

10.1 Environmental Setting/Affected Environment

This section provides information on soils in the study area (the area in which impacts may occur) which is limited to the Plan Area (the area covered by the BDCP). This includes portions of the Sacramento–San Joaquin Delta (Delta), Suisun Marsh, and Yolo Bypass. See Chapter 1, *Introduction*, for a detailed description of the Plan Area. The Plan Area was selected for the geographic scope of the analysis because all soil-related effects and constraints are restricted to the immediate location of the potential effect. Land outside of the Plan Area were not considered because there are no structures being proposed and because changed operations at upstream and within the water user service areas do not increase potential adverse effects on soils in those areas. The information is based largely on Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service) soil surveys for the seven counties in the Plan Area and the online Soil Survey Geographic (SSURGO) database. Other sources include California Department of Water Resources (DWR) and U.S. Geological Survey publications, academic technical reports and publications, and county and city general plans.

This section describes soil characteristics in the study area (Plan Area) with respect to the following.

- Soil associations.
- Soil chemical and physical characteristics.
- Soil suitability/limitations for various uses.
- Land subsidence resulting from biological oxidation of organic carbon in peat soil.

Other chapters that contain information related to soils are listed below.

- Soil resources, as they pertain to agricultural land use and important farmlands mapped by the Farmland Mapping and Monitoring Program (FMMP), are discussed in Chapter 13, *Land Use*.
- Soil resources, as they pertain to crop production (including potential salinization caused by irrigation), are discussed in Chapter 14, *Agricultural Resources*.
- Geotechnical properties of soils, as they pertain to soil stability, levee stability, and liquefaction, are described in Chapter 6, *Surface Water*, and Chapter 9, *Geology and Seismicity*.
- Carbon dioxide (CO₂) flux to the atmosphere from oxidation of organic matter in peat soil is discussed in Chapter 29, *Climate Change*, and Chapter 22, *Air Quality and Greenhouse Gas Emissions*.
- Water quality concerns and regulatory implications associated with soil erosion and sedimentation are summarized in this chapter, but are more thoroughly discussed in Chapter 8, *Water Quality*.
- Land subsidence from groundwater extraction and geologic causes is described in Chapter 7, *Groundwater*, and Chapter 9, *Geology and Seismicity*.

This chapter does not describe the soil setting or potential project effects in the State Water Project (SWP) and Central Valley Project (CVP) Export Service Areas Region (Export Service Areas Region) or

1 in the areas upstream of the Delta. As appropriate, this topic is addressed in Chapter 30, *Growth*
2 *Inducement*.

3 The setting information for soils, except where otherwise noted, is derived from the soils appendix that
4 was included in the conceptual engineering reports (CERs) prepared for the BDCP.

- 5 • Conceptual Engineering Report—Isolated Conveyance Facility—All Tunnel Option (California
6 Department of Water Resources 2010a).
- 7 • Conceptual Engineering Report—Isolated Conveyance Facility—Pipeline/Tunnel Option—
8 Addendum (California Department of Water Resources 2010b).
- 9 • Conceptual Engineering Report—Isolated Conveyance Facility—East Option (California
10 Department of Water Resources 2009a).
- 11 • Conceptual Engineering Report—Isolated Conveyance Facility—East Option—Addendum
12 (California Department of Water Resources 2010c).
- 13 • Conceptual Engineering Report—Isolated Conveyance Facility—West Option (California
14 Department of Water Resources 2009b).
- 15 • Conceptual Engineering Report—Isolated Conveyance Facility—West Option—Addendum
16 (California Department of Water Resources 2010d).
- 17 • Option Description Report—Separate Corridors Option (California Department of Water Resources
18 2010e).

19 **10.1.1 Potential Environmental Effects Area**

20 The study area (the area in which impacts may occur) evaluated for potential effects on soil is the Plan
21 Area (the area covered by the BDCP) and includes portions of Sacramento, Yolo, Solano, San Joaquin,
22 Contra Costa, and Alameda Counties and the cities of Sacramento, Isleton, West Sacramento, Rio Vista,
23 and Antioch, which lie within the Plan Area.

24 **10.1.1.1 Soil Associations**

25 Soil is a natural body comprised of solids (minerals and organic matter), liquid, and gases that occurs
26 on the land surface, occupies space, and is characterized by one or both of the following: horizons, or
27 layers, that are distinguishable from the initial material as a result of additions, losses, transfers, and
28 transformations of energy and matter or the ability to support rooted plants in a natural environment.
29 Areas are not considered to have soil if the surface is permanently covered by water too deep (typically
30 more than 8.2 feet) for the growth of rooted plants. The lower boundary that separates soil from the
31 nonsoil underneath is most difficult to define. Soil consists of horizons near the Earth's surface that, in
32 contrast to the underlying parent material, have been altered by the interactions of climate, relief, and
33 living organisms over time. Commonly, soil grades at its lower boundary to hard rock or to earthy
34 materials virtually devoid of animals, roots, or other marks of biological activity.

35 Soil formed in the Delta as the result of geologic processes over approximately the past 7,000 years.
36 These processes produced landward accumulation of sediment behind the bedrock barrier at the
37 Carquinez Strait, forming marshlands comprising approximately 100 islands that were surrounded by
38 hundreds of miles of channels (Weir 1950). Generally, mineral soil formed near the channels during
39 flood conditions and organic soil formed on marsh island interiors as plant residues accumulated faster
40 than they could decompose. Prior to the mid-1800s, the Delta was a vast marsh and floodplain, under

1 which peat soil developed to a thickness of up to 30 feet in many areas (Weir 1950), with a thickness of
2 approximately 55 feet in the vicinity of Sherman Island (Real and Knudsen 2009).

3 Management of Delta soil for agriculture and flood control over the past 100 years caused dramatic
4 changes to soil and the overall landscape. The Delta today is a highly modified system of artificial levees
5 and dredged waterways that were constructed to control flooding, to improve navigation, and to
6 support farming and urban development on approximately 57 reclaimed islands (Ingebritsen et al.
7 2000). The peat soil have been largely drained, resulting in oxidation of organic matter and subsequent
8 large-scale land subsidence on Delta islands.

9 Soils continue to be a key resource in the Delta (Delta Protection Commission 1993) and have physical
10 and chemical characteristics that qualify many areas as prime farmland (see Chapter 14, *Agricultural*
11 *Resources*). The growing season, drainage, and available moisture in many Delta soils provide an
12 excellent medium for growing a wide variety of crops. The soils also continue to support important
13 wetland ecosystems in the Delta and Suisun Marsh.

14 Because the study area is large, the soils are best described at a landscape scale, rather than at a
15 detailed scale. NRCS maps soils at a landscape scale by mapping soil associations. Soil associations are
16 groupings of individual soils that occur together in the landscape and are typically named after the two
17 or three dominant soil series. For example, the dominant soil components in the Gazwell-Rindge soil
18 association in Sacramento County are the Gazwell and Rindge soil series. Soil associations cover broad
19 areas that have a distinctive pattern of soils, relief, and drainage. Figure 10-1 shows the soil
20 associations in the Plan Area within each county (Soil Conservation Service 1966, 1972, 1977a, 1977b,
21 1988, 1992, 1993). This generalized soil map is useful for comparing the suitability of large areas for
22 general land use purposes. Larger scale maps showing the individual soil map units that comprise each
23 association are often used for evaluating soil suitability on a site-specific scale (e.g., selecting a building
24 site). Appendix 10A, *Soil Associations*, identifies the individual map units that comprise each
25 association.

26 Soils within the Plan Area can be generally grouped based on relationships with the following
27 physiographic settings. The geographic context of these relationships is described below.

- 28 • Basin, delta, and Suisun Marsh.
- 29 • Basin rims.
- 30 • Floodplains and stream terraces.
- 31 • Valley fill, alluvial fans, and low terraces.
- 32 • Uplands and high terraces.

33 **Basin, Delta, and Suisun Marsh Soils**

34 Basin and delta soils occupy the lowest elevations and are often protected by levees (Soil Conservation
35 Service 1992, 1993). Most of these low-lying soils contain substantial organic matter and are classified
36 as peats or mucks (Soil Conservation Service 1992, 1993); Figure 10-2 shows the percent organic
37 matter content of the upper 5 feet of soils in the Plan Area. Examples of organic soil associations in the
38 Delta include the Gazwell-Rindge association in Sacramento County, the Rindge-Kingile-Ryde and
39 Peltier-Egbert associations in San Joaquin County, and the Rindge-Kingile and Joice-Reyes associations
40 in Contra Costa County.

1 Peat soils contain large accumulations of partially decomposed plant material. In muck soils, plant
 2 material is decomposed to a greater degree than in peat soils. In the Delta, unaltered peat soils are
 3 characterized as having two layers: one relatively thin layer with plant material derived from tule, and
 4 an underlying deeper layer of plant material derived from reed, primarily *Phragmites communis*
 5 (Weir 1950). Peat soils are grouped in the soil order Histosols. By definition, Histosols contain more
 6 than 18% organic carbon if the mineral fraction of the soil contains at least 60% clay, or more than
 7 12% organic carbon if no clay is present (Buol et al. 1980:315-317). Histosols are further classified into
 8 suborders according to level of decomposition in the subsurface. Fibrists (i.e., peat) exhibit relatively
 9 minor decomposition, with fibric material dominant in the subsurface; Hemists are moderately
 10 decomposed with hemic organic material in the subsurface; and Sapristis (i.e., muck) are the most
 11 decomposed, with sapric material in the subsurface (Buol et al. 1980: 315-317). Soil series
 12 representing organic soils from those closest to a natural state, to those most altered (and possessing
 13 the highest to lowest organic matter content), are Venice, Staten, Egbert, and Roberts, respectively
 14 (California Department of Water Resources 2007). Soils with less organic matter may have been
 15 drained earlier than others (California Department of Water Resources 2007).

16 The thickness of the organic soils is greatest on islands of the central Delta. Figure 10-3 shows the total
 17 thickness of the organic soils¹, which extends well below the 5-foot depth typically described in NRCS
 18 soil surveys. The areas with the thickest organic soils include southern Grand, southern Tyler, southern
 19 Brannan, Twitchell, northern and southern Sherman, Venice, Medford, and western Bouldin Islands in
 20 Sacramento and San Joaquin Counties (Delta Protection Commission 1993). The Suisun Marsh has the
 21 largest contiguous area of highly organic soils, with poorly drained muck and peat soils in salt marshes,
 22 such as the Joice-Suisun association. In addition to being very deep, peat soils are also poorly drained
 23 and may have a high water table. They have a high water-holding capacity. These soils have good
 24 fertility, with 2–3.5% nitrogen; therefore, they make excellent agricultural soils when drained (Delta
 25 Protection Commission 1993).

26 Soils along the margin of the Delta contain more mineral material and less organic material than those
 27 in the central Delta. Mineral soils that occur in the Delta are typically fine textured with poor drainage
 28 (e.g., the Clear Lake association in Sacramento County, the Sacramento association in Yolo County, and
 29 the Sacramento-Omni association in Contra Costa County [Figure 10-1]). These soils also may be
 30 calcareous with high salinity and a high sodium content (e.g., the Willows-Pescadero association in Yolo
 31 and San Joaquin Counties [Figure 10-1]). Soils in the Yolo Bypass are primarily those of the Capay-
 32 Sacramento association and are moderately well-drained to poorly drained silty clay loams to clays, as
 33 shown in Figure 10-1 (Soil Conservation Service 1972).

34 The topsoil layer ranges between 20 and 60 inches thick.

35 **Basin Rim Soils**

36 Basin rim soils are found along the rims (edges) of basins. Soils in this physiographic setting are
 37 mineral soils that are poorly drained to well-drained, and have fine textures in their surface horizons.
 38 Some areas contain soils with a claypan layer in the subsurface. For example, the
 39 Marcuse-Solano-Pescadero association in Contra Costa County contains very poorly drained to
 40 somewhat poorly drained clays, loams, and clay loams (Figure 10-1). A cemented hardpan can occur at
 41 depths of 40–60 inches in Hollenbeck soils in San Joaquin County (Figure 10-1). Dierssen soils in

¹ The original source of this figure (California Department of Water Resources 2007) does not define “organic soils”, but is assumed to be those soil materials with a minimum of 15% organic matter content.

1 western Sacramento County have a sandy clay loam texture at the surface, a calcareous clay subsoil,
 2 and a hardpan at a depth of 20–45 inches (Figure 10-1) and also can have a perched water table at a
 3 depth of 6–36 inches in winter and early spring (Soil Conservation Service 1993).

4 The topsoil layer of the soils in this physiographic setting generally ranges between 5 and 14 inches
 5 thick.

6 **Floodplain and Stream Terrace Soils**

7 Floodplain and stream terrace soils are mineral soils located adjacent to major rivers and other
 8 streams, and may be associated with landward sediment accumulations behind natural levees. Soils are
 9 stratified, with relatively poor drainage and fine textures. Examples include Sailboat-Scribner-
 10 Cosumnes and Egbert-Valpac associations adjacent to the Sacramento River, and the Columbia-
 11 Cosumnes association adjacent to the Cosumnes River and other streams in Sacramento County
 12 (Figure 10-1). The Merritt-Grangeville-Columbia and Columbia-Vina-Coyote Creek associations in San
 13 Joaquin County (Figure 10-1) are additional examples.

14 The topsoil layer of the soils in this physiographic setting generally ranges between 8 and 20 inches
 15 thick.

16 **Valley Fill, Alluvial Fan, and Low Terrace Soils**

17 Valley fill, alluvial fan, and low terrace soils are typically very deep with variable texture and ability to
 18 transmit water. Alluvial fan soils range from somewhat poorly drained fine sandy loams and silty clay
 19 loams (e.g., the Sycamore-Tyndall association in Yolo County) to well-drained silt loams and silty clay
 20 loams (e.g., the Yolo-Brentwood association in Yolo County). Soils on low terraces include the San
 21 Joaquin association in Sacramento County and San Joaquin-Bruella and Madera soils in San Joaquin
 22 County, which are moderately well-drained with a claypan subsoil and have a cemented hardpan at a
 23 depth of 20–40 inches (Soil Conservation Service 1992, 1993). A perched water table may be present
 24 (e.g., the Capay-Sycamore-Brentwood association in Contra Costa County [Soil Conservation Service
 25 1977a]), or a high water table may sometimes be present as the result of irrigation (e.g., the Capay
 26 association on interfan basins of San Joaquin County [Soil Conservation Service 1992]). Delhi soils have
 27 sandy textures on dunes and are very deep and somewhat excessively drained (e.g., the Delhi-Veritas-
 28 Tinnin association on dunes, alluvial fans, and low fan terraces in San Joaquin County, and the Delhi
 29 association in Contra Costa County [Soil Conservation Service 1992, 1977a]).

30 The topsoil layer of the soils in this physiographic setting generally ranges between 6 and 26 inches
 31 thick.

32 **Upland and High Terrace Soils**

33 Upland and high terrace soils in general are well-drained and range in texture from loams to clays.
 34 These soils primarily formed in material weathered from sandstone, shale, and siltstone, and can occur
 35 on dissected terraces (e.g., Altamont-Diablo association in Solano and Alameda Counties) (Figure 10-1)
 36 or on mountainous uplands (Dibble-Los Osos and Millsholm associations in Solano County [Soil
 37 Conservation Service 1977b]). Erosion by surface water flows may be a hazard where slopes are steep.
 38 The subsoil may be slowly permeable (e.g., Corning-Hillgate association in Yolo County) (Figure 10-1),
 39 or a cemented hardpan may be present at depth (Redding-Yellowlark soils in San Joaquin County)
 40 (Figure 10-1).

1 The topsoil layer of the soils in this physiographic setting generally ranges between 7 and 30 inches
 2 thick, with the thicker A horizons always occurring among the soils that are clay throughout the profile.

3 **10.1.1.2 Soil Physical and Chemical Properties**

4 Soil physical and chemical characteristics affect the way a soil “behaves” under specific land uses. These
 5 characteristics are especially important for engineering considerations. Suitability and limitation
 6 ratings for various engineering uses are identified in Appendix 10B, *NRCS Soil Suitability Ratings*.
 7 Relevant soil physical and chemical properties described in this section are expansiveness (i.e., shrink-
 8 swell potential) and erodibility by water and wind. Physical and chemical properties of soils in the Plan
 9 Area are detailed in Appendix 10C, *Soil Chemical and Physical Properties*, and are described in the
 10 following sections. Other soil properties shown in Appendix 10C but not discussed below include those
 11 properties that are important for evaluation of soil suitability for agriculture, including Storie Index,
 12 Land Capability Classification, and Prime Farmland soils. A discussion of these characteristics, which
 13 are relevant to agricultural use, is provided in Chapter 13, *Land Use*, and Chapter 14, *Agricultural*
 14 *Resources*.

15 **Expansive Soils (Shrink-Swell Potential)**

16 Expansive soils increase in volume when wet and shrink in volume when dry. The degree of
 17 expansiveness, or shrink-swell potential, depends on the type and amount of clay content in the soil.
 18 The highest shrink-swell potential exists in soils with high amounts of smectitic clays. Expansiveness
 19 can be characterized by measuring a soil’s linear extensibility percentage (LEP), which is the change in
 20 length of an unconfined soil clod as moisture content is decreased from a moist to a dry state, reported
 21 as a percentage (Natural Resources Conservation Service 2010a). See Appendix 10C for the LEP of the
 22 soil map units for the upper 5 feet of the soil profile. Table 10-1 shows the shrink-swell soil classes
 23 based on LEP.

24 **Table 10-1. Shrink-Swell Soil Classes Based on Linear Extensibility Percentage**

Shrink-Swell Class	LEP
Low	<3
Moderate	3–6
High	6–9
Very High	≥9

Source: Natural Resources Conservation Service 2010b.

Note: LEP = linear extensibility percentage

25
 26 Figure 10-4 shows the LEP classes for the upper 5 feet of soil material. The LEP of soil materials below
 27 approximately 5 feet is not rated. Where one soil layer in the soil profile has a different LEP than other
 28 layers, the layer with the highest LEP is shown on the figure. Areas of the Plan Area with the highest
 29 soil shrink-swell potential include large portions of the northern and southwestern parts of the Delta,
 30 the Yolo Bypass, and areas within Suisun Marsh (Figure 10-4). Soils with the lowest shrink-swell
 31 potential occur in the central and southeastern parts of the Delta.

1 **Water Erodibility**

2 Water erosion results when raindrop impact detaches soil particles and flowing water removes and
 3 transports soil material. Sheet erosion removes soil from an area in a fairly uniform manner without
 4 development of discrete channels. Rill erosion removes soil through the cutting of many small but
 5 discrete channels where runoff concentrates. Gully erosion occurs when water cuts down into the soil
 6 along the line of flow, and the cut channels are deep enough that they cannot be obliterated through
 7 tillage. Soil loss through sheet and rill erosion can be predicted through models, such as the Revised
 8 Universal Soil Loss Equation (RUSLE). RUSLE predicts soil loss based on numerous factors, including
 9 rainfall erosivity, soil erodibility (defined below), slope length and steepness, vegetative cover, and
 10 management practices (Natural Resources Conservation Service 2010b).

