

### **3.3 GEOLOGY AND SOILS, AND MINERAL RESOURCES**

This section describes existing soils and geologic conditions of the Project Area and analyzes the potential impacts associated with the Project, with respect to the exposure of people and property to geologic hazards (including seismic hazards) and erosion. This section also describes the existing mineral resources in the Project Area and vicinity and analyzes the Project's potential impacts on those resources. This section is based on published information, including U.S. Department of Agriculture (USDA) data, Natural Resources Conservation Survey (NRCS) GIS Database files, maps and studies of fault zones and seismic risks in the Project vicinity, the Solano and Yolo County General Plans and associated Mineral Resource Zone maps.

Criteria for measuring a project's environmental impacts in this Program EIR (PEIR) are drawn from CEQA Guidelines Appendix G standards (OPR, 2013). The following Appendix G impact topics are not addressed in this PEIR because the Project has no potential to affect them:

- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property.
- 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.

#### **3.3.1 Setting**

##### **Environmental Setting**

###### *Regional Geologic Setting*

The Project is located in the northwestern portion of Great Valley Geomorphic Province. The California Coast Range rises to the west of the Project alignment, and consists of uplifted northwest-trending mountain ranges and valleys. The Coast Range generally consists of metamorphosed igneous and sedimentary rocks of the Franciscan Complex and the overlying unmetamorphosed sedimentary rocks.

Lower Putah Creek is situated on a broad alluvial fan that originates in the Coast Ranges to the west and extends to the deep alluviums of the valley floor at the Yolo Bypass. Stream and overbank silt and sand deposits are typical of the surface geology in this type of depositional environment. Rock outcrops are generally not present along the Lower Putah Creek stream channel. Limited exposures of a type of bedrock known as

the Pliocene age Tehama Formation are present in the area north of Putah Creek, just west of the town of Winters, but not in the stream channel (Helley and Barker, 1979, Sheet 4).

### *Local Geologic Setting*

#### Topography

The topography of the Project Area on a regional scale is generally flat lying and slopes down slightly to the east. Elevations range from 130 feet above mean sea level (msl) near the Putah Diversion Dam (PDD) at the west end of the Project Area, to 15 feet msl near Yolo Bypass at the eastern end of the Project Area.

#### Area Faults

Area faults include the Great Valley Fault 4 (Great Valley 4b, Gordon Valley), which is mapped as crossing the Project Area in the MacQuiddy (Lester) reach of the Project Area (County of Solano, 2008a, p. HS-23, Figure HS-3). The Great Valley Fault is considered a “blind thrust” fault, which displays no surface evidence of faulting (USGS, 2012a). The Great Valley Fault is capable of a maximum earthquake magnitude of 6.8 Mw (Moment Magnitude scale),<sup>1</sup> but is not currently considered an active fault (USGS, 2012b; USGS, 2012c; County of Solano, 2008b, p. 4.7-10).

The Solano County General Plan identifies the approximate location of the Midland Fault, branching off of the Great Valley Fault (County of Solano, 2008a, p. HS-23, Figure HS-3). This fault passes through the Project Area on the far downstream portion of the reach, near Interstate 505 (I-505) (County of Solano, 2008a, p. HS-23, Figure HS-3). This fault has no history of seismicity in the past 700,000 years and is not considered an active fault (County of Solano, 2008b, p. 4.7-10).

Other faults located in the vicinity of the Project include:

- Hunting Creek-Berryessa Fault located approximately 11 kilometers west of the western Project Area boundary (maximum magnitude = 7.1 Mw)

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<sup>1</sup> The **moment magnitude scale** (abbreviated as **MMS**; denoted as **M<sub>w</sub>** or **M**) is used by seismologists to measure the size of earthquakes in terms of the energy released. The scale was developed in the 1970s to succeed the 1930s-era Richter magnitude scale (ML). Even though the formulae are different, the new scale retains the familiar continuum of magnitude values defined by the older one.

- Green Valley Connected Fault located approximately 12 kilometers west of the western Project Area boundary (maximum magnitude = 6.8 Mw)
- Great Valley Fault 3 (Mysterious Ridge) located approximately 13 kilometers north of the northern Project Area boundary (maximum magnitude = 7.1 Mw)
- Great Valley Fault 5 (Pittsburg Kirby Hills) located approximately 15 kilometers south of the Project Area (maximum magnitude = 6.7 Mw)
- West Napa Fault located approximately 20 kilometers west of the western Project Area boundary (maximum magnitude = 6.7 Mw)

### Soil Types

According to the Soil Survey Geographic (SSURGO) database for Yolo and Solano Counties, California, obtained from USDA and NRCS, the predominant soil types in the Project Area are Riverwash (Rh- Yolo County, Rw- Solano County), Yolo loam (Yo), Yolo silt loam (Ya), Sycamore silt loam-flooded (Sr), and Sycamore silt loam-drained (Sp) (USDA, 2014). Project Area soil types are shown on the Soils Map, **Figures 3.3-1A through 3.3-1D**.

**Table 3.3-1** below summarizes characteristics of Project Area soil classes, including where they occur, their stability, ability to drain, ability to hold water, and relative tendency to erode. Descriptions of terms used in Table 3.3-1 follow after the table.

### Soil Erosion

As indicated in Table 3.3-1, below, Project Area soil erosion potentials range from negligible to very high. Erosion potential of the most common, predominant soil types in the Project Area ranges from *negligible* (Riverwash, typically present in the creek channel) to *low* (Yolo loam, Yolo silt loam, Sycamore silt loam-flooded, and Sycamore silt loam-drained, all typically present in the creek's alluvial fans). Though they are significantly less common overall in the Project Area, certain soil types that are found on the creek banks have a very high erosion potential: Corning gravelly loam, present on terraces with 2 to 15 percent slopes, and Altamont clay, present on terraces with 30 to 50 percent slopes (see Table 3.3-1). Erosion also is dependent upon slope angle or surface topography, wind or water velocity and vegetative cover.

The "K factor" represents the combination of detachability of the soil, runoff potential of the soil, and the transportability of the sediment eroded from the soil. The K factor is commonly used for estimating soil erosion potential, and therefore is relevant to

**Figure 3.3-1A Soils Map**

**Figure 3.3-1B Soils Map**

**Figure 3.3-1C Soils Map**

**Figure 3.3-1D Soils Map**

**Table 3.3-1 Lower Putah Creek Restoration Project Soils**

Soil Type	Land Forms <sup>a</sup>	Hydrologic Group <sup>a</sup>	Drainage Class <sup>a</sup>	Runoff/Soil Erosion from Water <sup>a</sup>	USCS <sup>a</sup>
Altamont clay, 30-50% slopes eroded (AcF2)	Terraces	D	Well- drained	Very High	CH, CL
Brentwood (silty) clay loam, 0-2% slopes (BrA)	Alluvial fans	B	Well- drained	Medium	CL, ML
Corning gravelly loam, 2-15% slopes, eroded (CtD2)	Terraces	D	Well- drained	Very High	SC-SM, SM, CH, CL, GC
Corning gravelly loam, 2-15% slopes, eroded (CvD2)	Terraces	D	Well- drained	Very High	SC-SM, GC-GM, SM, CH, CL, GC
Loamy alluvial land (Lm)	Flood plains	B	N/A	Very low	ML, SM, SP-SM
Reiff fine sandy loam (Ra)	Alluvial fans	B	Well- drained	Very low	CL-ML, ML, SM, SC-SM
Riverwash (Rh-Yolo County)	Stream channels	D	N/A	Negligible	SP, SP-SM, SW
Riverwash (Rw-Solano County)	Channels	D	N/A	Negligible	N/A
Sycamore silt loam, drained (Sp)	Alluvial fans	B	Somewhat poorly drained	Low	ML, CL, CL-ML
Sycamore silt loam, flooded (Sr)	Alluvial fans	C	Somewhat poorly drained	Low	ML, CL, CL-ML
Yolo silt loam (Ya)	Alluvial fans	B	Well- drained	Low	ML, CL, CL-ML
Yolo Loam (Yo)	Alluvial fans	B	Well- drained	Low	ML, CL, CL-ML

<sup>a</sup> See definitions below for additional explanation:

*Landforms* – Where the soil type is most likely found.

