated with grading, including the placement of fill, would increase the potential for soil erosion. The project applicant would be required to obtain a National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activities from the California Regional Water Quality Control Board (CRWQCB) prior to initiating construction. In accordance with this permit, the project applicant would be required to develop and implement a Storm Water Pollution Prevention Plan (SWPPP) identifying Best Management Practices (BMPs) to be utilized at the site. Further, as part of Shasta County's grading permit process, the project applicant would be required to adhere to established fill compaction requirements, slope grades, erosion control measures, etc. Following compliance with these standards and requirements, the potential for soil erosion associated with project implementation would be less than significant.

No mitigation measure is necessary for this less-than-significant impact.

Impact GEO-4.6-3 Unstable Geologic Unit or Soil *(Less-than-Significant Impact)*

The project site is not located in an area likely to be affected by liquefaction and/or lateral spreading, or in an area likely to contain highly expansive soils. Expansive soils are characterized by their ability to undergo significant volume change (shrink and swell) due to variation in soil moisture content. Changes in soil moisture could result from rainfall, landscape irrigation, utility leakage, roof drainage, and/or perched groundwater, and would trigger shrink/swell cycles in the soil. Potential impacts associated with shrink/swell cycles include unacceptable settlement or heave of structures, concrete slabs supported-on-grade, and pavements. Most of Shasta County is characterized by moderately expansive soils. These expansive soils generally contain clays that expand when moisture is absorbed into the crystal structure. This

results in a rise in the ground surface. Though expansive soils are not considered to pose a significant hazard within Shasta County, the effects of potentially expansive soils on structures can be reduced through proper engineering design and standard corrective measures (Shasta County, 2004). Construction in conformance with California Building Standards Code and Uniform Building Code Standards adopted by Shasta County will ensure that the potential for impacts related to soil expansivity are reduced to a level of less-than-significant.

No mitigation measure is necessary for this less-than-significant impact.

Impact GEO-4.6-4 Located on Expansive Soil *(Less-than-Significant Impact)*
See Impact-GEO-4.6-3 above.

No mitigation measure is necessary for this less-than-significant impact.

Impact GEO-4.6-5 Septic System Impacts *(No Impact)*
The proposed project would include connection to and expansion of Shasta County Service Area No. 17. As homes proposed for the Panorama Planned Development would be connected to the wastewater collection and treatment facilities maintained by Shasta County Service Area No. 17, no septic system impacts would be associated with the project.

There would be no impact with regard to septic systems.

4.6.4 LEVEL OF SIGNIFICANCE AFTER MITIGATION

Given existing project plans and standards, the project would not result in significant impacts with respect to geology and soils. No mitigation is required.

End of Section.