11 Appendix 10C includes soil erodibility factors for each soil map unit in the Plan Area. The soil
 12 erodibility factor (Kw) is a relative index of the susceptibility of a bare, cultivated soil to particle
 13 detachment and transport by raindrop impact and runoff, but does not reflect the influence of slope on
 14 potential erosion rates. Therefore, the erosion hazard may be low in a level area with soils that have a
 15 high Kw value. Experimentally measured Kw values vary from 0.02 to 0.69, with the higher end of the
 16 range representing soils with greater susceptibility to particle detachment and transport. Clayey and
 17 sandy soils have low Kw values because the soil particles are resistant to detachment from raindrop
 18 impact (clayey soils) or because of their higher infiltration capacity (sandy soils). Loamy soils have
 19 moderate Kw values. Silty soils are the most susceptible to water erosion, with high Kw values
 20 (Michigan State University 2002).

21 Figure 10-5 provides water erosion hazard ratings for the surface layer of soils in the Plan Area
 22 (Natural Resources Conservation Service 2010a). *Erosion hazard* refers to the degree to which a soil
 23 will be subject to accelerated erosion rates when the land surface is disturbed. Erosion hazard is
 24 primarily controlled by the soil erodibility factor and the steepness of the slope. The soil survey hazard
 25 ratings shown in Figure 10-5 are based on sheet or rill erosion in areas outside of roads and trail areas,
 26 where 50–75% of the land surface has been exposed by ground-disturbing activities². Hazard ratings
 27 range from “slight,” which indicates that erosion is unlikely under ordinary climatic conditions, to “very
 28 severe,” which indicates that significant erosion is expected, loss of soil productivity, and offsite
 29 damage are likely, and erosion-control measures are costly and generally impractical (Natural
 30 Resources Conservation Service 2010a). The ratings show the relative water erosion hazard that would
 31 exist during construction or other ground-disturbing activities. The water erosion hazard ratings are
 32 based on the dominant soil present, although other, minor soil components also may be present within
 33 the map unit. Because of the level to nearly level slopes, water erosion hazard is rated as slight
 34 throughout most of the Plan Area; in more sloping areas, the water erosion hazard ranges from
 35 moderate to very severe.

36 **Soil Erodibility by Wind**

37 Soil erodibility by wind is related to soil texture, organic matter content, calcium carbonate content,
 38 rock fragment content, mineralogy, and moisture content. NRCS assigns soil map units to one of eight
 39 wind erodibility groups (WEGs) based on susceptibility to blowing (Natural Resources Conservation

² For the purpose of this analysis, the erosion hazard rating for areas of Histosols and mucky mineral soils was modified from that provided in the SSURGO database to compensate for the influence of high organic matter content on the rating. The Histosols and mucky mineral soils in the Plan Area typically have a very low Kw value (i.e., 0.02). This low soil erodibility, combined with level to nearly level slopes, results in a slight erosion hazard in such areas; this characterization is consistent with the manuscript versions of the county soil survey reports.

1 Service 2010b): 1, 2, 3, 4, 4L, 5, 6, 7, and 8. The WEGs assume that the soil that has been cultivated or is
 2 bare. The organic soils of the Suisun Marsh and the central Delta have a high susceptibility to wind
 3 erosion, as indicated by their classification in WEGs 1 through 3. Figure 10-6 shows the WEG of the
 4 surface layer of the soils in the Plan Area (CPA).

5 **10.1.1.3 Soil Suitability and Use Limitation Ratings**

6 Physical and chemical properties of soils are used by NRCS to determine suitability for various uses,
 7 such as for agriculture, levee construction, urban development, or marsh wildlife habitat. Suitability
 8 and limitation ratings for soil use in embankments, dikes, and levees; shallow excavations; and
 9 corrosivity are identified in Appendix 10B, *NRCS Soil Suitability Ratings* (Natural Resources
 10 Conservation Service 2010b).

11 **Use Limitations for Embankments, Dikes, and Levees**

12 Construction of embankments, dikes, and levees requires soil material that is resistant to seepage,
 13 piping, and erosion and that has favorable compaction characteristics. Soils with limited suitability for
 14 construction of embankments and levees include those with high organic matter content, high stone
 15 content, elevated sodium, high shrink-swell potential, and high gypsum (calcium sulfate) content
 16 (Natural Resources Conservation Service 2010b).

17 Soil use limitation ratings of slightly limited, somewhat limited, limited, and very limited, are provided
 18 in Appendix 10B for each soil map unit. The rating is given for the whole soil, from the surface to a
 19 depth of about 5 feet, based on the assumption that soil horizons will be mixed in loading, dumping,
 20 and spreading. The ratings do not indicate the suitability of the undisturbed soil for supporting the
 21 embankment. Soil properties to a depth greater than the embankment height have an effect on the
 22 performance and safety of the embankment (e.g., low-density silts and clays in the supporting
 23 foundation generally have excessive settlement and low strength); therefore, geotechnical studies must
 24 generally be made to evaluate suitability as load-bearing surfaces. Nearly all soil units in the Plan Area
 25 have some restrictions associated with use for embankments, dikes, or levees, and the suitability of
 26 most soil types for these features is very limited (Appendix 10B).

27 **Use Limitations for Shallow Excavations**

28 Shallow excavations are trenches or holes dug in the soil to a maximum depth of 5 or 6 feet for
 29 construction of pipelines, sewer lines, telephone and power transmission lines, basements, and open
 30 ditches. These excavations are most commonly made by trenching machines or backhoes. Use
 31 limitation ratings are defined as slight, somewhat limited, limited, and very limited based on the soil
 32 properties that influence ease of excavation and resistance to sloughing. Restrictive properties
 33 adversely influence the ease of digging, filling, and compacting, and include shallow depth to bedrock or
 34 cemented pan and presence of large stones. Presence of a seasonally high water table and flooding may
 35 restrict the period when excavations can be made. Slope influences the ease of using machinery and
 36 accessibility. Soil texture and depth to water table influence the resistance of soil walls to sloughing
 37 (Natural Resources Conservation Service 2010b).

38 Use limitations for shallow excavations in the Plan Area are predominantly a result of caving potential
 39 of clay soils, slopes greater than 15%, soil saturation less than 2.5 feet in depth, and presence of high
 40 organic matter content to a depth of 20 inches below ground surface (Natural Resources Conservation
 41 Service 2010b). Nearly all soil map units in the Plan Area have some restrictions associated with
 42 shallow excavations, and many soil map units have a rating of very limited (Appendix 10B).

1 **10.1.1.4 Risk of Corrosion to Uncoated Steel**

2 Uncoated steel corrodes when soil-induced electrochemical or chemical actions convert iron from steel
 3 into its respective ions and cause the uncoated steel to dissolve or weaken (Natural Resources
 4 Conservation Service 2010b). The rate of deterioration of uncoated steel is controlled by soil moisture
 5 content, soil texture, acidity, and soluble salt content. The Soil Survey Handbook provides three classes
 6 of corrosion risk to uncoated steel (low, medium, and high), and the NRCS guidance for estimating
 7 corrosion risk is shown in Table 10-2.

8 **Table 10-2. Guidance for Estimating Corrosion Risk to Uncoated Steel^a**

Property	Limits		
	Low	Moderate	High
Drainage Class and Texture	Excessively drained coarse textured or well-drained, coarse to medium textured soils; or moderately well-drained coarse textured, soils; or somewhat poorly drained, coarse textured soils	Well-drained, moderately fine textured soils; or moderately well-drained, medium textured soils; or somewhat poorly drained, moderately coarse textured soils; or very poorly drained soils with stable high water table	Well-drained, fine textured or stratified soils; or moderately well-drained, fine and moderately fine textured or stratified soils; or somewhat poorly drained, medium to fine textured or stratified soils; or poorly drained soils with fluctuating water table
Total Acidity (milliequivalents per 100 grams) ^b	<8	8–12	≥12
Resistivity at Saturation (ohms per centimeter) ^c	≥5,000	2,000–5,000	<2,000
Conductivity of Saturated Extract (millimhos per centimeter) ^d	<0.3	0.3–0.8	≥0.8

Source: Natural Resources Conservation Service 2010b.

^a Based on data in the publication *Underground Corrosion*, Table 99, p. 167, Circular 579, U.S. Department of Commerce, National Bureau of Standards.

^b Total acidity is roughly equal to extractable acidity (as determined by Soil Survey Laboratories Method 6H1a, Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004).

^c Roughly equivalent to resistivity of fine- and medium-textured soils measured at saturation (Method 8E1, Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November, Natural Resources Conservation Service 2004). Resistivity at saturation for coarse-textured soil is generally lower than when obtained at field capacity and may cause the soil to be placed in a higher corrosion class.

^d Method 8A1a, Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, Version 4.0, November 2004. The relationship between resistivity of a saturated soil paste (Method 8E1) and electrical conductivity of the saturation extract (Method 8A1a), is influenced by variations in the saturation percentage, salinity, and conductivity of the soil minerals. These two measurements generally correspond closely enough to place a soil in one corrosion class. (For reference, 1 millimho per centimeter = 1 deciseimen per meter.)

9

1 In the Plan Area, most soil units are expected to have a high potential to cause corrosion to uncoated
2 steel (Figure 10-7 and Appendix 10B).

3 **10.1.1.5 Risk of Corrosion to Concrete**

4 Corrosion to concrete results from a chemical reaction between a base (the concrete) and a weak acid
5 (the soil solution). Construction activities may need to use special types of cement when local soils have
6 a high risk of corrosion (Natural Resources Conservation Service 2010b). The rate of concrete
7 deterioration depends on soil texture and acidity, the amount of sodium, or magnesium sulfate and
8 calcium sulfate (gypsum) present in the soil. In particular, soils containing gypsum generally require a
9 special cement to reduce risk of corrosion. The NRCS Soil Survey Handbook classifies risk of corrosion
10 to concrete as low, moderate, or high, in accordance with the guidelines provided in Table 10-3.

11 **Table 10-3. Soil Classification for Risk of Corrosion to Concrete**

Property	Limits ^a		
	Low	Moderate	High
Texture and Reaction	Sandy and organic soils with pH >6.5 or medium and fine textured soils with pH >6.0	Sandy and organic soils with pH 5.5 to 6.5 or medium and fine textured soils with pH 5.0 to 6.0	Sandy and organic soils with pH <5.5 or medium and fine textured soils with pH <5.0
Sodium and/or Magnesium Sulfate (ppm)	<1,000	1,000–7,000	>7,000
Sodium Chloride (ppm)	<2,000	2,000–10,000	>10,000

Source: Natural Resources Conservation Service 2010b.

Notes: pH = measure of acidity or alkalinity; ppm = part(s) per million

^a Based on data in *National Handbook of Conservation Practices*, Standard 606, Subsurface Drain, Natural Resources Conservation Service 1980.

ppm = parts per million

12

13 In the Plan Area, most soil units are expected to have a low to moderate potential to cause corrosion to
14 concrete (Figure 10-8).

15 **10.1.2 Land Subsidence**

16 Land subsidence is a gradual settling or sudden sinking of the earth's surface resulting from subsurface
17 movement of earth materials (Galloway et al. 2000). Although subsidence can have various causes, such
18 as aquifer compaction, drainage of organic soils, underground mining, extraction of oil and natural gas,
19 natural compaction, tectonic movement (changes resulting from movements in the Earth's crust), and
20 sinkholes, the primary cause in the Delta is decomposition of organic carbon in the peat soils. This
21 section summarizes the scientific and technical literature on land subsidence in the Delta.

22 **10.1.2.1 History**

23 For more than 7,000 years, a balance existed between sediment influx to the Delta, production of
24 organic sediment in the Delta, and export of sediment to San Francisco Bay. During this time, marsh

1 conditions were supported. Much of the area was covered with dense stands of tule (*Scirpus lacustris*),
 2 with riparian plant species occupying higher stream banks (natural levees) where mineral soils were
 3 present (Weir 1950). The land elevation was at or near sea level, and the land surface was inundated at
 4 high tide and when flood conditions were present. Equilibrium conditions promoted the development
 5 of peat soils to depths of up to approximately 30 feet in some areas (Weir 1950).

6 This equilibrium was first disrupted when large volumes of sediment influx occurred from hydraulic
 7 mining in the mid-1800s, then by subsequent reclamation of Delta tule marsh islands that took place
 8 from the late 1800s through about 1930 (Weir 1950). With passage of the Swamp and Overflow Act of
 9 1850 (when title of lands in the Delta passed from federal to state control), the marshlands began to be
 10 drained for conversion to agricultural use. Levees were constructed around Delta islands to exclude
 11 floods and tidal overflow. Much of the construction material was channel sediment excavated by a
 12 clamshell dredge. Following levee construction, tule marshes on island interiors began to die and were
 13 burned, drainage ditches were constructed at the perimeter of levees, and pumps were installed to
 14 transfer drainage water from the island interiors into the adjacent waterways (Weir 1950). The land
 15 was cultivated when it was dry enough for plowing.

16 The ages of Delta islands are related to the date they were reclaimed. For example, Lower Jones Tract
 17 was drained and put into cultivation in 1902, cultivation on Bacon Island began in 1915, and Mildred
 18 Island was first farmed in 1921. Most of the Delta was in cultivation in 1922, when land subsidence was
 19 first investigated (Weir 1950). The Delta's present form dates to the 1930s, when approximately
 20 100 islands and tracts had been drained and more than 1,000 miles of levees had been constructed
 21 (Ingebritsen et al. 2000).

22 **10.1.2.2 Causes of Subsidence**

23 The primary cause of land subsidence in the Delta has been attributed to microbial decomposition of
 24 peat soils (Ingebritsen et al. 2000; Deverel and Rojstaczer 1996). Waterlogged soils contain little
 25 oxygen, which is necessary for microbial decomposition of organic matter. Under anaerobic conditions,
 26 organic matter from plant materials accumulates faster than it can decompose. When the Delta islands
 27 were drained, the formerly saturated soils became oxygen rich and conditions favored microbial
 28 oxidation. When organic carbon is oxidized from peat soils, it is emitted as CO₂ gas to the atmosphere,
 29 thereby reducing the soil carbon pool and soil volume (Deverel and Rojstaczer 1996). The agricultural
 30 cultivation of the Delta's peat soils has, over time, contributed to the subsidence of most Delta islands,
 31 particularly in the West and Central Delta. Prior to agricultural development, the soil was waterlogged
 32 and anaerobic (oxygen-poor). Organic carbon accumulated faster than it could decompose. Drainage
 33 for agriculture led to aerobic (oxygen-rich) conditions that favor rapid microbial oxidation of the
 34 carbon in the peat soil. Most of the carbon loss is emitted as carbon dioxide gas to the atmosphere
 35 (Deverel and Rojstaczer 1996).

36 Other processes that may be contributing to land subsidence in the Delta are discussed below.

- 37 • Anaerobic decomposition of peat soils. Although anaerobic decomposition is considered a minor
 38 contributor to subsidence, some studies from the 1960s found that considerable decomposition
 39 occurred immediately below the groundwater table and accelerated with cycles of soil wetting and
 40 drying (Delta Protection Commission 1993).
- 41 • Soil compaction caused by consolidation and farm equipment. Shrinkage, consolidation, and
 42 compaction are responsible for the initial subsidence, specifically within about the first 3 years

- 1 after the water table is lowered. After this, a degree of stability is reached and subsidence declines
 2 to a steady rate, primarily because of oxidation (Natural Resources Conservation Service 2010b).
- 3 • Soil shrinkage. Organic soils shrink up to 50% in volume when dried; when undecomposed peat
 4 soils are exposed to the atmosphere, they will shrink upon drying (Delta Protection Commission
 5 1993).
 - 6 • Burning. This practice was common between 1900 and 1950, and was used to add nutrients to the
 7 soil, expose fresh peat, and control weeds and disease. Burning was especially common during
 8 World War II, when potatoes and sugar beets, crops with a high potassium requirement, were most
 9 in demand. Each burning event could result in loss of 3–5 inches of soil, and fields were typically
 10 burned every 3–5 years (Weir 1950). Burning has not been performed routinely since the 1960s.
 - 11 • Wind erosion. Wind erosion was estimated to result in the removal of 0.25–0.5 inch of topsoil per
 12 year. Peat soils have a low bulk density (often less than 1 gram per cubic centimeter before
 13 decomposition). During cultivation, clouds of dust surround tractors unless the soil is moist. If bare
 14 soils are exposed when fields are not being cropped, such as occurred historically on asparagus
 15 fields in the springtime, large amounts of soil can be lost to wind erosion (Weir 1950).
 - 16 • Dissolution of organic matter. This process is estimated to account for only about 1% of observed
 17 subsidence (Deverel and Rojstaczer 1996).
 - 18 • Water, oil, and gas extraction. Water and gas extraction are not important factors in land
 19 subsidence in the Delta (Rojstaczer et al. 1991). Although slight groundwater-induced subsidence
 20 may occur during the summer months, elevations rebound during the winter months. On the other
 21 hand, groundwater extraction has historically resulted in substantial subsidence in the San Joaquin
 22 Valley outside of the Delta, and reduced imported water deliveries could lead to increased
 23 groundwater reliance and renewed subsidence in these areas (Ingebritsen et al. 2000).

24 **10.1.2.3 Rates of Subsidence and Current Conditions**

25 The rate of decomposition of organic soils is related to temperature and moisture conditions (Buol et
 26 al. 1980). The microbial activity that drives the oxidation of peat soils approximately doubles with a
 27 10-degree increase in soil temperature. However, the rate of CO₂ loss is reduced when soils are wet and
 28 contain little oxygen (Deverel and Rojstaczer 1996). Therefore, activities that increase oxygen in the
 29 subsurface (e.g., construction of underdrains to improve drainage) lead to decomposition of peat soils,
 30 and the rate of decomposition increases during warmer times of the year.

31 Historical subsidence rates in the Delta have been found to strongly correlate with the organic matter
 32 content of the soil and the age of the reclaimed island (Rojstaczer and Deverel 1995). In 1948, Lower
 33 Jones Tract, Mildred Island, and Bacon Island were all between 10 and 11 feet below sea level and were
 34 continuing to subside at the rate of 3–4 inches per year. Rojstaczer and Deverel (1995) quoted sources
 35 that suggest historical subsidence rates ranged from 1.8 to 4.6 inches per year, with higher rates
 36 associated with areas in the central Delta. Ingebritsen et al. (2000) indicated that long-term average
 37 rates of subsidence are 1–3 inches per year.

38 Rojstaczer and Deverel (1993) and Mount and Twiss (2005) also showed that subsidence rates on
 39 Lower Jones Tract, Mildred Island, and Bacon Island have slowed with time.