*Hydrologic soil groups* – are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The four hydrologic soil groups are:

- **Group A.** Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well-drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
- **Group B.** Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well-drained or well-drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
- **Group C.** Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
- **Group D.** Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils associated with a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

*Water Capacity* – The amount of plant-available water that a soil can provide.



*Drainage Class* – (natural) refers to the frequency and duration of wet periods under conditions similar to those under which a soil formed.

*Runoff* – The rate of runoff and potential for soil erosion from water.

*USCS* – The Unified Soil Classification System classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

Source: NRCS Soil Database, 2003. *Soil Survey of Yolo County/Soil Survey of Solano County*.

analyzing potential erosion impacts of the Project. The State and federal RUSLE K Factor Watershed Mapping program indicates that the soils present along the Lower Putah Creek Project Area have a K factor of 0.37, indicating a moderate to moderately high erosion potential due to the combination of erosive soils and steep banks along the creek (NRCS/SWRCB, 2015). Erosion as a result of sheet flow, water moving over the top of the soil, is minor along the creek, mainly due to the high surface area covered by plants.

### Geologic and Seismic Hazards

#### Project Area Faults

As stated above under “Area Faults,” the Great Valley Fault 4, located near County Road 87E, is the only mapped fault that crosses the Project Area.

#### California Fault Rupture Hazard Zones

The purpose of the Alquist-Priolo Geologic Hazards Zones Act (AP Act), as summarized in California Department of Mines and Geology (CDMG) Special Publication 42 (SP 42), is to “prohibit the location of most structures for human occupancy across the traces of active faults and to mitigate thereby the hazard of fault-rupture” (DOC, 2014, p. 1). No mapped earthquake fault rupture hazard zones are present in the Project Area.

#### Project Area Earthquake Shaking

The Project Area is located in an area with a high potential for generating moderate to intense ground shaking<sup>2</sup>. The application indicates that PGA values range from 0.708g near the west end of the Project Area to 0.287g near the east end.

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<sup>2</sup> Peak ground acceleration (PGA) for the Maximum Considered Earthquake (MCE) was obtained from the USGS Ground Motion Parameter Application, which is available at:  
<http://earthquake.usgs.gov/designmaps/us/application.php>.

### Slope Stability and Potential for Slope Failure

Slope stability is generally dependent upon slope steepness, strength and orientation of the underlying material, surface water and groundwater conditions, vegetative cover, rainfall amount, and seismic forces. With the exception of the stream channel banks, there are no steep slopes in the Project Area that could become unstable.

The Solano County General Plan identifies the Project Area as having slopes of less than 4 percent and does not include the Project Area as an area of slope hazard (County of Solano, 2008a, Figure HS-4). The Solano County General Plan also observes that creek banks in general may become unstable during seismic events, and it restricts development, particularly housing and workplaces, along stream banks for this reason (County of Solano, 2008, pp. HS-22 and HS-34). The General Plan does not discuss or identify slope stability risks for Putah Creek in particular.

The Yolo County General plan identifies multiple stream bank areas along Cache Creek that are unstable, but it concludes, “Elsewhere in the County however, landslides are generally not a significant hazard.” and does not identify Putah Creek stream banks as an area of particular risk (County of Yolo, 2009a, p. HS-8). The Yolo County General plan identifies multiple stream bank areas along Cache Creek that are susceptible to landslide, but it concludes that landslides are generally not a significant hazard in the rest of the county and does not identify Putah Creek stream banks as an area of landslide risk (County of Yolo, 2009a, p. HS-8).

### Liquefaction and Seismic Settlement

Liquefaction describes a condition in which a saturated, cohesionless soil loses shear strength during earthquake shocks. Historically, liquefaction of soils has caused severe damage to structures, berms, levees, and roads. Soils most susceptible to liquefaction are saturated, loose, clean, uniformly graded, and fine-grained sand deposits. If liquefaction occurs, foundations resting on or within the liquefiable layer may undergo settlements. This will result in reduction of foundation stiffness and capacities. Areas of liquefaction potential would include areas with recent granular deposits or low plasticity sandy silts with the depth to groundwater less than 50 feet.

Lateral spreading is a type of land failure that occurs on gentle slopes due to liquefaction of the laterally supporting soil. Stream bank failures could occur due to lateral spread during seismic events. The Solano County General Plan also notes that creek banks, which may be underlain by loosely consolidated soils, are susceptible to lurching, the horizontal movement of ground next to slope faces (County of Solano,

2008, p. HS-22). The Solano County General Plan and earthquake planning documents indicate that liquefaction potential in the Project Area is moderate (County of Solano, 2008, p. HS-29, Figure HS-6; County of Solano, 2012, p. 6). The Yolo County General Plan and emergency planning documents do not identify the level of liquefaction risk in the Project Area (County of Yolo, 2009a, p. HS-9, Figure HS-2; see also County of Yolo, 2012 and County of Yolo, 2013).

Zones of Required Evaluation, referred to as “Seismic Hazard Zones” in Article 10, Section 3722 of the California Code of Regulations, are areas shown on Seismic Hazard Zone Maps where site evaluations are required to determine the need for mitigation of potential liquefaction and/or earthquake-induced landslide ground displacements. No areas in the Project Area have been mapped as Seismic Hazard Zones on state maps, and the Solano and Yolo County General Plans do not identify any Seismic Hazard Zones in the Project Area (DOC, 2015c; County of Solano, 2008; County of Yolo, 2009a).

#### *Mineral Resources Project Area Conditions*

##### Aggregate (Gravel) Mineral Resources

Under State law, the California Department of Conservation (DOC) maps mineral resources in the state. DOC reports and maps identify Mineral Resource Zone (MRZ) classifications. Classifications are based on the relative economic and resource value of the mineral resources in an area. There are four Mineral Resource Zone classifications: MRZ-1, a lower value designation for areas where geologic information indicates no significant mineral deposits exist; MRZ-2, areas containing identified mineral resources; MRZ-3, areas of undetermined mineral resource significance that cannot be evaluated from available data; and MRZ-4, areas of unknown mineral resource potential (DOC, 2000, p. 3).

The DOC has mapped one MRZ near the Project Area and another in the Project Area (DOC, 1988, Plates 18 to 20). The MRZ in the Project Area, located in and north of the Nishikawa and the western half of the Olmo-Hammond-UCD reaches, is classified as MRZ-1 (no significant mineral deposits) (DOC, 1988, Plate 18). An MRZ-3 zone (area of undetermined mineral resource significance) is located east of the City of Davis, approximately 0.25 miles north of the Project Area, north of the eastern half of the Olmo-Hammond-UCD reach and the western end of the I-80 to Old Davis Road reach (DOC, 1988, Plate 18).