40 Deverel and Rojstaczer (1996) found that, while a certain amount of subsidence was caused by
 41 seasonal fluctuation in water table elevations, subsidence due primarily to biological oxidation of peat
 42 soils on three islands (Jersey Island, Orwood Tract, and Sherman Island) occurred at a rate of 0.27 inch

1 per year, 0.32 inch per year, and 0.18 inch per year, respectively, in the 1990s. Dissolved organic
 2 carbon flux contributed less than 1% of the measured subsidence. Flux of dissolved organic carbon was
 3 greater and pH was lower in drainage waters when water table levels were seasonally located in soil
 4 layers containing highly decomposed organic matter.

5 Geographically, the soils within the centers of Delta islands typically have greater organic matter
 6 content than those near the margins close to levees. Consequently, the center areas also experience
 7 greater subsidence, and the land surface tends toward a saucer shape with the lowest elevation at
 8 island centers. Approximately 100 years following drainage of the Delta islands, many are 10–25 feet
 9 below sea level. Figure 10-9 shows the existing generalized elevations throughout most of the Plan
 10 Area. Areas that are at elevations lower than -5 feet can be assumed to have subsided.

11 Drainage ditches now maintain the water table at about 2.5–5 feet below the land surface. With
 12 continuing subsidence, however, ditches must be deepened periodically to keep the water table below
 13 the crop root zone.

14 Some recent estimates, including those developed as part of the DWR's Delta Risk Management
 15 Strategy, predict that 3–4 feet of additional subsidence will occur in the central portion of the Delta by
 16 2050 (California Department of Water Resources 2007).

17 **10.1.2.4 Consequences of Land Subsidence**

18 Land subsidence has direct or indirect consequences on land use, water supply and quality, and other
 19 operations and uses of the Delta. These consequences are discussed in this section.

20 **Levee Instability**

21 As land subsides, the difference in water surface elevation between channels and the island interior
 22 becomes greater. This hydraulic head difference between the water surface of the channels and the
 23 island interiors increases hydrostatic forces on levees, which decreases levee stability and contributes
 24 to seepage through and under levees (Mount and Twiss 2005). Furthermore, as the land subsides, the
 25 shallow groundwater level becomes nearer to the ground surface, and drainage ditches along the toe of
 26 the levee must be deepened to ensure that the water table remains below the crop root zone. This
 27 practice decreases levee stability by reducing lateral support to levee foundations, which also leads to
 28 increased risk of levee failure. Many of the Delta islands have experienced levee breaches. Levee
 29 instability is described more thoroughly in Chapter 6, *Surface Water*.

30 **Infrastructure Damage**

31 In addition to levees, subsidence can damage infrastructural improvements such as pipelines, roads,
 32 railroads, canals, bridges, utility tower foundations, storm drains, and sanitary sewers, as well as public
 33 and private buildings and water, oil, and gas well casings. These effects can be particularly acute in
 34 areas of differential subsidence, in which the amount of ground level lowering varies over short
 35 distances.

36 **Water Supply Disruption**

37 Levee instability because of subsidence could disrupt the water source for more than two-thirds of
 38 California's population. The presence of the western Delta islands is believed to inhibit the migration of
 39 the salinity interface between the San Francisco Bay and the Delta. Were these islands to experience a

1 levee breach and become inundated, water in the southern Delta might become too saline to use as
 2 drinking water (Ingebritsen et al. 2000). Effects related to salinity and water quality are discussed in
 3 Chapter 8, *Water Quality*.

4 **Greenhouse Gas Emissions and Climate Change**

5 On a global scale, soil organic carbon lost by oxidation and combustion can significantly contribute to
 6 the amount of CO₂ in the atmosphere. Worldwide annual input of carbon to the atmosphere from
 7 agricultural drainage of organic soils may be as much as 6% of that produced by fossil fuel combustion;
 8 the Delta has been estimated to contribute 2 million tons of carbon per year to the atmosphere through
 9 oxidation of peat soils (Rojstaczer and Deverel 1993). Increased carbon in the Earth's atmosphere has
 10 been tied to increased concentrations of greenhouse gases and global climate change (California
 11 Department of Water Resources 2005). Greenhouse gas emissions and global climate change are
 12 discussed in Chapter 29, *Climate Change* and Chapter 22, *Air Quality and Greenhouse Gas Emissions*.

13 **Water Quality Degradation**

14 Land subsidence can indirectly affect water quality by reducing levee integrity and increasing the risk
 15 of breaches. The present configuration of Delta islands may help ensure salinity intrusion does not
 16 increase salinity levels in Delta waterways, which would potentially reduce suitability of these waters
 17 for various uses, including drinking water supply and agricultural water supply. Although not a major
 18 cause of subsidence, dissolution of peat soils contributes dissolved organic carbon in drainage waters,
 19 which further reduces water quality. Water quality is discussed in Chapter 8, *Water Quality*.

20 **Soil Productivity Degradation**

21 As the land surface subsides, the plant root zone becomes nearer to the shallow groundwater level.
 22 This is of particular significance in areas that are close to or below sea level, such as the organic soils of
 23 the Delta. A shallow water table can cause saturation of the root zone, making a soil less productive and
 24 limiting the types of crops that can be grown. The effects of subsidence on crop production and types
 25 are further discussed in Chapter 14, *Agricultural Resources*.

26 **10.2 Regulatory Setting**

27 This section describes federal and state codes, plans, policies, regulations, and laws and regional or
 28 local plans, policies, regulations, and ordinances that pertain to soil resources. The focus of this section
 29 is on laws and regulations related to soil hazards. The codes, plans, policies, regulations, and
 30 ordinances discussed below inform minimum design and construction requirements for some aspects
 31 of the BDCP water conveyance facility (CM1) and the other conservation measures (CM2–CM22). These
 32 act as performance standards for engineers and construction contractors and their implementation is
 33 considered an environmental commitment of the agencies implementing the BDCP. This commitment is
 34 discussed further in Appendix 3B, *Environmental Commitments*.

35 **10.2.1 Federal Plans, Policies, and Regulations**

36 Federal laws and regulations that are relevant to soils include the portions of the Clean Water Act
 37 (CWA) and implementing regulations that establish requirements for stormwater discharges from
 38 construction sites. As noted, these laws and regulations are thoroughly described in Chapter 8, *Water*

1 *Quality*. However, because they are related to activities applicable to soil resources, such as excavation
2 and grading, they are summarized in this section.

3 **10.2.1.1 Clean Water Act Section 402, National Pollutant Discharge** 4 **Elimination System Program: Storm Water Permitting**

5 In November 1990, the U.S. Environmental Protection Agency (EPA) established regulations to mainly
6 address construction related run-off and sedimentation into streams that established stormwater
7 permit requirements for specific categories of industries, including construction (Phase I Rule). Under
8 Phase I, a stormwater permit was required for construction projects that disturbed 5 or more acres of
9 land, and for large Municipal Separate Storm Sewer Systems (MS4s). In December 1999, EPA
10 promulgated regulations (Phase II Rule) that expanded the National Pollutant Discharge Elimination
11 System (NPDES) to require a stormwater discharge permit for construction activities with a
12 disturbance area of 1–5 acres and for small MS4s. In California, EPA has delegated responsibility for
13 CWA implementation to the State Water Resources Control Board (State Water Board).

14 **10.2.2 State Plans, Policies, and Regulations**

15 **10.2.2.1 Porter-Cologne Water Pollution Control Act**

16 The Porter-Cologne Water Pollution Control Act (Porter-Cologne Act) (California Water Code, Division
17 7) is the state law governing water quality in California. Under the Porter-Cologne Act, responsibilities
18 for coordination and control of water quality are assigned to the State Water Board and nine Regional
19 Water Quality Control Boards (Regional Boards). The Delta and Suisun Marsh are in the jurisdictions of
20 the Central Valley Regional Board and the San Francisco Bay Regional Board, respectively. These
21 Regional Boards are responsible for ensuring that construction activities comply with the state general
22 permit regulating construction activities (discussed below).

23 **10.2.2.2 National Pollutant Discharge Elimination System General Permit** 24 **for Storm Water Discharges Associated with Construction and Land** 25 **Disturbance Activities**

26 In 2009, the State Water Board adopted the General Permit for Storm Water Discharges Associated
27 with Construction and Land Disturbance Activities, State Water Board Order No. 2009-0009-DWQ
28 (General Permit), which regulates stormwater discharges from construction sites that involve 1 acre or
29 more of disturbed area. Coverage under the General Permit is obtained by submitting permit
30 registration documents to the State Water Board, which include a risk level assessment and a site-
31 specific stormwater pollution prevention plan (SWPPP) that identifies an effective combination of
32 erosion control, sediment control, and non-stormwater best management practices (BMPs). The
33 General Permit requires that the SWPPP define a program of regular inspections of the BMPs and in
34 some cases sampling of water quality parameters. Bay Delta Conservation Plan (BDCP) construction
35 activities would require coverage under the General Permit.

36 **10.2.2.3 Municipal Separate Storm Sewer Systems Permits**

37 The Phase I Rule required that large MS4s obtain a stormwater discharge permit, and the Phase II Rule
38 expands the requirement to small MS4s. Generally, Phase I MS4s are covered by individual permits
39 while Phase II MS4s are covered by a general permit. In the Plan Area, individual MS4 permits have

1 been issued for several municipal jurisdictions, which are identified in Chapter 8, *Water Quality*. Phase I
 2 and II MS4 permits require permittees to develop and implement stormwater management plans that
 3 include provisions for reducing pollutant discharges from construction activities. Local jurisdictions are
 4 responsible for enforcement of those provisions. Future BDCP construction activities would need to
 5 implement soil erosion and sediment control measures that are consistent with municipal stormwater
 6 management plan requirements.

7 **10.2.2.4 Nonpoint Source Implementation and Enforcement Policy**

8 The state's Nonpoint Source Implementation and Enforcement Policy describes how its nonpoint
 9 source (NPS) plan is to be implemented and enforced, in compliance with Section 319 of the CWA,
 10 Coastal Zone Act Reauthorization Amendments, and the Porter-Cologne Act. In contrast to point source
 11 pollution that enters water bodies from discrete conveyances, NPS pollution enters water bodies from
 12 diffuse sources, such as land runoff, seepage, or hydrologic modification. NPS pollution is controlled
 13 through implementation of management measures. The NPS program contains recommended
 14 management measures for developing areas and construction sites, as well as wetland and riparian
 15 areas. Requirements for soil erosion and sediment controls to prevent NPS sediment discharges to
 16 waterways may be incorporated into permits issued by the San Francisco Bay Conservation and
 17 Development Commission (BCDC) or other regulatory entities.

18 **10.2.2.5 McAteer-Petris Act**

19 BCDC was permanently established by the McAteer-Petris Act of 1969, which gave the agency
 20 jurisdiction over certain activities in San Francisco Bay and portions of Suisun Marsh below the 10-foot
 21 contour line (including islands, levees, and grasslands), and any creeks or streams that flow into the
 22 bay. BCDC's authority includes issuing permits for dredging, grading, or construction, and repair or
 23 remodeling of structures within areas in the agency's jurisdiction.

24 **10.2.2.6 Suisun Marsh Preservation Act of 1977 and Suisun Marsh 25 Protection Plan (1976)**

26 The Suisun Marsh Preservation Act of 1977 adopted and called for the implementation of the Suisun
 27 Marsh Protection Plan (San Francisco Bay Conservation and Development Commission 1976). BCDC is
 28 the state agency designated to administer the plan, certify consistency of local protection programs
 29 with the plan, hear appeals on local governmental decisions affecting Suisun Marsh, and decide what
 30 developments should be permitted within the primary management zone. The objectives of the plan,
 31 developed in coordination with the California Department of Fish and Wildlife (DFW), are to preserve
 32 and enhance the quality and diversity of the Suisun Marsh aquatic and wildlife habitats, and to ensure
 33 retention of upland areas adjacent to the Suisun Marsh in uses compatible with its protection (San
 34 Francisco Bay Conservation and Development Commission 1976). BDCP activities in the Suisun Marsh
 35 that may be regulated under the Suisun Marsh Preservation Act include dredging, reduction of
 36 agricultural land by flooding of islands, and erosion control measures. If restoration activities are
 37 conducted in the Suisun Marsh in areas under BCDC jurisdiction, a permit from that agency would
 38 include measures to control soil erosion and sedimentation.

39 **10.2.2.7 California Building Code**

40 California's minimum standards for structural design and construction are provided in the California
 41 Building Code (CBC) (California Code of Regulations [CCR], Title 24). The CBC provides standards for

1 various aspects of construction, including excavation, grading, and fill. It provides requirements for
 2 classifying soils and identifying corrective actions when soil properties (e.g., expansive and corrosive
 3 soils) could lead to structural damage. BDCP water conveyance facility and restoration component
 4 construction activities would require conforming with the CBC.

5 **10.2.3 Regional and Local Plans, Policies, and Regulations**

6 **10.2.3.1 General Plans, Ordinances, and Codes**

7 Cities and counties have developed ordinances, policies, and other regulatory mechanisms for
 8 controlling pollutant discharges in construction site runoff, including grading and erosion control
 9 ordinances and drainage and land leveling ordinances. Development and implementation of local
 10 control measures, including adoption of ordinances, are generally requirements of MS4 permits issued
 11 by Regional Boards. An application for a grading permit typically includes vicinity and site maps, a
 12 grading plan, and an engineered erosion, sediment, and runoff control plan. Local permits are generally
 13 required for construction activities, and construction projects must conform to local drainage and
 14 erosion control policies and ordinances.

15 Certain county general plans that cover the Plan Area also contain policies to conserve topsoil or soil *as*
 16 *a resource*, without regard to its agricultural suitability or prime farmland status. Relevant provisions of
 17 these county general plans are outlined below.

18 **Contra Costa County General Plan**

19 A comprehensive update to the *Contra Costa County General Plan* was adopted on January 18, 2005, to
 20 guide future growth, development, and resource conservation through 2020 (Contra Costa County
 21 2005). Amendments to the general plan occurred in 1996 and 2005 to reflect changes to the land use
 22 map and the incorporation of the City of Oakley, and the Housing Element was updated in 2009 (Contra
 23 Costa County 2010).

24 Relevant goals of the Contra Costa County General Plan (Contra Costa County 2010) pertaining to soils
 25 as a resource are listed below.

- 26 ● **Goal 8-P:** To encourage the conservation of soil resources to protect their long-term productivity
 27 and economic value.
- 28 ● **Goal 8-Q:** To promote and encourage soil management practices that maintain the productivity of
 29 soil resources.

30 The following policy pertaining to soils as a resource appears in the general plan.

- 31 ○ **Policy 8-63:** The County shall protect soil resources within its boundaries.

32 **Sacramento County General Plan**

33 The *Sacramento County General Plan*, amended on November 9, 2011, provides for growth and
 34 development in the unincorporated area through 2050.

35 Relevant policies of the Sacramento County General Plan (County of Sacramento 2011) pertaining to
 36 soils as a resource are listed below.

- 37 ● **Policy AG-28:** The County shall actively encourage conservation of soil resources.

- 1 • **Policy CO-57:** In areas where top soil mining is permitted, it shall be done so as to maintain the
2 long term.

3 **Solano County General Plan**

4 The *Solano County General Plan* was adopted on August 5, 2008. The Agriculture and Resources
5 Elements of the general plan address conservation of agricultural land. The general plan is the guide for
6 both land development and conservation in the unincorporated portions of the county and contains the
7 policy framework necessary to fulfill the community’s vision for Solano County in 2030.

8 Relevant policies of the Solano County General Plan (Solano County 2008) pertaining to soils as a
9 resource are listed below.

10 **Agriculture Element**

- 11 ○ **Policy AG.I-22:** Promote sustainable agricultural activities and practices that support and
12 enhance the natural environment. These activities should minimize impacts on soil quality and
13 erosion potential, water quantity and quality, energy use, air quality, and natural habitats.
14 Sustainable agricultural practices should be addressed in the County’s proposed Climate Action
15 Plan to address climate change effects.

16 **Sacramento-San Joaquin Delta Policies**

- 17 ○ **Policy RS.P-21:** Preserve and protect the natural resources of the Delta including soils and
18 riparian habitat. Lands managed primarily for wildlife habitat should be managed to provide
19 inter-related habitats.

20 **Yolo County General Plan**

21 The *Yolo County 2030 Countywide General Plan* was adopted on November 10, 2009, and provides for
22 growth and development in the unincorporated area through 2030. The general objective of the
23 general plan is to guide decision making in the unincorporated areas in the county toward the most
24 desirable future possible and to identify efficient urbanization with the preservation of productive farm
25 resources and open space amenities (County of Yolo 2009). Among all the county general plans within
26 the Primary Zone of the Delta, Yolo County contains the most specific policies relating to protection of
27 soils as a resource.

28 Relevant policies and actions of the Yolo County general plan (County of Yolo 2009) pertaining to soils
29 as a resource are listed below.

30 **Conservation and Open Space Element**

31 The following policies that pertain to soils as a resource appear in the conservation and open space
32 element of the general plan.

- 33 ○ **Policy CO-2.14:** Ensure no net loss of oak woodlands, alkali sinks, rare soils, vernal pools or
34 geological substrates that support rare endemic species, with the following exception. The
35 limited loss of blue oak woodland and grasslands may be acceptable, where the fragmentation
36 of large forests exceeding 10 acres is avoided, and where losses are mitigated.
- 37 ○ **Policy CO-3.5:** Preserve and protect the County’s unique geologic and physical features, which
38 include geologic or soil “type localities”, and formations or outcrops of special interest.

1 The following action pertaining to soils as a resource appears in the conservation and open space
2 element of the general plan.

- 3 • **Action CO-A54:** The County’s unique geologic or physical features, which include geologic or soil
4 “type localities” and formations or outcrops of special interest, shall be researched, inventoried,
5 mapped, and data added to the County GIS database.

6 **Agriculture & Economic Development Element**

7 The following policy pertaining to soils as a resource appears in the agriculture and economic
8 development element of the general plan.

- 9 ○ **Policy AG-2.6:** Work with appropriate local, State and federal agencies to conserve, study, and
10 improve soils. Promote participation in programs that reduce soil erosion and increase soil
11 productivity.

12 **10.3 Environmental Consequences**

13 This section describes potential direct (both temporary and permanent) and indirect effects on soils
14 that would result with implementation of each alternative. Note that the discussion in this chapter
15 separates each of the alternatives’ proposed features into three categories; *physical/structural*
16 *components* and *operations*, both of which are evaluated at the project level; and *restoration actions*,
17 which are evaluated at the programmatic level. Broadly, the types of effects that are evaluated are
18 listed below.

- 19 • Accelerated soil erosion from water and wind.
- 20 • Loss of topsoil as a resource caused by excavation, overcovering, and inundation.
- 21 • Land subsidence due to biological oxidation of peat soils.
- 22 • Effects of corrosive, expansive, and compressible soils.

23 Potential adverse effects that are triggered by a seismic event (either earthquake-induced or
24 construction-related) are assessed in Chapter 9, *Geology and Seismicity*. Potential effects of irrigation-
25 induced salt loading to soils are assessed in Chapter 14, *Agricultural Resources*. Potential effects of
26 eroded soil (i.e., sediment) reaching receiving waters are assessed in Chapter 8, *Water Quality*.

27 Soil-related effects would be restricted to the Plan Area and would be associated primarily with the
28 footprint of the proposed conveyance facilities and restoration areas. Because all conveyance and
29 restoration activities related to the alternatives would be in the Plan Area, soils in the Upstream of the
30 Delta Region and SWP/CVP Export Service Areas would not be affected by proposed construction,
31 operation, maintenance, or restoration activities. Therefore, this section does not evaluate effects on
32 soils in those geographic areas.

33 Additionally, nine of the proposed conservation measures related to reducing other stressors (listed
34 below and described in detail in Chapter 3, *Description of the Alternatives*), which would be
35 implemented under all action alternatives, are not anticipated to result in any meaningful effects on
36 soils in the Plan Area because the actions implemented under these conservation measures would not
37 have a bearing on soils, nor would they be expected to result in any direct or indirect, permanent or
38 substantial temporary changes in soil conditions. Accordingly, these measures are not addressed
39 further in this effects analysis.

- 1 • Methylmercury Management (Conservation Measure [CM]12)
- 2 • Nonnative Aquatic Vegetation Control (CM13)
- 3 • Stockton Deep Water Ship Channel Dissolved Oxygen Levels (CM14)
- 4 • Predator Control (CM15)
- 5 • Nonphysical Fish Barriers (CM16)
- 6 • Illegal Harvest Reduction (CM17)
- 7 • Recreational Users Invasive Species Program (CM20)
- 8 • Nonproject Diversions (CM21)
- 9 • Avoidance and Minimization Measures (CM22)

10 10.3.1 Methods for Analysis

11 This section describes the methods used to evaluate soil-related hazards and potential effects of the
 12 alternatives in the Plan Area and the potential for the elements of the alternatives to increase human
 13 health risk and loss of property or other associated risks. These effects would be associated with
 14 construction activities, the footprint of disturbance from new facilities, and operation of the
 15 alternatives. Lands outside of the Plan Area were not considered because there are no structures being
 16 proposed and because changed operations upstream and within the water user service areas do not
 17 increase soil hazards in those areas. Both quantitative and qualitative methods were used to evaluate
 18 these effects, depending on the availability of data. Conservation and restoration activities were
 19 evaluated on a programmatic level using qualitative methods to identify potential soil-related effects.

20 The impact analysis for soils was performed using information on near-surface soils (i.e., the upper 5
 21 feet) and maps of peat thickness, soil organic matter content, and topography. The emphasis in the
 22 impact analysis was to identify where soils could be adversely affected by erosion or by excavation,
 23 overcovering, or inundation. The impact analysis also focused on identifying those soil characteristics
 24 that could pose a potentially serious threat to the integrity of structures. The analysis determines
 25 whether these conditions and associated risks can be reduced to an acceptable level by conformity with
 26 existing codes and standards, and by the application of accepted, proven engineering design and
 27 construction practices. A range of specific design and construction approaches are normally available
 28 to address a specific soil condition. For example, the potential for expansive soils to affect structural
 29 integrity could be controlled by use of soil lime treatment, a post-tensioned foundation, or other
 30 measure. Irrespective of the engineering approach to be used, the same stability criteria must be met to
 31 comply with code and standard requirements. Design solutions would be guided by relevant building
 32 codes and state and federal standards for foundations, earthworks, and other project facilities.

33 The following description of the site evaluation and design process is intended to clarify how site-
 34 specific hazard conditions are identified and eventually fully addressed through data collection,
 35 analysis and compliance with existing design and construction requirements.

36 As the BDCP and its various conservation measures were developed by DWR in anticipation of agency
 37 and public review through the NEPA/CEQA process, the agency compiled information on the
 38 geotechnical characteristics of the near-surface soils for the project alternatives. This soil information
 39 has been compiled under the supervision of professional engineers and documented in the project's
 40 geotechnical data reports (California Department of Water Resources 2010f, 2010g, 2011) and

1 conceptual engineering reports (CERs) (California Department of Water Resources 2009a, 2009b,
2 2010a, 2010b, 2010c, 2010d, 2010e). The latter reports are not final, site-specific design-level reports
3 but instead describe project alternative construction feasibility by identifying site conditions and
4 constraints.

5 The NEPA/CEQA analysis for the project alternatives includes review of soil survey data, the
6 geotechnical data reports, and CERs as well as other information to determine if potential adverse
7 effects caused by soil hazards can be overcome by applying accepted and proven engineering design
8 and construction practices.

9 The effects of soil hazards would be substantial if the risk of potential loss, injury or death cannot be
10 addressed by an engineering solution. Significance thresholds do not require the elimination of the
11 potential for structural damage from a construction site's soil conditions. Rather, the criteria require
12 evaluation of whether site conditions can be overcome through engineering design solutions that
13 reduce the substantial risk of people and structures to loss, injury or death. The codes and design
14 standards ensure that foundations, earthwork, and other facilities are designed and constructed such
15 that, while they may sustain damage caused by a soil hazards, the substantial risk of loss, injury or
16 death due to structural failure or collapse is reduced to an acceptable level. The NEPA/CEQA evaluation
17 determines whether conformity with existing federal, state, and local standards, guidelines, codes,
18 ordinances, and other regulations and application of accepted and proven engineering design and
19 construction practices would reduce the substantial risk of people and structures to loss, injury or
20 death to acceptable level.

21 Design-level detail will not be fully developed until after the NEPA/CEQA process is complete. After
22 NEPA/CEQA document certification and project approval, the final design will be developed, which will
23 require additional geotechnical studies to identify additional site-specific conditions that the final
24 engineering design will meet. These soil investigations will characterize, log, and test soils on a site-
25 specific basis to determine their load-bearing capacity, shrink-swell capacity, corrosivity, and other
26 parameters. The soil investigations and the recommendations that are derived from them will be
27 presented in a geotechnical report by a California registered civil engineer or a California certified
28 engineering geologist. The report will be prepared according to *Guidelines for Evaluating and Mitigating*
29 *Seismic Hazards in California* (California Geological Survey 2008) and reviewed and approved by the
30 BDCP proponents.

31 This final design would meet the guidelines and standards included in Appendix 3B, *Environmental*
32 *Commitments*, for all the project components. In the present case, these components include aspects of
33 the canals, pipelines, intake structures, levees, temporary and permanent access roads, borrow areas,
34 and spoil storage sites.

35 Based on the final geotechnical report and code and standards requirements, the final design of levees,
36 foundations, and related engineering structures will be developed by a California registered civil
37 engineer or a California certified engineering geologist with participation and review by DWR, and in
38 some cases county building departments, to ensure that design standards are met. The design and
39 construction specifications would then be incorporated into the construction contract for
40 implementation. During project construction, new or unanticipated soil conditions may be found that
41 are different from those described in the detailed, site-specific geotechnical report that guides the final
42 design. Under these circumstances, the soil condition will be evaluated and an appropriate method to
43 meet the design specification will be determined by the project engineer and approved by DWR.

1 **10.3.1.1 Impact Mechanisms**

2 **Accelerated Water and Wind Erosion**

3 Soil disturbance (e.g., grading, excavating, tunneling, borrow material excavating, and stockpiling)
4 during construction can lead to soil loss from water and wind erosion unless adequate management
5 practices are implemented to control erosion and sediment transport.

6 **Loss of Topsoil**

7 Loss of topsoil as a resource can be caused by excavation, overcovering, or inundation. The condition
8 (quality) and productivity of the topsoil can be degraded as a result of construction activities, such as
9 compaction.

10 **Subsidence and Compressibility**

11 Soil subsidence could result from a variety of factors, but primarily from oxidation of soil organic
12 matter and primarily only in high organic matter content soils (i.e., peats and mucks). Subsidence can
13 cause damage or failure of structures, utilities, and levees.

14 Soil compression/settlement can occur when the soil is under load. Structures constructed on soils
15 with poor load bearing capability can be damaged or fail when part or all of the structure settles under
16 load. Utilities connecting to the subsided or settled facilities can also be damaged.

17 **Soil Expansion and Contraction**

18 Soils with a high content of expansive clay are subject to shrinking and swelling with seasonal changes
19 in moisture content. Clay soils below the depth of the permanent water table are not subject to
20 shrinking and swelling. Soil expansion and contraction can cause damage or failure of foundations,
21 utilities, and pavements.

22 **Soil Corrosion**

23 Soil may corrode uncoated steel; the hazard of corrosion is controlled by soil water content, texture,
24 acidity, and content of soluble salts. Soil may also corrode concrete; the hazard of corrosion is
25 controlled by soil texture, acidity, and the amount of sodium or magnesium sulfate and sodium chloride
26 present in the soil. Corrosion can cause failure of pipelines and other in-ground utilities, culverts,
27 foundations, footings, and other facilities containing concrete and steel in contact with the soil.

28 **10.3.1.2 Construction Activity Effects**

29 The analysis of soil-related effects during construction is related to wind and water erosion hazard.

30 NRCS soil survey and geographic information system (GIS) data (i.e., SSURGO data [Natural Resources
31 Conservation Service 2010a]) for each county in the Plan Area were used to identify and map variations
32 in the soil's water and wind erosion hazard.

33 Because planned restoration activities are programmatic in nature, this analysis took a programmatic
34 approach to addressing impacts on soils at the ROAs. Soils in the ROAs were evaluated to determine
35 their susceptibility to wind and water erosion during grading and other types of ground disturbance
36 that would be expected during restoration construction activities.

1 10.3.1.3 Facility Effects

2 The analysis methods for soil-related effects on facilities are based on the following.

3 Soil Expansion and Corrosion

4 NRCS soil surveys and GIS data (i.e., SSURGO data [Natural Resources Conservation Service 2010a]) for
5 each county in the Plan Area were used to identify and map variations in shrink-swell potential and in
6 corrosivity to concrete and uncoated steel. This information was used to identify areas where such soils
7 could adversely affect public safety and the structural integrity of proposed facilities, and consequently,
8 where specific design measures for facilities would need to be implemented to avoid these effects.

9 Subsidence Potential

10 GIS and NRCS SSURGO data on the organic matter content of the near-surface soils, a map of the
11 thickness of peat soils, and an elevation map were used to identify areas that are subject to continued
12 subsidence.

13 Soil Compressibility

14 Soil compressibility/load bearing capability was assessed using NRCS soil surveys and GIS data (i.e.,
15 SSURGO data [Natural Resources Conservation Service 2010a]) for each county in the Plan Area.

16 10.3.1.4 Operational Component Effects

17 The potential effect on channel bank scour from changes in flow regimes was evaluated by reviewing
18 the current and expected operations channel flow rates.

19 The analysis of channel bank scour effects for the operational components relied mostly on the results
20 from Chapter 6, *Surface Water*—in particular, the expected change in channel flow rates (feet per
21 second). Soil erosion hazard as shown in Figure 10-5 was not used in the analysis because no data are
22 available to describe the erodibility of the soils that could be affected by the operational components
23 (i.e., those soils along channel banks). The soils along the channel banks may consist of fill material
24 (from levees) and may be partly or fully protected by riprap; these conditions make the NRCS data on
25 erosion hazard not applicable to assessing the hazard of channel bank erosion, because the NRCS soil
26 mapping upon which erosion hazard is based does not account for the local soil characteristics and
27 bank protection measures that may be present along the channel banks.

28 10.3.2 Determination of Effects

29 Effects on soils were considered adverse under NEPA and significant under CEQA if implementation of
30 an alternative would result in any of the following.

- 31 • Cause substantial soil erosion.
 - 32 ○ For purposes of this analysis, “substantial soil erosion” would occur when effluent monitoring
 - 33 indicates that the daily average turbidity of site runoff exceeds 250 nephelometric turbidity
 - 34 units (NTUs). This measurement is in accordance with Construction General Permit (CGP)
 - 35 numeric action level requirements under site-specific SWPPPs. Regarding wind-caused erosion,
 - 36 Sacramento Metropolitan Air Quality Management Districts’ CEQA guidelines require fugitive
 - 37 dust control practices related to the potential for creating wind-borne dust. The best

1 management practices outlined include suspending excavation, grading, and/or demolition
 2 activity when wind speeds exceed 20 mph. (These guidelines are sufficient to address dust
 3 control requirements of all the air quality management districts in the Plan Area.) Accordingly,
 4 continuing those activities when wind speed exceeds 20 mph would constitute an adverse
 5 effect with respect to wind erosion. (Neither substantial water erosion nor wind erosion effects
 6 are likely to occur because BDCP proponents would comply with all CGP, SWPPP, air quality
 7 management district, and other permit requirements to stop work or adjust BMPs to remain
 8 within applicable thresholds.)

- 9 ● Cause a substantial loss of topsoil.
 - 10 ○ For purposes of this analysis, “substantial loss of topsoil” would be caused by activities that
 - 11 would overcover, inundate, or remove topsoil such that the loss is irreversible, for example, by
 - 12 paving over it.
- 13 ● Subject people, structures, or property to soil instability caused by soil subsidence.
 - 14 ○ For purposes of this analysis, an adverse effect (NEPA) or significant impact (CEQA) would
 - 15 exist if project construction or operation created an increased likelihood for the potential for
 - 16 loss, injury or death related to soil instability caused by soil subsidence which cannot be offset
 - 17 by an engineering solution that reduces the risk to people and structures to an acceptable level.
 - 18 “Engineering solution” means conformity with all applicable government and professional
 - 19 standards, codes, ordinances, and regulations for site assessment, design and construction
 - 20 practices, including the American Society of Civil Engineers Minimum Design Loads for
 - 21 Buildings and Other Structures, CBC, and U.S. Army Corps of Engineers (USACE) Design and
 - 22 Construction of Levees (see Section 10.3.1.1, *Impact Mechanisms*).
- 23 ● Create substantial risks to life or property as a result of being located on expansive, corrosive, and
- 24 compressible soil (as defined in Table 18-1-B of the Uniform Building Code [1994]).
 - 25 ○ For purposes of this analysis, an adverse effect (NEPA) or significant impact (CEQA) would
 - 26 exist if project construction or operation created an increased likelihood for the potential for
 - 27 loss, injury or death related to location on expansive, corrosive, and compressible soils which
 - 28 cannot be offset by an engineering solution that reduces the risk to people and structures to an
 - 29 acceptable level. “Engineering solution” means conformity with all applicable government and
 - 30 professional standards, codes, ordinances, and regulations for site assessment, design and
 - 31 construction practices, including the DWR Interim Levee Design Criteria for Urban and
 - 32 Urbanizing Area State Federal Project Levees; USACE Engineering and Design—Earthquake
 - 33 Design and Evaluation for Civil Works Projects; USACE Design and Construction of Levees;
 - 34 American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures;
 - 35 and CBC requirements (see Section 10.3.1.1, *Impact Mechanisms*).
- 36 ● Be located on a geologic unit or soil that is unstable or that would become unstable as a result of
- 37 the project and potentially result in an onsite or offsite landslide, lateral spreading, subsidence,
- 38 liquefaction, or collapse.
 - 39 ○ For purposes of this analysis, any “geologic unit or soil that is unstable or would become
 - 40 unstable” would be those identified as such in Appendix 10B, *NRCS Soil Suitability Ratings*,
 - 41 which provides suitability and limitation ratings by the Natural Resources Conservation Service
 - 42 for various engineering uses. This chapter primarily addresses risks due to subsidence. Other
 - 43 causes of instability induced by earthquake or construction are assessed in Chapter 9, *Geology*
 - 44 *and Seismicity*. An adverse effect (NEPA) or significant impact (CEQA) would exist if the

1 potential for loss, injury or death related to soil instability cannot be offset by an engineering
 2 solution that reduces the risk to people and structures to an acceptable level. “Engineering
 3 solution” means conformity with all applicable government and professional standards, codes,
 4 ordinances, and regulations for site assessment, design and construction practices, including
 5 the American Society of Civil Engineers Minimum Design Loads for Buildings and Other
 6 Structures, CBC, and USACE Design and Construction of Levees (see Section 10.3.1.1, *Impact*
 7 *Mechanisms*).

- 8 • Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater
 9 disposal systems in areas where sewers are not available for the disposal of wastewater.

10 The effects criteria described above are carried forward for analysis in this chapter with the exception
 11 of the criteria related to soils capable of adequately supporting the use of septic tanks or alternative
 12 wastewater disposal systems. While pumping plants would include permanent restroom facilities,
 13 which would be equipped with a sanitary gravity drainage leading to a wastewater holding tank, effects
 14 are not anticipated to result from the facilities that would be constructed for the project because these
 15 facilities would be minor (constructed to serve only small operations and maintenance crews).
 16 Additionally, such facilities would require proper testing and permits from regulatory agencies, which
 17 would reduce any adverse environmental effects to less than significant.

18 **10.3.2.1 Compatibility with Plans and Policies**

19 Constructing the proposed water conveyance facility (CM1) and implementing CM2–CM22 could
 20 potentially result in incompatibilities with plans and policies related to soils. Section 10.2, *Regulatory*
 21 *Setting*, provides an overview of federal, state, regional and agency-specific plans and policies
 22 applicable to public services and utilities. This section summarizes ways in which BDCP is compatible
 23 or incompatible with those plans and policies. Potential incompatibilities with local plans or policies, or
 24 with those not binding on the state or federal governments, do not necessarily translate into adverse
 25 environmental effects under NEPA or CEQA. Even where an incompatibility “on paper” exists, it does
 26 not by itself constitute an adverse physical effect on the environment, but rather may indicate the
 27 potential for a proposed activity to have a physical effect on the environment. The relationship between
 28 plans, policies, and regulations and impacts on the physical environment is discussed in Chapter 13,
 29 *Land Use*, Section 13.2.3.

30 The construction and operation of all BDCP alternatives would comply with all regulations related to
 31 construction run-off and sedimentation, such as Section 402 of the Clean Water Act and Porter-Cologne
 32 Water Pollution Control Act. Both of these are enforced by the State Water Board. As discussed below,
 33 BDCP will seek General Permits for Storm Water Discharges Associated with Construction and Land
 34 Disturbance Activities in accordance with State Water Board Order No. 2009-0009-DWQ. In order to
 35 obtain a General Permit from the State Water Board, the BDCP proponents must submit a risk level
 36 assessment and a SWPPP, which will include many of the BMPs required to further the aims of various
 37 state and regional policies and plans.