The Lower Putah Creek floodplain was the site of historic aggregate (sand and gravel) mining operations (County of Yolo, 2005, p. 6-18; Bradley, 1915, p. 198). The Solano County General Plan Mineral Resources Map identifies one former sand and gravel mine location along Putah Creek, within the Project Area near the City of Winters, but does not identify this area or any others in the Putah Creek vicinity as Mineral Resource Zones (County of Solano, 2008a, p. RS-33, Figure RS-4). No aggregate mining is currently occurring in Putah Creek.

#### Petroleum and Natural Gas Resources

Lower Putah Creek, including portions of the Project Area, is located over the Winters Gas and Putah Sink Gas fields and the abandoned Dixon Gas and Davis Southeast Gas fields (DOC, 1999, Quads 8N 1E and 8N 3E). These natural gas fields are also identified in the Yolo County General Plan (County of Yolo, 2009a, pp. CO-44, CO-46, Figure CO-5). The Solano County General Plan does not identify any petroleum or natural gas resources in the Project Area (County of Solano, 2008a, pp. RS-51 to RS-52).

#### **Existing Conditions in Individual Project Reaches**

Specific information on the geological conditions, soil types, and mineral resources along each Project reach are described below. The underlying geology in each reach is the source of the soils, and in turn the physical characteristics of the soils define their properties, mineral resource value, and relative susceptibility to erosion, stability, liquefaction, and other factors relevant to analysis of potential Project impacts.

#### *NAWCA/Mariani*

#### Geology and Surface Soil Conditions

Like the rest of the Project Area, topography in this reach is generally flat except for the incised channel. No faults pass through this reach. Similar to the rest of the Project Area, this reach is located in an area of moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Solano and Yolo County General Plans do not identify this reach, including stream banks, as an area of slope or landslide hazard, but the Solano County General Plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22; County of Yolo, 2009a, pp. HS-8 to HS-9).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Riverwash (Rw), Reiff fine sandy loam (Ra), Brentwood clay loam, 0 to 2 percent slopes (BrA), Corning gravelly loam, 2 to 15 percent slopes,

eroded (CvD2), Altamont clay, 30 to 50 percent slopes eroded (AcF2), Riverwash (Rh), Reiff very fine sandy loam (Ra), Corning gravelly loam, 2 to 15 percent slopes, eroded (CtD2), Yolo silt loam (Ya), Reiff very fine sandy loam (Ra), Water (W).

#### Mineral Resources

The DOC has not identified any MRZs in this reach (DOC 2015a; DOC, 1988, Plates 18 to 20). The Solano and Yolo County General Plans do not identify any mineral resources within this reach. The DOC maps and the Solano and Yolo County General Plans do not identify any natural gas fields within this reach (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5).

#### *Duncan-Giovannoni*

#### Geology and Surface Soil Conditions

Topography in this reach is generally flat except for the incised channel. No faults pass through this reach. This reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Solano and Yolo County General Plans do not identify this reach, including stream banks, as an area of slope or landslide hazard, but the Solano County General Plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22; County of Yolo, 2009a, pp. HS-8 to HS-9).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Yolo loam (Yo), Riverwash (Rw), Riverwash (Rh), Yolo Silt loam (Ya), Corning gravelly loam, 2 to 15 percent slopes, eroded (CtD2), Brentwood silty clay loam, 0 to 2 percent slopes (BrA), Water (W).

#### Mineral Resources

The DOC has not identified any MRZs in this reach (DOC 2015a; DOC, 1988, Plates 18 to 20). The Solano and Yolo County General Plans do not identify any mineral resources within this reach. The DOC maps and the Solano and Yolo County General Plans do not identify any natural gas fields within this reach (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5).

### *Winters Putah Creek Nature Park*

#### Geology and Surface Soil Conditions

Topography in this reach is generally flat except for the incised channel. According to the Solano County General Plan, the Midland Fault passes through the Project Area on the far downstream portion of the reach, near I-505 (County of Solano, 2008a, p. HS-23, Figure HS-3). This fault has no history of seismicity in the past 700,000 years and is not considered an active fault (County of Solano, 2008b, p. 4.7-10). This reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Solano and Yolo County General Plans do not identify this reach, including stream banks, as an area of slope or landslide hazard, but the Solano County General Plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22; County of Yolo, 2009a, pp. HS-8 to HS-9).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Riverwash (Rw), Brentwood silty clay loam, 0 to 2 percent slopes (BrA), Riverwash (Rh), Yolo silt loam (Ya), Yolo Loam (Yo), Water (W).

#### Mineral Resources

This reach contains a former sand and gravel mine but the DOC has not identified any MRZs in this reach (DOC, 2015a; DOC, 1988, Plates 18 to 20). The Solano County General Plan Mineral Resources Map identifies a former sand and gravel mine location within this reach (County of Solano, 2008a, p. RS-33, Figure RS-4 Mineral Resources). The DOC maps and the Solano and Yolo County General Plans do not identify any natural gas fields within this reach (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5).

### *East of 505*

#### Geology and Surface Soil Conditions

Topography in this reach is generally flat except for the incised channel. No faults pass through this reach. Similar to the rest of the Project Area, this reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Solano and Yolo County General Plans do not identify this reach, including stream banks, as an area of slope or landslide hazard, but the Solano County General Plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely

consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22; County of Yolo, 2009a, pp. HS-8 to HS-9). Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Yolo loam (Yo), Yolo silt loam (Ya), Brentwood silty clay loam, 0 to 2 percent slopes (BrA), Riverwash (Rh), and Water (W).

#### Mineral Resources

The DOC has not identified any MRZs in this reach (DOC, 2015a; DOC, 1988, Plates 18 to 20). The Solano and Yolo County General Plans do not identify any mineral resources within this reach. The DOC maps and the Solano and Yolo County General Plans do not identify any natural gas fields within this reach (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5).

#### *Warren*

#### Geology and Surface Soil Conditions

Topography in this reach is generally flat lying except for the incised channel. No faults pass through this reach. This reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Solano and Yolo County General Plans do not identify this reach, including stream banks, as an area of slope or landslide hazard, but the Solano County General Plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22; County of Yolo, 2009a, pp. HS-8 to HS-9).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Yolo loam (Yo), Yolo silt loam (Ya), Riverwash (Rh), and Water (W).

#### Mineral Resources

The DOC has not identified any MRZs in this reach (DOC, 2015a; DOC, 1988, Plates 18 to 20). The Solano and Yolo County General Plans do not identify any mineral resources within this reach. The DOC and the Solano and Yolo County General Plans do not identify any natural gas fields within this reach (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5).

### *Upper McNamara*

#### Geology and Surface Soil Conditions

Like the rest of the Project Area, topography in this reach is generally flat except for the incised channel. No faults pass through this reach. This reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Solano and Yolo County General Plans do not identify this reach, including stream banks, as an area of slope or landslide hazard, but the Solano County General Plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22; County of Yolo, 2009a, pp. HS-8 to HS-9)).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Yolo loam (Yo), Yolo silt loam (Ya), Riverwash (Rw), Riverwash (Rh), and Water (W).

#### Mineral Resources

This reach lacks designated MRZs but does contain a natural gas field, Winters Gas. This gas field is identified in the DOC maps and the Yolo County General Plan (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5). The Solano and Yolo County General Plans do not identify any mineral resource areas within this reach.

### *Lower McNamara*

#### Geology and Surface Soil Conditions

Topography in this reach is generally flat except for the incised channel. No faults pass through this reach. This reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Solano and Yolo County General Plans do not identify this reach, including stream banks, as an area of slope or landslide hazard, but the Solano County General Plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22; County of Yolo, 2009a, pp. HS-8 to HS-9).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Yolo loam (Yo), Yolo silt loam (Ya), Riverwash (Rh), and Water (W).