38 **10.3.3 Effects and Mitigation Approaches**

39 **10.3.3.1 No Action Alternative**

40 The No Action Alternative is the future condition at the year 2060 that would occur if none of the action
 41 alternatives was approved and if no change from current management direction or the level of

1 management intensity occurred. The No Action Alternative includes projects and programs with
2 defined management or operational plans, including facilities under construction as of February 13,
3 2009, because those actions would be consistent with the continuation of existing management
4 direction or level of management for plans, policies, and operations by the BDCP proponents and other
5 agencies. The No Action Alternative assumptions also include projects and programs that received
6 approvals and permits in 2009 to remain consistent with existing management direction. A complete
7 list and description of programs and plans considered under the No Action Alternative is provided in
8 Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative*
9 *Impact Conditions*. Under the No Action Alternative, the condition of soils would continue largely as
10 they have under Existing Conditions.

11 **Accelerated Soil Erosion**

12 Under the No Action Alternative, it is anticipated that current rates of water and wind erosion would
13 continue in the future. Currently, erosion (primarily wind erosion) is largely a result of agricultural
14 practices. Additionally, accelerated water and wind erosion could take place in the Delta and statewide
15 as a result of implementation of numerous levee stabilization, dredge spoil disposal, and habitat
16 restoration projects. However, federal, state, and local regulations, codes, and permitting programs
17 would continue to require implementation of measures to prevent nonagricultural accelerated erosion
18 and sediment transport associated with construction.

19 **Loss of Topsoil**

20 The loss of topsoil as a result of excavation, overcovering, and inundation would continue in the Delta
21 and statewide under the No Action Alternative as a result of numerous land development and habitat
22 restoration projects. The land development projects would tend to cause loss of topsoil as a result of
23 excavation and overcovering, particularly by foundations, pavements, and other impervious surfaces.
24 Such losses of topsoil are effectively irreversible. In contrast, the loss of topsoil associated with habitat
25 restoration projects typically results from overcovering, such as placement of dredge spoils in subsided
26 areas, and inundation, such as the introduction of seasonal or perennial water into nonwetland
27 environments to establish seasonal wetlands or freshwater or tidal marshes. In this latter scenario, the
28 topsoil is effectively “lost” for as long as the area is inundated, but would remain available for cropping
29 or for livestock grazing if water management changes in the future. Finally, most dredging projects
30 have a spoil disposal/placement component, typically on land (as opposed to in water). The disposal
31 would therefore entail overcovering of and effective loss of topsoil.

32 **Subsidence**

33 Land subsidence in the Delta and the Suisun Marsh would continue to varying degrees under the No
34 Action Alternative. Ingebritsen et al. (2000) indicated that long-term average rates of subsidence in the
35 Delta are 1–3 inches per year. It is anticipated that this rate of subsidence would continue. Ongoing
36 subsidence would result from biological oxidation of organic soils, thereby continuing to threaten levee
37 stability, which in turn affects water quality and water supply because levee failure could cause saline
38 water to enter the Delta. However, the rate of subsidence in the future may be slower than the current
39 rate as the organic soils become more consolidated over time.

40 Several projects are now underway that would have a beneficial effect on subsidence, some with the
41 explicit goal of controlling or reversing subsidence. These entail inundating areas underlain by peat
42 soils to restore or create tidal marsh habitat. The inundation would tend to reduce biological oxidation

1 rates of the soil organic matter. Depending on the vegetation type, soil organic matter would
 2 accumulate over time in the restored marsh habitats, thereby raising the elevation of the area. Although
 3 these projects would tend to control or reverse subsidence only on the islands at which they are
 4 implemented, they would benefit the Delta as a whole by promoting the “blocking” effect of Delta
 5 islands on sea water intrusion in the Delta. The subsidence control/reversal projects would therefore
 6 help to maintain water quality and water supply in the Delta in the event of widespread levee failure.

7 **Soil Expansion, Corrosion, and Compression**

8 Ongoing and reasonably foreseeable future projects in the Plan Area are likely to encounter expansive,
 9 corrosive, and compressible soils. However, federal and state design guidelines and building codes
 10 would continue to require that the facilities constructed as part of these projects incorporate design
 11 measures to avoid the adverse effects of such soils.

12 **Ongoing Plans, Policies, and Programs**

13 The programs, plans, and projects included under the No Action Alternative are summarized in Table
 14 10-4, along with their anticipated effects on soils.

15 **Table 10-4. Effects on Soils from the Plans, Policies, and Programs for the No Action Alternative**

Agency	Program/Project	Status	Description of Program/Project	Effects on Soils
California Department of Water Resources	Mayberry Farms Subsidence Reversal and Carbon Sequestration Project	Completed October 2010	Permanently flooded a 308-acre parcel of DWR owned land (Hunting Club leased) and restored 274 acres of palustrine emergent wetlands within Sherman Island to create permanent wetlands and to monitor waterfowl, water quality, and greenhouse gases.	Reduced subsidence over approximately 308 acres and inundation of topsoil over approximately 274 acres.
DWR	Dutch Slough Tidal Marsh Restoration Project	Planning phase	Wetland and upland habitat restoration in area used for agriculture.	Inundation and overcovering (by dredge spoils) of topsoil over much of 1,166-acre site.
Freeport Regional Water Authority and Bureau of Reclamation	Freeport Regional Water Project	Completed late 2010	Project included an intake/ pumping plant near Freeport on the Sacramento River and a conveyance structure to transport water through Sacramento County to the Folsom South Canal.	Loss of approximately 50–70 acres of topsoil from excavation and overcovering.
Reclamation District 2093	Liberty Island Conservation Bank	Completed 2011	This project included restoration of inaccessible, flood prone land to wildlife habitat.	Inundation of approximately 186 acres of topsoil.
City of Stockton	Delta Water Supply Project (Phase 1)	Currently under construction	This project consists of a new intake structure and pumping station adjacent to the San Joaquin River; a water treatment plant along Lower Sacramento Road; and water pipelines along Eight Mile, Davis, and Lower Sacramento Roads.	Loss of 106 acres of topsoil from excavation and overcovering.

Agency	Program/Project	Status	Description of Program/Project	Effects on Soils
DWR	Delta Levees Flood Protection Program	Ongoing	Levee rehabilitation projects in the Delta.	Unknown but probably small acreage of overcovering of topsoil.
USACE	Suisun Channel (Slough) Operations and Maintenance Project	Ongoing	Maintenance dredging of an entrance channel in Suisun Bay, with turning basin.	Unknown acreage of overcovering of topsoil from dredge material disposal.
DWR	Central Valley Flood Management Planning Program	Planning phase	Among other management actions, involves levee raising and construction of new levees for flood control purposes.	Unknown acreage of overcovering of topsoil from levee earthwork.
Bureau of Reclamation	Delta-Mendota Canal/California Aqueduct Intertie	Anticipated completion by 2012.	The purpose of the intertie is to better coordinate water delivery operations between the California Aqueduct (state) and the Delta-Mendota Canal (federal) and to provide better pumping capacity for the Jones Pumping Plant. New project facilities include a pipeline and pumping plant.	Loss of approximately 2 acres of topsoil from excavation and overcovering.
California Department of Water Resources	North Delta Flood Control and Ecosystem Restoration Project	Final EIR certified and Notice of Determination filed in 2010.	Project is intended to improve flood management and provide ecosystem benefits in the North Delta area through actions such as construction of setback levees and configuration of flood bypass areas to create quality habitat for species of concern. These actions are focused on McCormack-Williamson Tract and Staten Island. The purpose of the Project is to implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes.	Unknown but probably significant acreage of overcovering of topsoil from tidal inundation, excavation and overcovering.
NMFS/USFWS	2008 and 2009 Biological Opinion	Ongoing	The Biological Opinions issued by NMFS and USFWS establish certain RPAs and RPMs to be implemented. Some of the RPAs require habitat restoration which may require changes to existing levees and channel improvements.	RPAs requiring habitat restoration may result in up to 8,000 acres of inundated topsoil and potential overcovering of topsoil from levee earthwork.

- 1
- 2 In total, the plans and programs would result in the loss of at least 3,618 acres of topsoil from
- 3 overcovering or inundation. Because of the amount of topsoil that would be lost under the No Action
- 4 alternative, these plans, policies, and programs would be deemed to have direct and adverse effects on
- 5 topsoil loss in the Delta.
- 6 Subsidence would be controlled or reversed on approximately 308 acres, resulting in a beneficial effect.
- 7 **CEQA Conclusion:** In total, the plans and programs under the No Action Alternative (see Table 10-4 and
- 8 Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative*

1 *Impact Conditions*) would result in the loss of at least 3,618 acres of topsoil from overcovering or
 2 inundation between the present and 2060. This would constitute a significant impact. Subsidence
 3 would be controlled or reversed on approximately 308 acres, resulting in a beneficial impact.

4 **10.3.3.2 Alternative 1A—Dual Conveyance with Pipeline/Tunnel and** 5 **Intakes 1–5 (15,000 cfs; Operational Scenario A)**

6 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances** 7 **as a Result of Constructing the Proposed Water Conveyance Facilities**

8 Construction of water conveyance facilities would involve vegetation removal, constructing building
 9 pads and levees, excavation, overexcavation for facility foundations, surface grading, trenching, road
 10 construction, spoil and reusable tunnel material (RTM) storage, soil stockpiling, and other activities
 11 over approximately 7,500 acres during the course of constructing the facilities. Vegetation would be
 12 removed (via grubbing and clearing) and grading and other earthwork would be conducted at the
 13 intakes, pumping plants, the intermediate forebay, the Byron Tract Forebay, canal and gates between
 14 the Byron Tract Forebay tunnel shafts and the approach canal to the Banks Pumping Plant, borrow
 15 areas, RTM and spoil storage areas, setback and transition levees, sedimentation basins, solids handling
 16 facilities, transition structures, surge shafts and towers, substations, transmission line footings, access
 17 roads, concrete batch plants, fuel stations, bridge abutments, barge unloading facilities, and laydown
 18 areas. Some of the work would be conducted in agriculture areas that are fallow at the time. Some of
 19 the earthwork activities may also result in steepening of slopes and soil compaction, particularly for the
 20 embankments constructed for the intermediate forebay and the Byron Tract Forebay. These conditions
 21 tend to result in increased runoff rates, degradation of soil structure, and reduced soil infiltration
 22 capacity, all of which could cause accelerated erosion, resulting in loss of topsoil.

23 ***Water Erosion***

24 The excavation, grading, and other soil disturbances described above that are conducted in gently
 25 sloping to level areas, such as the interiors of Delta islands, are expected to experience little or no
 26 accelerated water erosion because of the lack of runoff energy to entrain and transport soil particles.
 27 Any soil that is eroded within island interiors would tend to remain on the island, provided that
 28 existing or project levees are in place to serve as barriers from keeping the eroded soil (i.e., sediment)
 29 from entering receiving waters.

30 In contrast, graded and otherwise disturbed tops and sideslopes of existing and project levees and
 31 embankments are of greater concern for accelerated water erosion because of their steep gradients.
 32 Although soil eroded from the landside of levees would be deposited on the island interiors, soil eroded
 33 from the disturbed top and water side of levees could reach adjoining waterways. Soil eroded from
 34 natural slopes in upland environments could also reach receiving waters.

35 ***Wind Erosion***

36 Most of the primary work areas that would involve extensive soil disturbance (i.e., staging areas,
 37 borrow areas, and intakes) within the Alternative 1A footprint are underlain by soils with a moderate
 38 or high susceptibility to wind erosion (Natural Resources Conservation Service 2010a) (Figure 10-6).
 39 Of the primary areas that would be disturbed, only the proposed borrow/spoil area southwest of
 40 Clifton Court Forebay and the Byron Tract Forebay generally have a low wind erosion hazard.

1 Construction activities (e.g., excavation, filling, grading, and vehicle traffic on unimproved roads) that
2 could lead to accelerated wind erosion are generally the same as those for water erosion. These
3 activities may result in vegetation removal and degradation of soil structure, both of which would make
4 the soil much more subject to wind erosion. Removal of vegetation cover and grading increase
5 exposure to wind at the surface and obliterate the binding effect of plant roots on soil aggregates. These
6 effects make the soil particles much more subject to entrainment by wind. However, most of the areas
7 that would be extensively disturbed by construction activities are already routinely disturbed by
8 agricultural activities, such from disking and harrowing. These activities would be associated with
9 construction of the pumping plants, the intermediate forebay, most of the Byron Tract Forebay, borrow
10 areas, RTM and spoil storage areas, sedimentation basins, solids handling facilities, substations, access
11 roads, concrete batch plants, and laydown areas. Consequently, with the exception of loading and
12 transporting of soil material to storage areas, the disturbance that would result from constructing the
13 conveyance facilities in many areas would not substantially depart from the existing condition,
14 provided that the length of time that the soil is left exposed during the year does not change compared
15 to that associated with agricultural operations. Because the SWPPPs prepared for the various
16 components of the project will be required to prescribe ongoing best management practices to control
17 wind erosion (such as temporary seeding), the amount of time that the soil would be exposed during
18 construction should not significantly differ from the existing condition.

19 Unlike water erosion, the potential adverse effects of wind erosion are generally not dependent on
20 slope gradient and location relative to levees or water. Without proper management, the wind-eroded
21 soil particles can be transported great distances.

22 Excavation of soil from borrow areas and transport of soil material to spoil storage areas would
23 potentially subject soils to wind erosion. It is likely that approximately 8 million cubic yards of peat soil
24 material would be disposed of as spoils; this material would be especially susceptible to wind erosion
25 while being loaded onto trucks, transported, unloaded, and distributed.

26 **NEPA Effects:** These potential effects could be substantial because they could cause substantial
27 accelerated erosion. However, as described in section 10.3.1, *Methods for Analysis*, and Appendix 3B,
28 *Environmental Commitments*, DWR would be required to obtain coverage under the General Permit for
29 Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion
30 control plan. Many SWPPPs and erosion control plans are expected to be prepared for the project, with
31 a given SWPPP and erosion control plan prepared for an individual component (e.g., one intake) or
32 groups of component (e.g., all the intakes), depending on the manner in which the work is contracted.
33 DWR would be responsible for preparing and implementing a SWPPP and erosion control plan as
34 portions of the construction are contracted out and applications are made to the State Water Board for
35 coverage under a General Permit.

36 The General Permit requires that SWPPPs be prepared by a Qualified SWPPP Developer (QSD) and
37 implemented under the supervision of a Qualified SWPPP Practitioner (QSP). As part of the procedure
38 to gain coverage under the General Permit, the QSD would determine the Risk Level (1, 2, or 3) of the
39 project site, which involves an evaluation of the site's *Sediment Risk* and *Receiving Water Risk*. *Sediment*
40 *Risk* is based on the tons per acre per year of sediment that the site could generate in the absence of
41 erosion and sediment control BMPs. *Receiving Water Risk* is an assessment of whether the project site
42 is in a sediment-sensitive watershed, such as those designated by the State Water Board as being
43 impaired for sediment under Clean Water Act section 303(d). Much of the northern half of the Plan
44 Area is in a sediment-sensitive watershed; such areas would likely be Risk Level 2. The remaining
45 areas, generally southwest of the San Joaquin River, are not in a sediment-sensitive watershed.

1 The results of the Risk Level determination partly drive the contents of the SWPPP. In accordance with
 2 the General Permit, the SWPPP would describe site topographic, soil, and hydrologic characteristics;
 3 construction activities and a project construction schedule; construction materials to be used and other
 4 potential sources of pollutants at the project site; potential non-stormwater discharges (e.g., trench
 5 dewatering); erosion and sediment control, non-stormwater, and “housekeeping” BMPs to be
 6 implemented; a BMP implementation schedule; a site and BMP inspection schedule; and ongoing
 7 personnel training requirements. The SWPPPs would also specify the forms and records that must be
 8 uploaded to the State Water Board’s online Stormwater Multiple Application and Report Tracking
 9 System (SMARTS), such as quarterly non-stormwater inspection and annual compliance reports. In
 10 those parts of the Plan Area that are determined to be Risk Level 2 or 3, water sampling for pH and
 11 turbidity would be required; the SWPPP would specify sampling locations and schedule, sample
 12 collection and analysis procedures, and recordkeeping and reporting protocols.

13 The QSD for the SWPPPs would prescribe BMPs that are tailored to site conditions and project
 14 component characteristics. Partly because the potential adverse effect on receiving waters depends on
 15 location of a work area relative to a waterway, the BMPs would be site-specific, such that those applied
 16 to level island-interior sites (e.g., RTM storage areas) would be different than those applied to water-
 17 side levee conditions (e.g., intakes).

18 All SWPPPs, irrespective of the site and project characteristics, are likely to contain the following BMPs.

- 19 ● Preservation of existing vegetation.
- 20 ● Perimeter control.
- 21 ● Fiber roll and/or silt fence sediment barriers.
- 22 ● Watering to control dust entrainment.
- 23 ● Tracking control and “housekeeping” measures for equipment refueling and maintenance.
- 24 ● Solid waste management.

25 Most sites would require temporary and permanent seeding and mulching. Sites that involve
 26 disturbance or construction of steep slopes may require installation of erosion control blankets or rock
 27 slope protection (e.g., setback levees at intakes). Turbidity curtains would be required for in-water
 28 work. Excavations that will require dewatering (such as for underground utilities and footings) will
 29 require proper storage of the water, such as land application or filtration. Soil and material stockpiles
 30 (such as for borrow material) would require perimeter protection and covering or watering to control
 31 wind erosion. Concrete washout facilities would be established to prevent surface and ground water
 32 contamination. Such BMPs, if properly installed and maintained, would ensure compliance with the pH
 33 and turbidity level requirements defined by the General Permit.

34 The QSP would be responsible for day-to-day implementation of the SWPPP, including BMP
 35 inspections, maintenance, water quality sampling, and reporting to the State Water Board. In the event
 36 that the water quality sampling results indicate an exceedance of allowable pH and turbidity levels, the
 37 QSD would be required to modify the type and/or location of the BMPs by amending the SWPPP; such
 38 modifications would be uploaded by the QSD to SMARTS.

39 Accelerated water and wind erosion as a result of construction of the proposed water conveyance
 40 facility could occur under Alternative 1A, but proper implementation of the requisite SWPPP and
 41 compliance with the General Permit (as discussed in Appendix 3B, *Environmental Commitments*,

1 Commitment 3B.2) would ensure that there would not be substantial soil erosion resulting in daily site
2 runoff turbidity in excess of 250 NTUs, and therefore, there would not be an adverse effect.

3 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
4 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR
5 would seek coverage under the state General Permit for Construction and Land Disturbance Activities
6 (as discussed in Appendix 3B, *Environmental Commitments*) necessitating the preparation of a SWPPP
7 and an erosion control plan. Because implementation of the SWPPP and compliance with the General
8 Permit would control accelerated soil erosion, there would not be substantial soil erosion resulting in
9 daily site runoff turbidity in excess of 250 NTUs, and therefore, the impact would be less than
10 significant. No mitigation is required.

11 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 12 **Constructing the Proposed Water Conveyance Facilities**

13 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation during
14 construction of Alternative 1A (e.g., forebays, borrow areas, tunnel shafts, levee foundations, intake
15 facilities, pumping plants); overcovering (e.g., levees and embankments, spoil storage, pumping plants);
16 and water inundation (e.g., forebays, sedimentation basins, solids lagoons). Table 10-5 presents an
17 itemization of the effects on soils caused by excavation, overcovering, and inundation, based on GIS
18 analysis by facility type. Because of the nature of the earthwork to construct many of the facilities, more
19 than one mechanism of topsoil loss may be involved at a given facility. For example, levee construction
20 would require both excavation to prepare the subgrade and overcovering to construct the levee. The
21 table shows that the greatest extent of topsoil loss would be associated with overcovering such as
22 spoil/RTM storage areas, unless measures are undertaken to salvage the topsoil and reapply it on top
23 of excavated borrow areas or on top of the spoils once they have been placed.

24 **Table 10-5. Approximate Topsoil Lost as a Result of Excavation, Overcovering, and Inundation Associated with**
25 **the Proposed Water Conveyance Facility**

Topsoil Loss Mechanism	Acreage Affected
Excavation (intakes, shafts, borrow areas)	823
Overcovering (spoil storage, reusable tunnel material storage)	5,093
Inundation (forebays, sedimentation basins, solids lagoons)	1,855
Total	7,771

Note: Some mechanisms for topsoil loss entail more than one process of soil loss. For example,
construction of setback levees would first require overexcavation for the levee foundation (i.e.,
excavation), then placement of fill material (i.e., overcovering).

26
27 DWR has made an Environmental Commitment for Disposal Site Preparation which would require that
28 a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will be set
29 aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas, thereby
30 lessening the effect. However, this effect would be adverse because it would result in a substantial loss
31 of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would also be available to reduce the severity of
32 this effect.

33 **CEQA Conclusion:** Construction of the water conveyance facilities would involve irreversible removal,
34 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss of
35 topsoil. Despite a commitment for Disposal Site Preparation, the impact on soils in the Plan Area would

1 be significant. Mitigation Measures SOILS-2a and SOILS-2b would partially mitigate for these impacts,
2 but not to a less-than-significant level. Therefore, this impact is considered significant and unavoidable.

3 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

4 A requirement of the General Permit is to minimize the extent of soil disturbance during
5 construction. As described in Appendix 3B, *Environmental Commitments*, the SWPPPs prepared for
6 construction activities will include a BMP that specifies the preservation of existing vegetation
7 through installation of temporary construction barrier fencing to preclude unnecessary intrusion of
8 heavy equipment into non-work areas. The BDCP proponents will ensure that the SWPPPs and
9 BMPs limiting ground disturbance are properly executed during construction by the contractors.

10 However, the BMP specifying preservation of existing vegetation may only limit the extent of
11 surface area disturbed and not the area of excavated soils. Accordingly, soil-disturbing activities
12 will be designed such that the area to be excavated, graded, or overcovered is the minimum
13 necessary to achieve the purpose of the activity.

14 Minimizing the extent of soil disturbance will reduce the amount of topsoil lost, this will result in
15 avoidance of this effect over only a small proportion of the total extent of the graded area that will
16 be required to construct the habitat restoration areas, approximately 5% or less. Consequently, a
17 large extent of topsoil will be affected even after implementation of this mitigation measure.

18 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil 19 Storage and Handling Plan**

20 Depending on the thickness of the topsoil³ at a given construction or restoration site, up to 3 feet of
21 the topsoil will be salvaged from construction work areas, stockpiled, and then applied over the
22 surface of spoil and RTM storage sites and borrowed areas to the maximum extent practicable.
23 Exceptions to this measure are areas smaller than 0.1 acre; areas of nonnative soil material, such as
24 levees, where the near-surface soil does not consist of native topsoil; where the soil would be
25 detrimental to plant growth; and any other areas identified by the soil scientist in evaluating
26 topsoil characteristics (discussed below). This mitigation measure will complement and is related
27 to activities recommended under Mitigation Measure AES-1c, in Chapter 17, *Aesthetics and Visual
28 Resources* as well as to the environmental commitment for Disposal and Reuse of Spoils, RTM, and
29 Dredged Material.

30 Topsoil excavated to install conveyance, natural gas, and sewer pipelines will be segregated from
31 the subsoil excavated from open-cut trenches, stockpiled, and reapplied to the surface after the
32 pipe has been installed.

33 The detailed design of the BDCP-related construction activities will incorporate an evaluation,
34 based on review of soil survey maps supplemented by field investigations and prepared by a
35 qualified soil scientist, that specifies the thickness of the topsoil that should be salvaged, and that
36 identifies areas in which no topsoil should be salvaged. The soil scientist will use the exceptions
37 listed above as the basis for identify areas in which no topsoil should be salvaged. The BDCP
38 proponents will ensure that the evaluation is prepared by a qualified individual, that it adequately

³ For the purposes of this mitigation measure, *topsoil* is defined as the O, Oi, Oe, Oa, A, Ap, A1, A2, A3, AB, and AC horizons. Three feet of topsoil was selected because it corresponds to the primary root zone depth of most crops grown in the Delta. With the exception of the Histosols (i.e., peat and muck soils), most of the topsoils in the Plan Area are less than 3 feet thick.

1 addresses all conveyance facilities, and that areas identified for topsoil salvage are incorporated
2 into the project design and that the contractors execute the salvage operations.

3 A qualified soil scientist will also prepare topsoil stockpiling and handling plans for the individual
4 conveyance and restoration components, establishing such guidelines as the maximum allowable
5 thickness of soil stockpiles, temporary stockpile stabilization/revegetation measures, and
6 procedures for topsoil handling during salvaging and reapplication. The maximum allowable
7 stockpile thickness will depend on the amount of time that the stockpile needs to be in place and is
8 expected to range from approximately three to 10 feet. The plans will also specify that, where
9 practicable, the topsoil be salvaged, transported, and applied to its destination area in one
10 operation (i.e., without stockpiling) to minimize degradation of soil structure and the increase in
11 bulk density as a result of excessive handling. The stockpiling and handling plans will also specify
12 maximum allowable stockpile sideslope gradients, seed mixes to control wind and water erosion,
13 cover crop seed mixes to maintain soil organic matter and nutrient levels, and all other measures to
14 avoid soil degradation and soil erosional losses caused by excavating, stockpiling, and transporting
15 topsoil. The BDCP proponents will ensure that each plan is prepared by a qualified individual, that
16 it adequately addresses all relevant activities and facilities, and that its specifications are properly
17 executed during construction by the contractors.

18 Adherence to this measure will ensure that topsoil is appropriately salvaged, stockpiled, and
19 reapplied. Nevertheless, adverse soil quality effects can also be associated with stockpiling. Such
20 effects commonly include loss of soil carbon, degraded aggregate stability, reduced growth of the
21 mycorrhizal fungi, and reduced nutrient cycling. Such effects may make the soil less productive
22 after it is applied to its destination site, compared to its pre-salvage condition. Depending on the
23 inherent soil characteristics, the manner in which it is handled and stockpiled, and the duration of
24 its storage, the reapplied topsoil may recover quickly to its original condition or require many
25 years to return to its pre-salvage physical, chemical, and biological condition (Strohmayer 1999;
26 Vogelsang and Bever 2010).

27 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
28 **from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed**
29 **Water Conveyance Facilities**

30 The intakes, pumping plants, and pipelines would be constructed in areas in which the near-surface
31 soils have approximately 2–4% organic matter content. Compared to organic soils, these mineral soils
32 would not be subject to appreciable subsidence caused by organic matter decomposition because there
33 is relatively little organic matter available to decompose. The tunnels would be constructed at a depth
34 below that of the peat (Figure 10-2); consequently, subsidence caused by organic matter
35 decomposition at tunnel depth is expected to be minimal. Without adequate engineering, the forebay
36 levees and interior could be subject to appreciable subsidence.

37 Damage to or collapse of the pipelines and tunnels could occur where these facilities are constructed in
38 soils and sediments that are subject to subsidence and differential settlement. Subsidence- or
39 differential sediment-induced damage or collapse of these facilities could cause a rapid release of
40 water to the surrounding soil, causing an interruption in water supply, and producing underground
41 cavities, depressions at the ground surface, and surface flooding. Facilities that have subsided would be
42 subject to flooding, and levees that have subsided would be subject to overtopping.

43 Damage to other conveyance facilities, such as intakes, pumping plants, transition structures, and
44 control structures, caused by subsidence/settlement under the facilities and consequent damage to or

1 failure of the facility could also occur. Facility damage or failure could cause a rapid release of water to
2 the surrounding area, resulting in flooding, thereby endangering people in the vicinity.

3 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on soils
4 that are subject to subsidence. However, as described in section 10.3.1, *Methods for Analysis*, and
5 Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all facilities to
6 identify the types of soil avoidance or soil stabilization measures that should be implemented to ensure
7 that the facilities are constructed to withstand subsidence and settlement and to conform to applicable
8 state and federal standards. These studies would build upon the geotechnical data reports (California
9 Department of Water Resources 2010a, 2010b, 2011) and the CERs (California Department of Water
10 Resources 2010a, 2010b). Such standards include the American Society of Civil Engineers Minimum
11 Design Loads for Buildings and Other Structures, CBC, and USACE Design and Construction of Levees.
12 The results of the studies, which would be conducted by a California registered civil engineer or
13 California certified engineering geologist, would be presented in geotechnical reports. The reports
14 would contain recommended measures to prevent subsidence. The geotechnical report will be prepared in
15 accordance with state guidelines, in particular *Guidelines for Evaluating and Mitigating Seismic Hazards*
16 *in California* (California Geological Survey 2008).

17 Liquid limit (i.e., the moisture content at which a soil passes from a solid to a liquid state) and organic
18 material content testing should be performed on soil samples collected during the site-specific field
19 investigations to determine site-specific geotechnical properties. High organic matter content soils that
20 are unsuitable for support of structures, roadways, and other facilities would be overexcavated and
21 replaced with engineered fill, and the unsuitable soils disposed of offsite as spoil, as described in more
22 detail below. Geotechnical evaluations would be conducted to identify soils materials that are suitable
23 for engineering purposes.

24 Additional measures to address the potential adverse effects of organic soils could include construction
25 of structural supports that extend below the depth of organic soils into underlying materials with
26 suitable bearing strength. For example, the CER indicates that approximately 35 feet of soil would be
27 excavated and a pile foundation supporting a common concrete mat would be required for the intake
28 pumping plants. The piles would be 24-inches in diameter and concrete-filled, extending to 65 to 70
29 feet below the founding level of the plant. Piles extended to competent geologic beds beyond the weak
30 soils would provide a solid foundation to support the pumping plants.

31 For the sedimentation basins, the CER indicates that most of the underlying soils would be excavated to
32 a depth of 30 feet below grade and removed from the site and suitable soil material imported to the site
33 to re-establish it to subgrade elevation. Removal of the weak soils and replacement with engineered fill
34 using suitable soil material would provide a solid foundation for the sedimentation basins.

35 At the proposed Byron Tract Forebay, the CER specifies that because most of the soils within the
36 footprints of the forebay and the forebay embankments have high organic matter content, they would
37 be excavated and removed from the site. Removal of the weak soils to reach competent soils would
38 provide a solid foundation upon which to construct the forebay and its embankment.

39 At the spillway and stilling basin for the intermediate spillway, the CER indicates that unsuitable soils
40 would be excavated to competent material and that the spillway would incorporate water-stopped
41 contraction joints at intervals to accommodate a degree of settlement and subsoil deformation.
42 Removal of the weak soils to reach competent soils and providing a joint system would provide a solid
43 foundation for the spillway and stilling basin and enable the spillway to withstand settlement and
44 deformation without jeopardizing its integrity.

1 Certain methods and practices may be utilized during tunnel construction to help reduce and manage
 2 settlement risk. The CER indicates that the ground improvement techniques to control settlement at
 3 the shafts and tunnels may involve jet-grouting, permeation grouting, compaction grouting, or other
 4 methods that a contractor may propose. Jet-grouting involves use of high-pressure, high-velocity jets to
 5 hydraulically erode, mix and partially replace the surrounding soil with a cementitious grout slurry,
 6 thereby creating a cemented zone of high strength and low permeability around of tunnel bore.
 7 Permeation grouting involves introduction of a low-viscosity grout (sodium silicate, microfine cement,
 8 acrylate or polyurethane) into the pores of the soil around the tunnel bore, which increases the
 9 strength and cohesion of granular soils. Compaction grouting involves injecting the soil surrounding
 10 the tunnel bore with a stiff, low slump grout under pressure, forming a cemented mass that increases
 11 soil bearing capacity. These measures would have the effect of better supporting the soil above the
 12 borehole and would prevent unacceptable settlement between the borehole and the tunnel segments.
 13 Additionally, settlement monitoring points, the number and location of which would be identified
 14 during detailed design, would be established along the pipeline and tunnel routes during construction
 15 and the results reviewed regularly by a professional engineer. The monitoring therefore would provide
 16 early detection of excessive settlement such that corrective actions could be made before the integrity
 17 of the tunnel is jeopardized.

18 Conforming with state and federal design standards would protect the integrity of the conveyance
 19 facilities against any subsidence that takes place. As described in section 10.3.1, *Methods for Analysis*
 20 and in Appendix 3B, *Environmental Commitments*, such design codes and standards include the
 21 California Building Code and resource agency and professional engineering specifications, such as the
 22 American Society of Civil Engineers *Minimum Design Loads for Buildings and Other Structures*, ASCE-7-
 23 05, 2005. Conformance with these codes and standards is an environmental commitment by DWR to
 24 safeguard the stability of cut and fill slopes and embankments as the water conveyance features are
 25 operated. Conforming with the standards and guidelines may necessitate such measures as excavation
 26 and removal of weak soils and replacement with engineered fill using suitable, imported soil,
 27 construction on pilings driven into competent soil material, and construction of facilities on cast-in-
 28 place slabs. These measures would reduce the potential hazard of subsidence or settlement to
 29 acceptable levels by avoiding construction directly on or otherwise stabilizing the soil material that is
 30 prone to subsidence. As a result, there would be no adverse effect.

31 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
 32 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of
 33 the facility. However, DWR would be required to design and construct the facilities according to state
 34 and federal design standards and guidelines (e.g., California Building Code, American Society of Civil
 35 Engineers Minimum Design Loads for Buildings and Other Structures, ASCE-7-05, 2005). Conforming
 36 with these codes would reduce the potential hazard of subsidence or settlement to acceptable levels by
 37 avoiding construction directly on or otherwise stabilizing the soil material that is prone to subsidence.
 38 Because these measures would reduce the potential hazard of subsidence or settlement to meet design
 39 standards, this impact is considered less than significant. No mitigation is required.

40 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**
 41 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

42 The integrity of the water conveyance facilities, including tunnels, pipelines, intake facilities, pumping
 43 plants, access roads and utilities, and other features, could be adversely affected by expansive,
 44 corrosive, and compressible soils.

1 **Expansive Soils**

2 Soil expansion is a concern only at soil depths that are subject to seasonal changes in moisture content.
3 Only a small portion of the Alternative 1A alignment possesses soils with high shrink-swell potential
4 (note areas of high linear extensibility in Figure 10-4). Most of these areas are in Sacramento (Dierssen
5 association) and Alameda (Rincon-San Ysidro association) Counties. Proposed locations for
6 construction features (such as tunnel intakes and their associated structures, borrow/spoils sites, RTM
7 areas, and temporary access roads) are generally situated in areas of soils with low to moderate shrink-
8 swell potential (see Figure 10-4). However, a borrow/spoils area, a temporary work area, a concrete
9 batch plant and a fuel station location in the southern portion of the Alternative 1A alignment, south of
10 Clifton Court Forebay and the proposed Byron Tract Forebay, may contain soils with high to very high
11 shrink-swell potential.

12 Soils with a high shrink-swell potential (i.e., expansive soils) could damage facilities or cause the
13 facilities to fail. For example, foundations and pavements could be cracked or shifted and pipelines
14 could rupture.

15 **Soils Corrosive to Concrete**

16 The near-surface (i.e., upper 5 feet) soil corrosivity to concrete is high throughout much of the
17 Alternative 1A alignment. The near-surface soils at the five intake and pumping plant facilities
18 generally have a low corrosivity to concrete. The near-surface soils at the tunnel shafts have a low to
19 high corrosivity to concrete. Data on soil corrosivity to concrete below a depth of approximately 5 feet
20 (i.e., where pipelines, tunnels, and the deeper part of the tunnel shafts would be constructed) are not
21 available. However, given the variability in the composition of the soils and geologic units on and
22 within which the conveyance facilities would be constructed, corrosivity hazards are likely to range
23 from low to high. Because soil corrosivity to concrete is high among the near-surface peat soils in the
24 Delta, a high corrosivity is also expected to be present among the peat soils at depth. Site-specific soil
25 investigations would need to be conducted to determine the corrosivity hazard at depth at each
26 element of the conveyance facility. However, as described in 10.3.1, *Methods for Analysis*, and Appendix
27 3B, *Environmental Commitments*, geotechnical studies would be conducted at all facilities to identify
28 site-specific soil corrosivity hazards. The resulting geotechnical report, prepared by a California
29 registered civil engineer or a California certified engineering geologist, would describe these hazards
30 and recommend the measures that should be implemented to ensure that the facilities are constructed
31 to withstand corrosion and to conform with applicable state and federal standards, such as the CBC.

32 Soils that are moderately and highly corrosive to concrete may cause the concrete to degrade, thereby
33 threatening the integrity of the facility. Degradation of concrete may cause pipelines and tunnels to leak
34 or rupture and cause foundations to weaken.

35 **Soils Corrosive to Uncoated Steel**

36 The near-surface soils along the Alternative 1A alignment generally are highly corrosive to uncoated
37 steel. Sections of the southern end of the alignment are moderately corrosive to uncoated steel. Data on
38 soil corrosivity to uncoated steel below a depth of approximately 5 feet (i.e., where pipelines, tunnels,
39 and the deeper part of the tunnel shafts would be constructed) are not available. However, given the
40 variability in the composition of the soils and geologic units on and within which the conveyance
41 facilities would be constructed, corrosivity hazards are likely to range from low to high. Site-specific
42 soil investigations would need to be conducted to determine the corrosivity hazard at depth at each
43 element of the conveyance facility.

1 Soils that are moderately and highly corrosive to uncoated steel (including steel rebar embedded in
2 concrete) may cause the concrete to degrade, threatening the integrity of these facilities.