### Mineral Resources

Like the Upper McNamara Reach, this reach lacks mineral resources but does contain a natural gas field, Winters Gas. This gas field is identified in the DOC maps and the Yolo County General Plan (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5). The DOC has not identified any MRZs in this reach (DOC, 2015a; DOC, 1988, Plates 18 to 20). The Solano and Yolo County General Plans do not identify any mineral resource areas within this reach.

### *MacQuiddy (Lester)*

### Geology and Surface Soil Conditions

Topography in this reach is generally flat except for the incised channel. The Great Valley Fault 4 (Great Valley 4b, Gordon Valley) is mapped as crossing the Project Area in this reach (County of Solano, 2008a, p. HS-23, Figure HS-3). The Great Valley Fault is capable of a maximum earthquake magnitude of 6.8 Mw, but is not currently considered an active fault (County of Solano, 2008b, p. 4.7-10). Similar to the rest of the Project Area, this reach is in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Solano and Yolo County General Plans do not identify this reach, including stream banks, as an area of slope or landslide hazard, but the Solano County General Plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22; County of Yolo, 2009a, pp. HS-8 to HS-9).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Yolo loam (Yo), Yolo silt loam (Ya), Riverwash (Rh), and Water (W)

### Mineral Resources

This reach lacks mineral resources but does contain a natural gas field, Winters Gas. This gas field is identified in the DOC maps and the Yolo County General Plan (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5). The DOC has not identified any MRZs in this reach (DOC, 2015a; DOC, 1988, Plates 18 to 20). The Solano and Yolo County General Plans do not identify any mineral resource areas within this reach.

### *Russell Ranch*

#### Geology and Surface Soil Conditions

Topography in this reach is generally flat except for the incised channel. No faults pass through this reach. This reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Solano and Yolo County General Plans do not identify this reach, including stream banks, as an area of slope or landslide hazard, but the Solano County General Plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22; County of Yolo, 2009a, pp. HS-8 to HS-9).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Yolo loam (Yo), Yolo silt loam (Ya), Riverwash (Rw), Riverwash (Rh), and Water (W).

#### Mineral Resources

Like the three reaches upstream, this reach lacks mineral resources but does contain a natural gas field, Winters Gas. This gas field is identified in the DOC maps and the Yolo County General Plan (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5). The DOC has not identified any MRZs in this reach (DOC, 2015a; DOC, 1988, Plates 18 to 20). The Solano and Yolo County General Plans do not identify any mineral resource areas within this reach.

### *Stevenson Bridge*

#### Geology and Surface Soil Conditions

Topography in this reach is generally flat except for the incised channel. No faults pass through this reach. Similar to the rest of the Project Area, this reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Solano and Yolo County General Plans do not identify this reach, including stream banks, as an area of slope or landslide hazard, but the Solano County General Plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22; County of Yolo, 2009a, pp. HS-8 to HS-9).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Yolo loam (Yo), Yolo silt loam (Ya), Riverwash (Rw), Riverwash (Rh), and Water (W).

#### Mineral Resources

The DOC has not identified any MRZs in this reach (DOC, 2015a; DOC, 1988, Plates 18 to 20). The Solano and Yolo County General Plans do not identify any mineral resources within this reach. The DOC and the Solano and Yolo County General Plans do not identify any natural gas fields within this reach (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5).

#### *Glide Ranch*

#### Geology and Surface Soil Conditions

Topography in this reach is generally flat except for the incised channel. No faults pass through this reach. This reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Solano and Yolo County General Plans do not identify this reach, including stream banks, as an area of slope or landslide hazard, but the Solano County General Plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22; County of Yolo, 2009a, pp. HS-8 to HS-9).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Yolo loam (Yo), Yolo silt loam (Ya), Riverwash (Rw), Riverwash (Rh), and Water (W).

#### Mineral Resources

The DOC has not identified any MRZs in this reach (DOC, 2015a; DOC, 1988, Plates 18 to 20). The Solano and Yolo County General Plans do not identify any mineral resources within this reach. The DOC and the Solano and Yolo County General Plans do not identify any natural gas fields within this reach (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5).

### *Nishikawa*

#### Geology and Surface Soil Conditions

Topography in this reach is generally flat lying except for the incised channel. No faults pass through this reach. Similar to the rest of the Project Area, this reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zone are present. The Solano and Yolo County General Plans do not identify this reach, including stream banks, as an area of slope or landslide hazard, but the Solano County General Plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22; County of Yolo, 2009a, pp. HS-8 to HS-9).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Yolo loam (Yo), Yolo silt loam (Ya), Riverwash (Rw), and Water (W).

#### Mineral Resources

In a report on aggregate resources, the DOC has mapped an MRZ-1 zone (no significant mineral deposits) in this reach (DOC, 1988, Plate 18). This zone extends into the adjoining reach to the east. The DOC maps and the Solano and Yolo County General Plans do not identify any natural gas fields within this reach (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5).

### *Olmo-Hammond-UCD*

#### Geology and Surface Soil Conditions

Topography in this reach is generally flat except for the incised channel. No faults pass through this reach. This reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Solano and Yolo County General Plans do not identify this reach, including stream banks, as an area of slope or landslide hazard, but the Solano County General Plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22; County of Yolo, 2009a, pp. HS-8 to HS-9).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Yolo loam (Yo), Yolo silt loam (Ya), Riverwash (Rw), Reiff fine sandy loam (Ra), Yolo silty clay loam (Ys), Loamy alluvial land (Lm) and Water (W).

#### Mineral Resources

The DOC has mapped an MRZ-1 zone (no significant mineral deposits) in this reach (DOC, 1988, Plate 18). The zone straddles the western portion of this reach and the Nishikawa reach to the west. The DOC maps and the Solano and Yolo County General Plans do not identify any natural gas fields within this reach (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5).

#### *I-80 to Old Davis Road*

#### Geology and Surface Soil Conditions

Topography in this reach is generally flat except for the incised channel. No faults pass through this reach. This reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Solano County General Plan does not identify this reach, including stream banks, as an area of slope or landslide hazard, but the plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Yolo loam (Yo), Riverwash (Rw), Reiff fine sandy loam (Ra), and Water (W).

#### Mineral Resources

The DOC has not identified any MRZs in this reach (DOC, 2015a; DOC, 1988, Plates 18 to 20). The Solano and Yolo County General Plans do not identify any mineral resources within this reach. The DOC maps and the Solano and Yolo County General Plans do not identify any natural gas fields within this reach (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5).

### *Old Davis Road to Mace*

#### Geology and Surface Soil Conditions

Topography in this reach is generally flat except for the incised channel. No faults pass through this reach. This reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Solano County General Plan does not include this reach, including stream banks, as an area of slope hazard, but the plan does observe that creek banks generally may be susceptible to lurching if they are underlain by loosely consolidated soils (County of Solano, 2008, Figure HS-4, p. HS-22).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Yolo loam (Yo), Yolo silt loam (Ya), Riverwash (Rw), Riverwash (Rh), Reiff fine sandy loam (Ra), Loamy alluvial land (Lm), and Water (W).

#### Mineral Resources

This reach lacks mineral resources but does contain a natural gas field, Davis Southeast Gas. This gas field is identified in the DOC maps and the Yolo County General Plan (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5). The DOC has not identified any MRZs in this reach (DOC, 2015a; DOC, 1988, Plates 18 to 20). The Solano and Yolo County General Plans do not identify any mineral resource areas within this reach.

### *Mace to Road 106A*

#### Geology and Surface Soil Conditions

Topography in this reach is generally flat except for the incised channel. No faults pass through this reach. This reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones are present. The Yolo County General Plan does not identify this reach, including stream banks, as an area of slope or landslide hazard (County of Yolo, 2009a, pp. HS-8 to HS-9).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Reiff fine sandy loam (Ra), Sycamore silt loam, drained (Sp), Riverwash (Rh) Yolo silt loam (Ya), and Water (W).

### Mineral Resources

The DOC has not identified any MRZs in this reach (DOC, 2015a; DOC, 1988, Plates 18 to 20). The Solano and Yolo County General Plans do not identify any mineral resources within this reach. The DOC maps and the Solano and Yolo County General Plans do not identify any natural gas fields within this reach (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5).

#### *Road 106A to Yolo Bypass Wildlife Area*

### Geology and Surface Soil Conditions

Topography in this reach is generally flat except for the incised channel. No faults pass through this reach. Similar to the rest of the Project Area, this reach is located in an area with a high potential for moderate to intense ground shaking, although no mapped earthquake fault rupture hazard zones (areas unfit for most habitable structures) or Seismic Hazard Zones (zones of special risk for liquefaction and landslides) are present. The Yolo County General Plan does not identify this reach, including stream banks, as an area of slope or landslide hazard (County of Yolo, 2009a, pp. HS-8 to HS-9).

Soils in this reach have a moderate to moderately high erosion potential. Soil types occurring in this reach include Sycamore silt loam, drained (Sp), Sycamore silt loam, flooded (Sr), Riverwash (Rh) Yolo silt loam (Ya), and Water (W).

### Mineral Resources

This reach lacks mineral resources but does contain a natural gas field, Putah Sink Gas. This gas field is identified in the DOC maps and the Yolo County General Plan (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5). The DOC has not identified any MRZs in this reach (DOC 2015a; DOC, 1988, Plates 18 to 20). The Solano and Yolo County General Plans do not identify any mineral resources within this reach.

## **Regulatory Setting**

### *State Regulations*

#### Alquist-Priolo-Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. The Alquist-Priolo Earthquake Fault Zoning Act's main purpose is to prevent the construction of buildings

used for human occupancy on the surface trace of active faults (DOC, 2014, p. 1). The Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards.

#### Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act (1990) addresses non-surface fault rupture earthquake hazards such as liquefaction and seismically induced landslides. This Act requires the State Geologist to designate Seismic Hazard Zones. These zones assist cities and counties in fulfilling their responsibilities for protecting the public from the effects of non-surface fault rupture earthquake hazards such as strong ground shaking, earthquake-induced landslides, liquefaction, or other ground failures.

#### Surface Mining and Reclamation Act of 1975

The California Legislature enacted the Surface Mining and Reclamation Act of 1975 (SMARA) to protect the State's supply of mineral resources while also minimizing negative effects of surface mining on public health, property, and the environment. SMARA is administered by the DOC's Office of Mine Reclamation (DOC-OMR) and the State Mining and Geology Board (SMGB) (DOC, 2013). Under SMARA, cities and counties adopt land use and reclamation procedures through ordinances that regulate local mining and reclamation activities. These ordinances are subject to review by the SMGB for consistency with SMARA. SMARA requires all city and county general plans to identify mapped mineral resource designations approved by the SMGB (County of Solano, 2008a, p. RS-32).

#### *Local Regulations Pertaining to Geology*

##### Solano County General Plan

The following goals, policies, and regulations from the Solano County General Plan are relevant to the proposed Project related to geology and soils.

##### Resources Element

Goal RS.G-10: Foster sound management of the land and water resources in Solano County's watersheds to minimize erosion and protect water quality using best management practices and protect downstream waterways and wetlands. (County of Solano, 2008a, p. RS-6)

##### Public Health and Safety Element

Goal HS.G-1: Minimize the potential for loss of life and property resulting from natural or human-caused hazards. (County of Solano, 2008a, p. HS-5)



Policy HS.P-12. Require new development proposals in moderate or high seismic hazard areas to consider risk caused by seismic activity and to include project features that minimize these risks. (County of Solano, 2008a; p. HS-33)

### Yolo County General Plan

The policies, goals, and implementation actions from Yolo County’s 2030 Countywide General Plan are relevant to geology and soils impacts:

#### Conservation and Open Space Element

Policy CO-3.5: Preserve and protect the County’s unique geologic and physical features, which include geologic or soil “type localities”, and formations or outcrops of special interest. (County of Yolo, 2009a, p. CO-46)

#### Health and Safety Element

Policy HS-1.1: Regulate land development to avoid unreasonable exposure to geologic hazards.

Policy HS-1.3: Require environmental documents in connection with CEQA to address seismic safety issues and to provide adequate mitigation for existing and potential hazards identified.

Action HS-A2: Rely upon the most current and comprehensive hazard mapping available in the evaluation of potential seismic hazards associated with proposed new development. (County of Yolo, 2009a; p. HS-11)

### *Local Regulations Pertaining to Mineral Resources*

### Solano County General Plan

The Solano County General Plan identifies mineral resources produced in the county: mercury, sand and gravel, clay, stone products, calcium, and sulfur (County of Solano, 2008a, pp. RS-32 to RS-36). The General Plan Mineral Resources Map identifies a sand and gravel mine location near the City of Winters, along Lower Putah Creek and within the Project Area, but does not identify any Mineral Resource Zones in the Putah Creek area (County of Solano, 2008a, p. RS-33, Figure RS-4 Mineral Resources). The county also contains natural gas fields, although the General Plan does not specifically identify any in the Putah Creek area (County of Solano, 2008a, pp. RS-51 to RS-52). The following General Plan policies and regulations are relevant to mineral resource impacts:

Policy RS.P-33: The County shall preserve, for future use, areas with important mineral resources by preventing residential, commercial, and industrial development that would be incompatible with mining practices to the extent feasible. (County of Solano, 2008a, p. RS-35)

#### Yolo County General Plan

Yolo County's 2030 Countywide General Plan discusses mineral resources in its Conservation and Open Space element (County of Yolo, 2009a, pp. CO-43 to CO-48). The following General Plan policies, goals, and implementation actions are relevant to mineral resource impacts:

Goal CO-3: Mineral Resources. Protect mineral and natural gas resources to allow for their continued use in the economy.

Policy CO-3.1: Encourage the production and conservation of mineral resources, balanced by the consideration of important social values, including recreation, water, wildlife, agriculture, aesthetics, flood control, and other environmental factors.

Action CO-A37: Designate and zone lands containing identified mineral deposits to protect them from the encroachment of incompatible land uses so that aggregate resources remain available for the future. (Policy CO-3.1)

Action CO-A39: Encourage the responsible development of aggregate deposits along Cache Creek as significant both to the economy of Yolo County and the region. (Policy CO-3.1)

Action CO-A45: Prohibit commercial mining in or adjoining Putah Creek. (Policy CO-3.1, Policy CO-3.2)

Action CO-A47: Ensure that mined areas are reclaimed to a usable condition that is readily adaptable for alternative land uses, such as agriculture, wildlife habitat, recreation, and groundwater management facilities.

Action CO-A49: Consider the exploration, drilling, and extraction of natural gas as compatible with agriculture and open space uses. (Policy CO-3.3)

Action CO-A50: Evaluate any impacts to identified natural gas fields as part of the development review process. (Policy CO-3.3)  
(County of Yolo, 2009a, pp. CO-47 to CO-49)

#### Solano County Code

Chapter 29 of the Solano County Code, Surface Mining and Reclamation, establishes procedures for mining operations permitting and reclamation (County of Solano, 2013). It does not contain any restrictions on the location of mining operations.