3 **Compressible Soils**

4 Soils that are weakly consolidated or that have high organic matter content (such as peat or muck soils)
5 present a risk to structures and infrastructure because of high compressibility and poor bearing
6 capacity. Soils with high organic matter content tend to compress under load and may decrease in
7 volume as organic matter is oxidized. Much of the Alternative 1A tunnel alignment is underlain by near-
8 surface soils that consist of peat. The soils in the area where the intakes and their associated structures
9 would be located have a relatively low organic matter content. Based on liquid limits reported in
10 county soil surveys, near-surface soils in the Alternative 1A alignment vary from low to medium
11 compressibility.

12 Damage to or collapse of the pipelines, intakes, pumping plants, transition structures, and control
13 structures, could occur where these facilities are constructed in soils and sediments that are subject to
14 subsidence and differential settlement. Because of compressible soils, such effects could occur at the
15 five intakes, all the pumping plants, and the sedimentation basins. Subsidence- or differential
16 sediment-induced damage or collapse of these facilities could cause a rapid release of water to the
17 surrounding soil, causing an interruption in water supply and producing underground cavities,
18 depressions at the ground surface, and surface flooding.

19 The tunnels would be constructed at a depth below the peat (Figure 9-4); therefore, subsidence caused
20 by organic matter decomposition below the tunnels is expected to be minimal. Surface and subsurface
21 settlement may occur during tunnel construction; however, certain methods and practices may be used
22 during tunnel construction to help reduce and manage settlement risk. Chapter 9, *Geology and*
23 *Seismicity*, discusses the risks of settlement during tunnel construction and methods to reduce the
24 amount of settlement (Impact GEO-2).

25 Embankments that have subsided would be subject to overtopping, leading to flooding on the landside
26 of the embankments. The embankment that would be subject to this hazard is the new Byron Tract
27 Forebay.

28 **NEPA Effects:** Various facilities would be located on expansive, corrosive, and compressible soils.
29 However, all facility design and construction would be executed in conformance with the CBC, which
30 specifies measures to mitigate effects of expansive soils, corrosive soils, and soils subject to
31 compression and subsidence. The CBC requires measures such as soil replacement, lime treatment, and
32 post-tensioned foundations to offset expansive soils. The CBC requires such measures as using
33 protective linings and coatings, dielectric (i.e., use of an electrical insulator polarized by an
34 applied electric field) isolation of dissimilar materials, and active cathodic protection systems to
35 prevent corrosion of concrete and steel.

36 Potential adverse effects of compressible soils and soils subject to subsidence could be addressed by
37 overexcavation and replacement with engineered fill or by installation of structural supports (e.g.,
38 pilings) to a depth below the peat where the soils have adequate load bearing strength, as required by
39 the CBC and by USACE design standards. Geotechnical studies would be conducted at all the facilities to
40 determine the specific measures that should be implemented to reduce these soil hazards to levels
41 consistent with the CBC. Liquid limit and soil organic matter content testing would be performed on
42 collected soil samples during the site-specific field investigations to determine site-specific

1 geotechnical properties. Settlement monitoring points would be established along the route during
2 tunnel construction and results reviewed regularly by a professional engineer.

3 The engineer would develop final engineering solutions to any hazardous condition, consistent with the
4 code and standards requirements of federal, state, and local oversight agencies. As described in section
5 10.3.1, *Methods for Analysis*, and in Appendix 3B, *Environmental Commitments*, such design codes,
6 guidelines, and standards include the California Building Code and resource agency and professional
7 engineering specifications, such as the DWR *Interim Levee Design Criteria for Urban and Urbanizing*
8 *Area State Federal Project Levees*, and USACE *Engineering and Design—Earthquake Design and*
9 *Evaluation for Civil Works Projects*.

10 By conforming with the CBC and other applicable design standards, potential effects associated with
11 expansive and corrosive soils and soils subject to compression and subsidence would be offset. There
12 would be no adverse effect.

13 **CEQA Conclusion:** Many of the Alternative 1A facilities would be constructed on surface soils that are
14 moderately or highly corrosive to concrete and uncoated steel, as well as soils that are moderately or
15 highly subject to compression under load. Corrosive soils could damage in-ground facilities or shorten
16 their service life. Compression/settlement of soils after a facility is constructed could result in damage
17 to or failure of the facility. Surface soils that are moderately to highly expansive are present throughout
18 the Alternative 1A alignment except in the central part of the Delta, roughly between Staten Island and
19 Bacon Island. Expansive soils could cause foundations, underground utilities, and pavements to crack
20 and fail. However, DWR would be required to design and construct the facilities in conformance with
21 state and federal design standards, guidelines, and building codes. The CBC requires measures such as
22 soil replacement, lime treatment, and post-tensioned foundations to offset expansive soils. The CBC
23 requires such measures as using protective linings and coatings, dielectric (i.e., use of an electrical
24 insulator polarized by an applied electric field) isolation of dissimilar materials, and active cathodic
25 protection systems to prevent corrosion of concrete and steel in conformance with CBC requirements.
26 Potential effects of compressible soils and soils subject to subsidence could be addressed by
27 overexcavation and replacement with engineered fill or by installation of structural supports (e.g.,
28 pilings) to a depth below the peat where the soils have adequate load bearing strength, as required by
29 the CBC and by USACE design standards. Conforming with these codes and standards (Appendix 3B,
30 *Environmental Commitments*) is an environmental commitment by DWR to ensure that potential effects
31 associated with expansive and corrosive soils and soils subject to compression and subsidence would
32 be offset. Therefore, the impact would be less than significant. No mitigation is required.

33 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 34 **Operations**

35 River channel bank erosion/scour is a natural process. The rate of natural erosion can increase during
36 high flows and as a result of wave effect on banks during high wind conditions.

37 In general, changes in river flow rates associated with BDCP operations would remain within the range
38 that presently occurs. However, the operational components would cause changes in the tidal flows in
39 some Delta channels, specifically those that lead into the major habitat restoration areas (Suisun Marsh,
40 Cache Slough, Yolo Bypass, and South Delta ROAs). In major channels leading to the restoration areas
41 (e.g., Lindsey, Montezuma, and Georgiana sloughs and Middle River), tidal flow velocities may increase
42 by an unknown amount; any significant increases could cause some localized accelerated
43 erosion/scour. However, detailed hydrodynamic (tidal) modeling would be conducted prior to any
44 BDCP habitat restoration work in these ROA areas, and the changes in the tidal velocities in the major

1 channels connecting to these restoration areas would be evaluated. If there is any indication that tidal
 2 velocities would be substantially increased, the restoration project design would be modified (such as
 3 by providing additional levee breaches or by requiring dredging in portions of the connecting channels)
 4 so that bed scour would not increase sufficiently to cause an erosion impact. Moreover, as presently
 5 occurs and as is typical with most naturally-functioning river channels, local erosion and deposition
 6 within the tidal habitats is expected as part of the restoration.

7 For most of the existing channels that would not be subject to tidal flow restoration, there would be no
 8 adverse effect to tidal flow volumes and velocities. The tidal prism would increase by 5–10%, but the
 9 intertidal (i.e., mean higher high water [MHHW] to mean lower low water [MLLW]) cross-sectional
 10 area also would be increased such that tidal flow velocities would be reduced by 10–20% compared to
 11 the existing condition. Consequently, no appreciable increase in scour is anticipated.

12 **NEPA Effects:** The effect would not be adverse because there would be no net increase in river flow
 13 rates and, accordingly, no net increase in channel bank scour.

14 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in channels
 15 and sloughs, potentially leading to increases in channel bank scour. However, where such changes are
 16 expected to occur (i.e., at the mouths of tidal marsh channels), the project would also entail expansion
 17 of the channel cross-section to increase the tidal prism at these locations. The net effect would be to
 18 reduce the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no
 19 appreciable increase in scour is anticipated. The impact would be less than significant. No mitigation is
 20 required.

21 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**
 22 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,**
 23 **CM18 and CM19**

24 Implementing conservation measures CM2–CM11 would include breaching, lowering, or removing
 25 levees; constructing setback levees and cross levees or berms; raising the land elevation by excavating
 26 relatively high areas to provide fill for subsided areas or by importing fill material; surface grading;
 27 deepening and/or widening tidal channels; excavating new channels; modifying channel banks; and
 28 other activities. Moreover, excavation and grading to construct facilities, access roads, and other
 29 features would be necessary under the two conservation measures that are not associated with the
 30 ROAs (i.e., *CM18 Conservation Hatcheries* and *CM19 Urban Stormwater Treatment*). These activities
 31 could cause adverse effects on soil erosion rates and cause a loss of topsoil, as discussed below.

32 **Water Erosion**

33 Activities associated with conservation measures that could lead to accelerated water erosion include
 34 clearing, grubbing, demolition, grading, and other similar disturbances. Such activities steepen slopes
 35 and compact soil. These activities tend to degrade soil structure, reduce soil infiltration capacity, and
 36 increase runoff rates, all of which could cause accelerated erosion and consequent loss of topsoil.

37 Gently sloping to level areas, such as where most of the restoration actions would occur, are expected
 38 to experience little or no accelerated water erosion because of the lack of runoff energy to entrain and
 39 transport soil particles.

40 Graded and otherwise disturbed tops and sideslopes of existing and project levees and embankments
 41 are of greater concern for accelerated water erosion because of their steep gradients. Soil eroded from

1 the disturbed top and water side of levees could reach adjoining waterways (if present), unless erosion
2 and sediment control measures are implemented.

3 **Wind Erosion**

4 Wind erosion potential varies widely among and within the ROAs (Figure 10-6). Areas within ROAs
5 with high wind erodibility are largely correlated with the presence of organic soils. Wind erodibility in
6 the Suisun Marsh, Cache Slough, and South Delta ROAs ranges from high to low. The Yolo Bypass ROA
7 generally has a low wind erodibility hazard.

8 Implementation of conservation measures (e.g., excavation, filling, grading, and vehicle traffic on
9 unimproved roads) that could lead to accelerated wind erosion are the same as those for water erosion.
10 These activities may entail vegetation removal and degradation of soil structure, both of which would
11 make the soil more subject to wind erosion. Removal of vegetation cover and grading increase soil
12 exposure at the surface and obliterate the binding effect of plant roots on soil aggregates. These effects
13 make the soil particles more subject to entrainment by wind.

14 Unlike water erosion, the potential for wind erosion is generally not dependent on slope gradient and
15 location, nor is the potential affected by context relative to a receiving water. Without proper
16 management, the wind-eroded soil particles can be transported great distances.

17 The transport of soil material from the conveyance facilities for use as fill in subsided areas within the
18 ROAs could subject the soils to wind erosion, particularly if the fill material consists of peat. The peat
19 would be especially susceptible to wind erosion while being loaded onto trucks, transported, unloaded,
20 and distributed onto the restoration areas.

21 **NEPA Effects:** These effects could potentially result in substantial accelerated erosion. However, as
22 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the
23 BDCP proponents would be required to obtain coverage under the General Permit for Construction and
24 Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan. The
25 General Permit requires that SWPPPs be prepared by a QSD and requires SWPPPs be implemented
26 under the supervision of a QSP. The QSD would select erosion and sediment control BMPs such as
27 preservation of existing vegetation, seeding, mulching, fiber roll and silt fence barriers, erosion control
28 blankets, watering to control dust entrainment, and other measures to comply with the practices and
29 turbidity level requirements defined by the General Permit. Partly because the potential adverse effect
30 on receiving waters depends on location of a work area relative to a waterway, the BMPs would be site-
31 specific. The QSP would be responsible for day-to-day implementation of the SWPPP, including BMP
32 inspections, maintenance, water quality sampling, and reporting to the State Water Board.

33 Proper implementation of the requisite SWPPP and compliance with the General Permit would ensure
34 that accelerated water and wind erosion associated with implementation of the conservation measures
35 would not be an adverse effect.

36 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
37 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP
38 proponents would seek coverage under the state General Permit for Construction and Land
39 Disturbance Activities (as discussed in Appendix 3B, *Environmental Commitments*). Permit conditions
40 would include erosion and sediment control BMPs (such as revegetation, runoff control, and sediment
41 barriers) and compliance with water quality standards. As a result of implementation of Permit
42 conditions, the impact would be less than significant. No mitigation is required.

1 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
 2 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2–**
 3 **CM11**

4 Topsoil effectively would be lost as a resource as a result of its excavation (e.g., levee foundations,
 5 water control structures); overcovering (e.g., levees, embankments, application of fill material in
 6 subsided areas); and water inundation (e.g., aquatic habitat areas).

7 **NEPA Effects:** Implementation of habitat restoration activities at the ROAs would result in excavation,
 8 overcovering, or inundation of approximately 77,600 acres of topsoil. This effect would be adverse
 9 because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b
 10 would be available to reduce the severity of this effect.

11 **CEQA Conclusion:** Implementation of conservation measures CM2–CM11 would involve excavation,
 12 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby
 13 resulting in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would minimize
 14 and compensate for these impacts to a degree, but not to a less-than-significant level. This impact is
 15 considered significant and unavoidable.

16 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

17 Please see Mitigation Measure SOILS-2a under Impact SOILS-2.

18 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 19 **Storage and Handling Plan**

20 Please see Mitigation Measure SOILS-2b under Impact SOILS-2.

21 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 22 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed**
 23 **Conservation Measures CM2–CM11**

24 With the exception of the Suisun Marsh ROA, the ROAs are not in areas of high subsidence nor where
 25 the soils have a high organic matter content (Figures 10-2 and 10-9). Consequently, only the Suisun
 26 Marsh ROA would be expected to be subject to substantial subsidence. Based on its current elevation,
 27 the Suisun Marsh ROA has not experienced significant subsidence, despite the fact that the soils are
 28 organic and of considerable thickness (Figure 10-3).

29 Damage to or failure of the habitat levees could occur, where these are constructed in soils and
 30 sediments that are subject to subsidence and differential settlement. Levee damage or failure could
 31 cause surface flooding in the vicinity.

32 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
 33 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
 34 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
 35 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
 36 berms, and other features are constructed to withstand subsidence and settlement and to conform to
 37 applicable state and federal standards. Such standards include the USACE Design and Construction of
 38 Levee and DWR Interim Levee Design Criteria for Urban and Urbanizing Area State-Federal Project
 39 Levees.

1 For example, high organic matter content soils and all soils otherwise subject to subsidence that are
 2 unsuitable for supporting levees would be overexcavated and replaced with engineered fill, and the
 3 unsuitable soils disposed of offsite as spoils. Geotechnical evaluations will be conducted to identify soils
 4 materials that are suitable for engineering purposes. Liquid limit and organic content testing should be
 5 performed on collected soil samples during the site-specific field investigations to determine site-
 6 specific geotechnical properties.

7 With construction of all levees, berms, and other conservation features designed and constructed to
 8 withstand subsidence and settlement and through conformance with applicable state and federal
 9 design standards, this effect would not be adverse.

10 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
 11 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
 12 of the facility. However, because the BDCP proponents would be required to design and construct the
 13 facilities according to state and federal design standards and guidelines (which may involve, for
 14 example, replacement of the organic soil), the impact would be less than significant. No mitigation is
 15 required.

16 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,
 17 and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2-
 18 CM11**

19 ***Expansive Soils***

20 The ROAs generally have soils with moderate or high shrink-swell potential. The ROAs with a
 21 significant extent of highly expansive soils are the Yolo Bypass and Cache Slough ROAs (Figure 10-4).
 22 None appears to have appreciable areas of soils with very high expansiveness.

23 Potential adverse effects of expansive soils are a concern only to structural facilities within the ROAs,
 24 such as water control structures. Seasonal shrinking and swelling of moderately or highly expansive
 25 soils could damage water control structures or cause them to fail, resulting in a release of water from
 26 the structure and consequent flooding, which would cause unplanned inundation of aquatic habitat
 27 areas.

28 ***Corrosive Soils***

29 Soils in all the ROAs possess high potential for corrosion of uncoated steel, and the Suisun Marsh ROA
 30 and portions of the West Delta ROA possess soils with high corrosivity to concrete.

31 ***Compressible Soils***

32 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne,
 33 and South Delta ROAs. Areas of low to medium compressibility occur in the South Delta ROA. Silts and
 34 clays with a liquid limit less than 35% are considered to have low compressibility. Silts and clays with a
 35 liquid limit greater than 35% and less than 50% are considered to have medium compressibility and
 36 greater than 50% are considered highly compressible. Organic soils typically have high liquid limits
 37 (greater than 50%) and are therefore considered highly compressible.

38 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and compressible
 39 soils. However, ROA-specific environmental effect evaluations and geotechnical studies and testing
 40 would be completed prior to construction within the ROAs. The site-specific environmental evaluation

1 would identify specific areas where engineering soil properties, including soil compressibility, may
 2 require special consideration during construction of specific features within ROAs. Conformity with
 3 USACE, CBC, and other design standards for construction on expansive, corrosive, and/or compressible
 4 soils would prevent adverse effects.

5 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that are
 6 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
 7 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
 8 could damage in-ground facilities or shorten their service life. Compression or settlement of soils after
 9 a facility is constructed could result in damage to or failure of the facility. However, because the BDCP
 10 proponents would be required to design and construct the facilities according to state and federal
 11 design standards, guidelines, and building codes (which may involve, for example, soil lime
 12 stabilization, cathodic protection of steel, and soil replacement), this impact would be considered less
 13 than significant. No mitigation is required.

14 **10.3.3.3 Alternative 1B—Dual Conveyance with East Alignment and Intakes** 15 **1–5 (15,000 cfs; Operational Scenario A)**

16 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances** 17 **as a Result of Constructing the Proposed Water Conveyance Facilities**

18 The mechanisms of this impact are similar to those described for Alternative 1A; however, considerably
 19 more excavation would be necessary to construct the canal along the eastern alignment than would be
 20 necessary for tunnel boring under Alternative 1A. Construction of water conveyance facilities would
 21 involve vegetation removal; constructing building pads, levees, canals, and tunnel siphons; excavation;
 22 overexcavation for facility foundations; surface grading; trenching; road construction; spoil storage;
 23 soil stockpiling; and other activities over approximately 21,500 acres during the course of constructing
 24 the facilities. Vegetation would be removed (via grubbing and clearing) grading and other earthwork
 25 would be conducted at the intakes, pumping plants, the proposed Byron Tract Forebay, canal and gates
 26 between the Byron Tract Forebay tunnel shafts and the approach canal to the Banks Pumping Plant,
 27 borrow areas, RTM and spoil storage areas, setback and transition levees, sedimentation basins, solids
 28 handling facilities, transition structures, surge shafts and towers, substations, transmission line
 29 footings, access roads, concrete batch plants, fuel stations, bridge abutments, barge unloading facilities,
 30 and laydown areas. Some of the work would be conducted in areas that are fallow at the time.
 31 Excavation of a large volume of borrow material would be required to construct the canals. Some of the
 32 earthwork activities may also result in steepening of slopes and soil compaction, particularly for the
 33 embankments constructed for the intermediate forebay and the proposed Byron Tract Forebay. These
 34 conditions tend to result in increased runoff rates, degradation of soil structure, and reduced soil
 35 infiltration capacity, all of which could cause accelerated erosion, resulting in loss of topsoil.