#### Yolo County Code of Ordinances

The following Yolo County ordinance in Title 10 Environment, Chapter 4, Off-Channel Surface Mining, of the county code is relevant to mineral resource impacts:

##### Section 10-4.103. Purposes.

The purposes of this chapter are as follows:

- (a) The extraction of sand and gravel is essential to the continued economic well-being of the State and to the needs of society. Although the County encourages the production of sand and gravel, consideration must also be balanced by other societal values, including but not limited to recreation, water resources, wildlife, agriculture, and aesthetics;
- (b) The potential environmental impacts, operational methods, and reclaimed end uses of in-channel surface excavation are significantly different from those associated with off-channel surface mining. Thus, it is appropriate to provide separate performance standards and findings for both in-channel and off-channel activities, so that regulations contained within this title are sensitive to the specific issues involved in each of the two (2) types of operations;
- (c) Due to concerns about the impacts of excavation within the channel to structures, property, and riparian habitat, in-stream surface excavation will be minimized and will only be permitted as part of erosion control, flood control, and similar channel maintenance activities. Therefore, in order to provide the aggregate necessary for the County's needs, off-channel mining will be encouraged;
- (d) Off-channel surface mining must be carefully monitored, in order to eliminate residual hazards to the public health and safety, and to maximize the benefits to the County from surface mining operations; and
- (e) Off-channel surface mining takes place in diverse areas, where the geologic, climatic, biological, and social conditions are significantly different. Surface mining permits must be specifically adapted to the requirements of the particular land

being mined. Therefore, this chapter imposes general performance standards, by which off-channel surface mining operations shall be measured in order to ensure that resources and infrastructure are managed in a consistent manner to maximize their overall benefit.

(County of Yolo, 1996.)

### **3.3.2 Significance Criteria**

The following thresholds for measuring a project’s environmental impacts are based on CEQA Guidelines Appendix G (OPR, 2013). For the purposes of this PEIR, impacts are considered to be significant if any of the following would result from implementation of the proposed Project:

1. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
  - a. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault. (Refer to Division of Mines and Geology Special Publication 42)
  - b. Strong seismic ground shaking.
  - c. Seismic-related ground failure, including liquefaction.
  - d. Landslides.
2. Result in substantial soil erosion or the loss of topsoil.
3. 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 landslide, lateral spreading, subsidence, liquefaction or collapse.
4. Result in loss of availability of a known mineral resource that would be of value to the region and the residents of the State.
5. Result in loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.

### **3.3.3 Impacts and Mitigation Measures**

Impacts and mitigation measures are described below both generally and by reach. Applicable impacts and mitigation measures for each reach are summarized in **Table 3.3-2**, at the end of this section.

## General Impacts and Mitigation Measures

### Impact 3.3-1: Impacts from Seismic Activity.

#### Faults and Ground Shaking

As described above in the Local Geologic Setting/Project Area Conditions, the Project is located in an area with a high potential for moderate to intense ground shaking and low likelihood of ground rupture. Most Project activities would occur on private lands and would not involve creating new or additional public access.

The California Building Standards Code (which has been adopted by both Solano and Yolo Counties) contains a broad definition of “structure” (“that which is built or constructed”). However, the Project would not erect habitable structures of any kind; any structures would be limited to those described in Chapter 2, *Project Description*, such as those for bank stabilization (which would improve bank stability compared with existing conditions) and temporary flow diversion. Project activities would not bring large numbers of people to the Project Area: during construction and during operational maintenance activities, an average of six workers would be in the area at any given time. Therefore, even in the event of strong seismic ground shaking, any damage to structures installed by the Project would be unlikely to injure people or result in major damage to Project structures.

#### Liquefaction

As described above in the Local Geologic Setting/Project Area Conditions, Seismic Hazard Zone Maps show no liquefaction areas within the Project Area. The Solano County General Plan and earthquake planning documents indicate that liquefaction potential in the Project Area is moderate (County of Solano, 2008, p. HS-29, Figure HS-6; County of Solano, 2012, p. 6). The Yolo County General Plan and emergency planning documents do not identify the level of liquefaction risk in the Project Area, but the General Plan identifies the Project Area’s landslide susceptibility as low (County of Yolo, 2009a, p. HS-9, Figure HS-2; see also County of Yolo, 2012 and County of Yolo, 2013). Thus, the Project would have a **less-than-significant impact** related to exposing people or structures to potential substantial adverse effects involving seismic-related ground failure, including fault rupture, seismic ground shaking, and liquefaction. No mitigation measures are required.

**Impact 3.3-2: Result in New or Exacerbated Slope Failure Hazards.**

As described above Local Geologic Setting/Project Area Conditions, no Project Areas at risk and potentially requiring mitigation for landslides are shown on Seismic Hazard Zone Maps. The Solano County General Plan identifies the Project Area as having slopes of less than 4 percent and does not include the Project Area as an area of slope hazard (County of Solano, 2008a, Figure HS-4). With the exception of the stream banks, there are no steep slopes in the Project Area that could become unstable.

Regarding slope failure risks from the streambanks themselves, one of the purposes of Project activities is to stabilize streambanks in the Project Area, which would reduce risk of landslides compared with existing conditions. As described in Chapter 2, *Project Description*, a variety of creek bank stabilization methods would be implemented within the Project footprint, including installing natural rock boulders at the toe of the bank, minor bank filling, and “laying back” of the bank to decrease its relative angle. Application of these methods would decrease the Project-associated slope failure risk and would not increase existing risks of from landslides. These methods would also reduce risks related to liquefaction.

There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Under these conditions, the construction manager and equipment operators would take all precautions to minimize this hazard as part of normal operations.

Finally, Project activities would not bring large numbers of people to the Project Area: during construction and during operational maintenance activities, an expected average of six workers would be in the Project Area at any given time, and so, even in the unlikely event of a stream bank collapse, any structural damage to structures erected by the Project would be unlikely to injure people or to result in substantial economic loss or other substantial adverse effects.

Therefore, the Project would have a **less-than-significant impact** related to potential substantial adverse effects involving landslides of the stream bank or other on- or off-site features. No mitigation measures are required.

### **Impact 3.3-3: Potential for Substantial Soil Erosion During or After Project Construction.**

#### Channel Erosion

As described above in the Local Geologic Setting/Project Area Conditions, the soils present along Lower Putah Creek have a K factor of 0.37, indicating a moderate to moderately high erosion potential. However, as is discussed in Chapter 2, *Project Description*, one of the purposes of Project activities is to reduce existing erosion in the Project reaches. The Project would utilize a number of stabilization methods, including slope recontouring, constructing rock cross-vane grade/flow control structures and installing of rock revetment, log revetment, and/or root wads to stabilize stream banks and reduce erosion. Meandering of the low-flow stream channel within the incised larger channel over time is a natural process and would not be considered an adverse impact if sediment inputs and outputs are more or less in equilibrium. However, in a few places the lateral erosion has been exacerbated by historic channel manipulations and these require site-specific modifications. In those places, reduced erosion would be a long-term benefit of the Project.

Project activities could result in potentially significant temporary increases in within-channel and bank erosion during construction activities, including channel reconfiguration (grading and clearing); maintenance activities such as weed management; and gravel augmentation, scarification, and maintenance. These activities and potential effects are analyzed in additional detail in Section 3.1, *Hydrology*.

Construction and temporary post-construction bank erosion impacts to the low-flow channel and terrace (below stream banks) would be reduced to a **less-than-significant level** through regulatory compliance and the application of Mitigation Measure 3.1-1 (see Section 3.1, *Hydrology*, for this measure). Project activities would be subject to CWA Section 401, Water Quality Certification, for discharges of dredged and fill materials through the Central Valley Regional Water Quality Control Board (CVRWQCB) (SWRCB, 2014). As part of this certification, CVRWQCB would require erosion controls in all areas disturbed by Project activities, as is discussed in further detail in Section 3.2, *Water Quality*, of this EIR. These regulatory controls would ensure that the Project's erosion impacts are less than significant.

A Storm Water Pollution Prevention Plan (SWPPP) would be required for Project activities that disturb one or more acres of soil under the National Pollution Discharge Elimination System (NPDES) General Permit for Construction Storm Water Discharges.

The SWPPP(s) would also incorporate visual, chemical, and sediment monitoring programs as required. See Sections 3.1, *Hydrology*, and 3.2, *Water Quality*, for additional detail on SWPPP requirements.

A SWPPP may not be required for certain Project activities, such as weed control and activities that disturb less than one acre of soil. In those situations, Mitigation Measure 3.1-1 (see Section 3.1, *Hydrology*) would ensure that Project impacts remain less than significant by implementing best management practices (BMPs) designed to avoid or minimize adverse impacts associated with erosion.

Erosion and sediment controls implemented to comply with Section 401, Water Quality Certification, with any required SWPPPs, combined with Mitigation Measure 3.1-1 would ensure that Project impacts resulting in substantial soil erosion or the loss of topsoil would be **less than significant**. No additional mitigation is required.

#### **Impact 3.3-4: Loss of Important Mineral Resources.**

##### Aggregate (Gravel) Resources

The California DOC identifies an MRZ-3 in Davis that contains mineral deposits of which the significance cannot be evaluated from available data. The MRZ-3 is located 0.25 miles north and outside of the Project Area and therefore would not be impacted by the Project.

The Lower Putah Creek floodplain was the site of at least one historic gravel-mining operation (County of Yolo, 2005, p. 6-18; Bradley, 1915, p. 198). The Solano County General Plan Mineral Resources Map identifies one sand and gravel mine location along Putah Creek, near the City of Winters, but does not identify this area or any others in the Putah Creek vicinity as a Mineral Resource Zone (County of Solano, 2008a, p. RS-33, Figure RS-4 Mineral Resources). Gravel mining in the Putah Creek area is no longer commercially viable because gravel from the area is low quality and there are now less expensive substitutes available from nearby sources, such as the high-grade aggregate deposit in the Cache Creek area (County of Yolo, 2009a, pp. CO-43 to CO-44). All current commercial aggregate operations in Yolo County are located on the stream terraces of Cache Creek (County of Yolo, 2009b, p. 683). In addition, Yolo County General Action CO-A45 prohibits commercial mining in or adjoining Putah Creek. (See also Policy CO-3.1 and Policy CO-3.2, which require balancing of mineral resource production, conservation, and extraction with environmental and land use compatibility factors.) (County of Yolo, 2009a, pp. CO-46, CO-48)



Following SMARA, the Putah Creek area became a minor source of lower quality aggregate for a time, but has been long superseded by the development of high-value gravel resources throughout the region (such as Cache Creek). The Putah Creek area was not historically a significant source of aggregate resources of value to the region and residents of the State, and now extraction is prohibited by Yolo County (County of Yolo, 2009a, pp. CO-48). (Solano County's General Plan and county code do not specifically prohibit mining in or near Putah Creek.) The Project would have **no impact** on the availability of aggregate to the region and residents of the State. No mitigation is required.

#### Natural Gas Resources

The Solano County General Plan does not identify any petroleum or natural gas resources in the Project Area (County of Solano, 2008a pp. RS-51 to RS-52). The Yolo County General Plan does identify several natural gas fields located in the Project Area (County of Yolo, 2009a, pp. CO-44 and CO-46, Figure CO-5). These are the Winters Gas and Putah Sink Gas fields, and the abandoned Dixon Gas and Davis Southeast Gas fields (DOC, 1999, Quads 8N 1E and 8N 3E respectively). Project activities would not damage or otherwise impact the natural gas fields because Project activities would take place only on the surface and would not prevent use or development of the natural gas fields; therefore, the Project would have **no impact** on mineral or natural gas resources. No mitigation is required.

#### **Site-Specific Impacts and Mitigation Measures**

##### *NAWCA/Mariani*

#### Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards. Therefore, in this reach, the Project would have a **less-than-significant** impact related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to

erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event an SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4; Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

#### Mineral Resources

There are no known mineral resources or natural gas fields in this reach. The proposed Project would have **no impact**.

#### *Duncan-Giovannoni*

#### Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach, the Project would have a **less-than-significant** impact related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4; Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

#### Mineral Resources

There are no known mineral resources or natural gas fields in this reach. The proposed Project would have **no impact**.

#### *Winters Putah Creek Nature Park*

#### Geology

According to the Solano County General Plan, the Midland Fault passes through the Project Area on the far downstream portion of the reach, near I-505 (County of Solano, 2008a, p. HS-23, Figure HS-3). This fault has no history of seismicity in the past 700,000 years and is not considered an active fault (County of Solano, 2008b, p. 4.7-10).

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach, the Project would have a **less-than-significant** impact related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4; Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

#### Mineral Resources

The Solano County General Plan Mineral Resources Map identifies a former sand and gravel mine located within this reach, but the General Plan does not identify this area or any others in the Putah Creek vicinity as MRZs (County of Solano, 2008a, p. RS-33, Figure RS-4). Gravel mining in the Putah Creek area is no longer commercially viable because gravel from the area is low quality and there are now less expensive substitutes available from nearby sources (County of Yolo, 2009a, pp. CO-43 to CO-44). In addition, Yolo County General Action CO-A45 prohibits commercial mining in or adjoining Putah Creek (County of Yolo, 2009a, pp. CO-46, CO-48). There are no known natural gas fields in this reach. Therefore the Project would have **no impact** on mineral or natural gas resources in this reach.

#### *East of 505*

#### Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach, the Project would have a **less-than-significant** impact related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities,

Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4; Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks, which could act to minimize lateral spread risk. The proposed Project would have **no impact** in this reach related to geologic stability.

#### Mineral Resources

There are no known mineral resources or natural gas fields in this reach. The proposed Project would have **no impact**.

#### *Warren*

#### Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach, the Project would have a **less-than-significant** impact related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4: Project activities would not heighten the existing condition lateral spread risk of the creek. This is

because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

#### Mineral Resources

There are no known mineral resources or natural gas fields in this reach. The proposed Project would have **no impact**.

#### *Upper McNamara*

#### Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach, the Project would have a **less-than-significant** impact related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4; Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks, which could act to minimize lateral spread risk. The proposed Project would have **no impact** in this reach related to geologic stability.

### Mineral Resources

This reach lacks mineral resources but does contain a natural gas field, Winters Gas. Project activities would not damage or otherwise impact the natural gas fields because they would take place only on the surface and would not involve deep subsurface activities. Project activities also would not prevent use or development of the natural gas fields because they would not preclude access to future development of the gas fields; therefore the Project would have **no impact** on mineral or natural gas resources in this reach.

### *Lower McNamara*

#### Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2: the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach, the Project would have a **less-than-significant** impact related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4; Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

### Mineral Resources

Like the Upper McNamara Reach, this reach lacks mineral resources but does contain a natural gas field, Winters Gas. Project activities would not damage or otherwise impact the natural gas fields because they would take place only on the surface and would not involve deep subsurface activities. Project activities also would not prevent use or development of the natural gas fields because they would not preclude access to future development of the gas fields; therefore the Project would have **no impact** on mineral or natural gas resources in this reach.

### *MacQuiddy (Lester)*

### Geology

The Great Valley Fault 4 crosses the Project Area in this reach (County of Solano, 2008a, p. HS-23, Figure HS-3). Although the fault is capable of a maximum earthquake magnitude of 6.8 Mw, it is not currently considered an active fault (County of Solano, 2008b, p. 4.7-10) and there are no mapped earthquake fault rupture hazard zones or Seismic Hazard Zones present in this segment.

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach the Project would have a **less-than-significant** impact related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.



Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4; Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

#### Mineral Resources

Like the Upper and Lower McNamara Reaches, this reach lacks mineral resources but does contain a natural gas field, Winters Gas. Project activities would not damage or otherwise impact the natural gas fields because they would take place only on the surface and would not involve deep subsurface activities. Project activities also would not prevent use or development of the natural gas fields because they would not preclude access to future development of the gas fields; therefore, the Project would have **no impact** on mineral or natural gas resources in this reach.

#### *Russell Ranch*

#### Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2: the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach, the Project would have a **less-than-significant** impact related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4: Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

#### Mineral Resources

Project activities would not damage or otherwise impact the natural gas fields because Project activities would take place only on the surface and would not involve deep subsurface activities. Project activities also would not prevent use or development of the natural gas fields because they would not preclude access to future development of the gas fields; therefore the Project would have **no impact** on mineral or natural gas resources.

#### *Stevenson Bridge*

#### Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards. Therefore, in this reach, the Project would have a **less-than-significant** impact related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4: Project activities

would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

#### Mineral Resources

There are no known mineral resources or natural gas fields in this reach. The proposed Project would have **no impact**.

#### *Glide Ranch*

#### Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach, the Project would have a **less-than-significant** impact related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4; Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

### Mineral Resources

There are no known mineral resources or natural gas fields in this reach. The proposed Project would have **no impact**.

### *Nishikawa*

### Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach, the Project would have a **less-than-significant** impact related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4; Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

### Mineral Resources

There are no known mineral resources or natural gas fields in this reach. In a report on aggregate resources, the DOC has mapped an MRZ-1 zone (no significant mineral

deposits) in this reach (DOC, 1988, Plate 18). The proposed Project would have **no impact**.

#### *Olmo-Hammond-UCD*

##### Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach, the Project would have a **less-than-significant** impact related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4; Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

##### Mineral Resources

There are no known mineral resources or natural gas fields in this reach. In a report on aggregate resources, the DOC has mapped an MRZ-1 zone (no significant mineral deposits) in the western portion of this reach (DOC, 1988, Plate 18). The proposed Project would have **no impact**.

*I-80 to Old Davis Road*Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach, the Project would have a **less-than-significant** impact related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4; Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

Mineral Resources

There are no known mineral resources or natural gas fields in this reach. The proposed Project would have **no impact**.

*Old Davis Road to Mace*Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or

landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach, the Project would have a **less-than-significant** impact related to exposing people or structures to potential substantial adverse effects involving seismic activity and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4; Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

#### Mineral Resources

This reach lacks mineral resources but does contain a natural gas field, Davis Southeast Gas. This gas field is identified by the DOC and the Yolo County General Plan (DOC, 1999, Quads 8N 1E and 8N 3E; County of Solano, 2008a, pp. RS-51 to RS-52; County of Yolo, 2009a, p. CO-44, Figure CO-5). Project activities would not damage or otherwise impact the natural gas fields because Project activities would take place only on the surface and would not involve deep subsurface activities. Project activities also would not prevent use or development of the natural gas fields because they would not preclude access to future development of the gas fields; therefore the Project would have **no impact** on mineral or natural gas resources.

### *Mace to Road 106A*

#### Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach, the Project would have a **less-than-significant impact** related to seismic hazards and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4; Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

#### Mineral Resources

There are no known mineral resources or natural gas fields in this reach. The proposed Project would have **no impact**.

### *Road 106A to Yolo Bypass Wildlife Area*

#### Geology

Impacts from seismic activity and landslides in this reach are the same as those generally analyzed in Impacts 3.3-1 and 3.3-2; the proposed Project would not increase existing seismic and landslide risks and would not increase long-term seismic or



landslide risks. There is a small potential for inadvertent, short-term bank destabilization during construction, which could present a hazard to workers on-site. Normal grading operations would include consideration of these hazards; therefore, in this reach, the Project would have a **less-than-significant impact** related to exposing people or structures to potential substantial adverse effects involving seismic activity and landslides.

Impacts related to soil erosion in this reach are the same as those generally analyzed in Impact 3.3-2; Project activities would not increase existing erosion or increase long-term erosion risks. Project activities could result in potential short-term effects related to erosion during construction activities. Erosion and sediment controls implemented to comply with Section 401 Water Quality Certification and any required SWPPPs would ensure that short-term construction-related Project erosion and siltation impacts would be **less than significant**. In the event a SWPPP is not required for Project activities, Mitigation Measure 3.1-1 would reduce any potential construction related erosion and siltation impacts to a **less-than-significant** level.

Impacts related to on- or off-site, lateral spreading, subsidence, liquefaction or collapse in this reach are the same as those generally analyzed in Impact 3.3-4; Project activities would not heighten the existing condition lateral spread risk of the creek. This is because the Project entails creek restoration activities aimed at stabilizing the stream banks. The proposed Project would have **no impact** in this reach related to geologic stability.

#### Mineral Resources

This reach lacks mineral resources but does contain a natural gas field, Putah Sink Gas. Project activities would not damage or otherwise impact the natural gas fields because Project activities would take place only on the surface and would not involve deep subterranean activities. Project activities also would not prevent use or development of the natural gas fields because they would not preclude access to future development of the gas fields; therefore, the Project would have **no impact** on mineral or natural gas resources.

**Table 3.3-2 Summary of Geologic Impacts and Mitigation Measures**

Reach	Impact 3.3-1			Impact 3.3-4	Applicable Mitigation Measures
	Seismic Hazards	Impact 3.3-2 Slope Failure	Impact 3.3-3 Erosion	Loss of Mineral Resources	
NAWCA/Mariani	LS	LS	SM	NI	MM 3.1-1
Duncan-Giovannoni	LS	LS	SM	NI	MM 3.1-1
Winters Putah Creek Nature Park	LS	LS	SM	NI	MM 3.1-1
East of 505	LS	LS	SM	NI	MM 3.1-1
Warren	LS	LS	SM	NI	MM 3.1-1
Upper McNamara	LS	LS	SM	NI	MM 3.1-1
Lower McNamara	LS	LS	SM	NI	MM 3.1-1
MacQuiddy (Lester)	LS	LS	SM	NI	MM 3.1-1
Russell Ranch	LS	LS	SM	NI	MM 3.1-1
Stevenson Bridge	LS	LS	SM	NI	MM 3.1-1
Glide Ranch	LS	LS	SM	NI	MM 3.1-1
Nishikawa	LS	LS	SM	NI	MM 3.1-1
Olmo-Hammond-UCD	LS	LS	SM	NI	MM 3.1-1
I-80 to Old Davis Road	LS	LS	SM	NI	MM 3.1-1
Old Davis Road to Mace	LS	LS	SM	NI	MM 3.1-1
Mace to Road 106A	LS	LS	SM	NI	MM 3.1-1
Road 106A to YBWA	LS	LS	SM	NI	MM 3.1-1

Notes: NI = No Impact, LTS = Less than Significant Impact, SM = Significant but mitigable to less than significant with measures identified in this section, SU = Significant and Unavoidable, even after mitigation.