36 **Water Erosion**

37 The excavation, grading, and other soil disturbances described above that are conducted in gently
 38 sloping to level areas, such as the interiors of Delta islands, are expected to experience little or no
 39 accelerated water erosion because of the lack of runoff energy to entrain and transport soil particles.
 40 Any soil that is eroded within island interiors would tend to remain on the island, provided that
 41 existing or project levees are in place to serve as barriers to keep the eroded soil (i.e., sediment) from
 42 entering receiving waters.

1 In contrast, graded and otherwise disturbed tops and sideslopes of existing and project canals, levees,
 2 and embankments are of greater concern for accelerated water erosion because of their steeper
 3 gradients. Although soil eroded from the land side of levees would be deposited on the island interiors,
 4 soil eroded from the disturbed top and water side of levees could reach adjoining waterways. Soil
 5 eroded from natural slopes in upland environments could also reach receiving waters.

6 **Wind Erosion**

7 Many of the primary work areas that would involve extensive soil disturbance (i.e., the canals, staging
 8 areas, borrow/spoil areas, and intakes) within the Alternative 1B footprint are underlain by soils with a
 9 moderate or high susceptibility to wind erosion (Natural Resources Conservation Service 2010a)
 10 (Figure 10-6). Of the primary areas that would be disturbed, the proposed borrow/spoil area
 11 southwest of Clifton Court Forebay, the proposed Byron Tract Forebay and parts of the southern half of
 12 the alignment generally have a low wind erosion hazard.

13 Construction activities (e.g., excavation, filling, grading, and vehicle traffic on unimproved roads) that
 14 could lead to accelerated wind erosion are generally the same as those for water erosion. These
 15 activities may result in vegetation removal and degradation of soil structure, both of which would make
 16 the soil much more subject to wind erosion. Removal of vegetation cover and grading increase soil
 17 exposure at the surface and obliterate the binding effect of plant roots on soil aggregates. These effects
 18 make the soil particles much more subject to entrainment by wind. However, most of the areas that
 19 would be extensively disturbed by construction activities are already routinely disturbed by
 20 agricultural activities, such from disking and harrowing. These areas are the pumping plants, most of
 21 the proposed Byron Tract Forebay, borrow areas, RTM and spoil storage areas, sedimentation basins,
 22 solids handling facilities, substations, access roads, concrete batch plants, and laydown areas.
 23 Consequently, with the exception of loading and transporting of soil material to storage areas, the
 24 disturbance that would result from constructing the conveyance facilities in many areas would not
 25 substantially depart from the existing condition, provided that the length of time that the soil is left
 26 exposed during the year does not change compared to that associated with agricultural operations.
 27 Because the SWPPPs prepared for the various components of the project will be required to prescribe
 28 ongoing best management practices to control wind erosion (such as temporary seeding), the amount
 29 of time that the soil would be exposed during construction should not significantly differ from the
 30 existing condition.

31 Unlike water erosion, the potential adverse effects of wind erosion are generally not dependent on
 32 slope gradient and location relative to levees or water. Without proper management, the wind-eroded
 33 soil particles can be transported great distances.

34 Excavation of soil from borrow areas and transport of soil material to spoil storage areas would
 35 potentially subject soils to wind erosion. It is likely that approximately 159 million cubic yards of peat
 36 soil material would be disposed of as spoils; this material would be especially susceptible to wind
 37 erosion while being loaded onto trucks, transported, unloaded, and distributed.

38 **NEPA Effects:** These potential effects could be substantial because they could cause accelerated
 39 erosion. However, as described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental*
 40 *Commitments*, DWR would be required to obtain coverage under the General Permit for Construction
 41 and Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan.
 42 While the SWPPPs would not be prepared until just prior to construction and application to the State
 43 Water Board for a General Permit, please see the discussion under Alternative 1A, Impact SOILS-1, for
 44 more details on what SWPPPs would entail, and likely BMPs which would be included.

1 Accelerated water and wind erosion as a result of construction of the proposed water conveyance
 2 facility could occur under Alternative 1B, but proper implementation of the requisite SWPPP and
 3 compliance with the General Permit (as discussed in Appendix 3B, *Environmental Commitments*,
 4 Commitment 3B.2) would ensure that there would not be substantial soil erosion resulting in daily site
 5 runoff turbidity in excess of 250 NTUs, and therefore, there would not be an adverse effect.

6 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 7 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR
 8 would seek coverage under the state General Permit for Construction and Land Disturbance Activities
 9 (as discussed in Appendix 3B, *Environmental Commitments*, Commitment 3B.2), necessitating the
 10 preparation of a SWPPP and an erosion control plan. As a result of implementation of the SWPPP, and
 11 Permit conditions, there would not be substantial soil erosion resulting in daily site runoff turbidity in
 12 excess of 250 NTUs, and therefore, the impact would be less than significant. No mitigation is required.

13 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 14 **Constructing the Proposed Water Conveyance Facilities**

15 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation during
 16 construction of the water conveyance facilities associated with Alternative 1B (e.g., canal alignment,
 17 borrow areas, levee foundations, intake facilities, pumping plants); overcovering (e.g., levees and
 18 embankments, spoil storage, pumping plants); and water inundation (e.g., forebay, sedimentation
 19 basins, and solids lagoons). Table 10-6 presents an itemization of the effects on soils caused by
 20 excavation, overcovering, and inundation, based on GIS analysis by facility type. Due to the nature of
 21 the earthwork to construct many of the facilities, more than one mechanism of soil loss may be
 22 involved at a given facility. For example, levee construction would require both excavation to prepare
 23 the subgrade and overcovering to construct the levee. The table shows that the greatest extent of
 24 topsoil loss would be associated with overcovering such as spoil storage areas, unless measures are
 25 undertaken to salvage the topsoil and reapply it on top of excavated borrow areas or on top of the
 26 spoils once they have been placed.

27 **Table 10-6. Topsoil Lost as a Result of Excavation, Overcovering, and Inundation Associated with the Proposed**
 28 **Water Conveyance Facility**

Topsoil Loss Mechanism	Acreage Affected
Excavation (intakes, canals, borrow areas)	7,926
Overcovering (spoil storage, reusable tunnel material storage)	13,055
Inundation (forebay, sedimentation basins, solids lagoons)	851
Total	21,832

Note: Some mechanisms for topsoil loss entail more than one process of soil loss. For example,
 construction of setback levees would first require overexcavation for the levee foundation (i.e.,
 excavation), then placement of fill material (i.e., overcovering).

29
 30 DWR has made an Environmental Commitment for Disposal Site Preparation which would require that
 31 a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will be set
 32 aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas, thereby
 33 lessening the effect. However, this effect would be adverse because it would result in substantial loss of
 34 topsoil. Mitigation Measures SOILS-2a and SOILS-2b would also be available to reduce the severity of
 35 this effect.

1 **CEQA Conclusion:** Construction of the water conveyance facilities would involve irreversible removal,
 2 overcovering, and inundation of topsoil over large areas, thereby resulting in a substantial loss of
 3 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would
 4 be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these
 5 impacts, but not to a less-than-significant level. Therefore, this impact is considered significant and
 6 unavoidable.

7 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

8 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

9 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 10 **Storage and Handling Plan**

11 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

12 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 13 **from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed**
 14 **Water Conveyance Facilities**

15 The northern half of the proposed canal alignment, the intakes, pumping plants, pipelines, and Byron
 16 Tract Forebay adjacent to the Clifton Court Forebay would be constructed where the near-surface soils
 17 contain less than approximately 2% organic matter; these areas therefore would not be subject to
 18 appreciable subsidence caused by organic matter decomposition. The southern half of the canal
 19 alignment, four siphons, and one tunnel would be constructed where the near-surface soils have
 20 approximately 4–23% organic matter content (Figure 10-2); consequently, subsidence caused by
 21 organic matter decomposition could be considerable. Without adequate engineering, part of the canal,
 22 siphons, and a tunnel could be subject to appreciable subsidence.

23 Damage to or collapse of the canal, tunnels, siphons, bridge abutments, and other facilities could occur
 24 where these facilities are constructed in soils and sediments that are subject to subsidence and
 25 differential settlement. Subsidence or differential sediment-induced damage or collapse of these
 26 facilities could cause a rapid release of water to the surrounding soil, causing an interruption in water
 27 supply and producing underground cavities, depressions at the ground surface, and surface flooding.
 28 Facilities that have subsided would be subject to flooding.

29 Damage to other conveyance facilities, such as intakes, pumping plants, transition structures, and
 30 control structures, caused by subsidence/settlement under the facilities and consequent damage to or
 31 failure of the facility, could also occur. Facility damage or failure could cause a rapid release of water to
 32 the surrounding area, resulting in flooding, thereby endangering people in the vicinity. However,
 33 existing subsidence and soil organic matter content is generally low in the areas where these facilities
 34 are proposed, so there is little likelihood of this happening.

35 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on soils
 36 that are subject to subsidence. However, as described in section 10.3.1, *Methods for Analysis*, and
 37 Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all facilities to
 38 identify the types of soil avoidance or soil stabilization measures that should be implemented to ensure
 39 that the facilities are constructed to withstand subsidence and settlement and to conform to applicable
 40 state and federal standards. These investigations would build upon the geotechnical data reports
 41 (California Department of Water Resources 2001a, 2010b, 2011) and the CERs (California Department

1 of Water Resources 2009a, 2010c). Such standards include the American Society of Civil Engineers
2 Minimum Design Loads for Buildings and Other Structures, CBC, and USACE Design and Construction of
3 Levees. The results of the investigations, which would be conducted by a California registered civil
4 engineer or California certified engineering geologist, would be presented in geotechnical reports. The
5 reports would contain recommended measures to prevent subsidence. The geotechnical report will
6 prepared in accordance with state guidelines, in particular *Guidelines for Evaluating and Mitigating*
7 *Seismic Hazards in California* (California Geological Survey 2008).

8 Liquid limit and organic material content testing should be performed on soil samples collected during
9 the site-specific field investigations to determine site-specific geotechnical properties. High organic
10 matter content soils that are unsuitable for support of structures, bridge abutments, roadways and
11 other facilities would be overexcavated and replaced with engineered fill, and the unsuitable soils
12 disposed of offsite as spoil, as described in more detail below. Geotechnical evaluations will be
13 conducted to identify soil materials that are suitable for engineering purposes. Additional measures to
14 address the potential adverse effects of organic soils could include construction of structural supports
15 that extend below the depth of organic soils into underlying materials with suitable bearing strength.
16 For example, the CER indicates that approximately 35 feet of soil would be excavated and a pile
17 foundation supporting a common concrete mat would be required for the intake pumping plants. The
18 piles would be 24-inches in diameter and concrete-filled, extending to 65 to 70 feet below the founding
19 level of the plant. Piles extended to competent geologic beds, beyond the weak soils would provide a
20 solid foundation to support the pumping plants.

21 For the sedimentation basins, the CER indicates that most of the underlying soils would be excavated to
22 a depth of 30 feet below grade and removed from the site and suitable soil material imported to the site
23 to re-establish it to subgrade elevation. Removal of the weak soils and replacement with engineered fill
24 using suitable soil material would provide a solid foundation for the sedimentation basins.

25 Certain methods and practices may be utilized during tunnel siphon construction to help reduce and
26 manage settlement risk. The CER indicates that the ground improvement techniques to control
27 settlement at the shafts and tunnels may involve jet-grouting, permeation grouting, compaction
28 grouting, or other methods that a contractor may propose. These measures would have the effect of
29 better supporting the soil above the borehole and would prevent unacceptable settlement between the
30 borehole and the tunnel segments. Additionally, settlement monitoring points, the number and location
31 of which would be identified during detailed design, would be established along the pipeline and tunnel
32 routes during construction and the results reviewed regularly by a professional engineer. The
33 monitoring therefore would provide early detection of excessive settlement such that corrective
34 actions could be made before the integrity of the tunnel is jeopardized.

35 Conforming with state and federal design standards would ensure that any subsidence that occurs
36 under the conveyance facilities would not jeopardize their integrity. As described in the section 10.3.1,
37 *Methods for Analysis*, and in Appendix 3B, *Environmental Commitments*, such design codes and
38 standards include the California Building Code and resource agency and professional engineering
39 specifications, such as the American Society of Civil Engineers Minimum Design Loads for Buildings and
40 Other Structures, ASCE-7-05, 2005. Conforming with these codes and standards is an environmental
41 commitment by DWR to ensure cut and fill slopes and embankments will be stable as the water
42 conveyance features are operated. Conforming with the standards and guidelines may necessitate such
43 measures as excavation and removal of weak soils and replacement with engineered fill using suitable,
44 imported soil, construction on pilings driven into competent soil material, and construction of facilities
45 on cast-in-place slabs. These measures would reduce the potential hazard of subsidence or settlement

1 to acceptable levels by avoiding construction directly on or otherwise stabilizing the soil material that
2 is prone to subsidence. There would be no adverse effect.

3 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
4 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of
5 the facility. However, DWR would be required to design and construct the facilities according to state
6 and federal design standards and guidelines (e.g., California Building Code, American Society of Civil
7 Engineers Minimum Design Loads for Buildings and Other Structures, ASCE-7-05, 2005). Conforming
8 with these codes would reduce the potential hazard of subsidence or settlement to acceptable levels by
9 avoiding construction directly on or otherwise stabilizing the soil material that is prone to subsidence.
10 Because these measures would reduce the potential hazard of subsidence or settlement to meet design
11 standards, this impact is considered less than significant. No mitigation is required.

12 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water** 13 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

14 The integrity of the water conveyance facilities, including the canal, intake facilities, pumping plants,
15 access roads and utilities, and other features, could be adversely affected by expansive, corrosive, and
16 compressible soils.

17 ***Expansive Soils***

18 Soil expansion is a concern only at soil depths that are subject to seasonal changes in moisture content.
19 The Alternative 1B alignment is underlain by soils with low to high shrink-swell potential (note areas
20 of high linear extensibility in Figure 10-4). The majority of the soils with high shrink-swell potential are
21 where the intakes, pumping plants, pipelines, sedimentation basin, one of the tunnels, and the northern
22 third of the canal alignment are proposed. Most of these areas are in Sacramento County (Dierssen and
23 Egbert-Valpac association soils). The remaining conveyance facilities would generally be located where
24 the soils have low or moderate shrink-swell potential. Soil expansion-contraction is not expected to be
25 a concern at these types of facilities.

26 Soils with a high shrink-swell potential (i.e., expansive soils) could damage facilities or cause the
27 facilities to fail. For example, foundations and pavements could be cracked or shifted and pipelines
28 could rupture.

29 ***Soils Corrosive to Concrete***

30 The near-surface (i.e., upper 5 feet) soil corrosivity to concrete ranges from low to high along the
31 Alternative 1B alignment, although most of the alignment is in areas of low to moderate corrosivity.
32 The near-surface soils at the five intake and pumping plant facilities generally have a moderate
33 corrosivity to concrete. The near-surface soils at the proposed tunnel alignment near Walnut Grove and
34 the northern siphons have a moderate corrosivity to concrete. The proposed tunnel alignment near
35 Stockton and the Clifton Court Forebay have low corrosivity to concrete. Data on soil corrosivity to
36 concrete below a depth of approximately 5 feet (i.e., where pipelines, tunnels, and the deeper part of
37 the tunnel shafts will be constructed) are not available. However, given the variability in the
38 composition of the soils and geologic units on and within which the conveyance facilities would be
39 constructed, corrosivity hazards are likely to range from low to high. Site-specific soil investigations
40 will need to be conducted to determine this. Because soil corrosivity to concrete is high among the
41 near-surface peat soils in the Delta, a high corrosivity is also expected to be present among the peat
42 soils at depth. Site-specific soil investigations would need to be conducted to determine the corrosivity

1 hazard at depth at each element of the conveyance facility. However, as described in 10.3.1, *Methods for*
2 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
3 facilities to identify site-specific soil corrosivity hazards. The resulting geotechnical report, prepared by
4 a California registered civil engineer or a California certified engineering geologist, would describe
5 these hazards and recommend the measures that should be implemented to ensure that the facilities
6 are constructed to withstand corrosion and to conform with applicable state and federal standards,
7 such as the CBC.

8 Soils that are moderately and highly corrosive to concrete may cause the concrete to degrade, thereby
9 threatening the integrity of the facility. Degradation of concrete may cause pipelines to leak or rupture
10 and cause foundations to weaken.

11 ***Soils Corrosive to Uncoated Steel***

12 The near-surface soils along the Alternative 1B alignment have a moderate or high corrosivity to
13 uncoated steel. With the exception of a significantly sized area west of Stockton, virtually the entire
14 alignment has a high risk of corrosion to uncoated steel. Data on soil corrosivity to uncoated steel
15 below a depth of approximately 5 feet (i.e., where pipelines, tunnels, and siphons would be
16 constructed) are not available. However, given the variability in the composition of the soils and
17 geologic units on and within which the conveyance facilities would be constructed, corrosivity hazards
18 are likely to range from low to high. Site-specific soil investigations would need to be conducted to
19 determine the corrosivity hazard at depth at each element of the conveyance facility.

20 Soils that are moderately and highly corrosive to uncoated steel (including steel rebar embedded in
21 concrete) may cause the concrete to degrade, threatening the integrity of these facilities.

22 ***Compressible Soils***

23 Soils that are weakly consolidated or that have high organic matter content (such as peat or muck soils)
24 present a risk to structures and infrastructure due to high compressibility and poor bearing capacity.
25 Soils with high organic matter content tend to compress under load and may decrease in volume as
26 organic matter is oxidized. The southern half of the Alternative 1B alignment is underlain by near-
27 surface soils with significant organic matter content. Although the intakes would generally be located
28 on mineral soils, according to the CER some of these soils are soft and have poor bearing capacity. Some
29 of the pumping plants and pipelines also would be located on such soils. Based on liquid limits reported
30 in county soil surveys, near-surface soils in the Alternative 1B alignment vary from low to medium
31 compressibility.

32 Part of the Byron Tract Forebay embankment would be subject to this hazard.

33 Damage to or collapse of the intakes, pumping plants, transition structures, and control structures,
34 could occur where these facilities are constructed in soils and sediments that are subject to subsidence
35 and differential settlement. Because of compressible soils, such effects could occur at the five intakes,
36 all the pumping plants, and the sedimentation basins, Subsidence- or differential sediment-induced
37 damage to or collapse of these facilities could cause a rapid release of water to the surrounding soil,
38 causing an interruption in water supply and producing underground cavities, depressions at the
39 ground surface, and surface flooding. Facilities that have subsided would be subject to flooding and
40 levees that have subsided would be subject to overtopping and consequent flooding on the land side of
41 the levee.

1 **NEPA Effects:** Various facilities would be located on expansive, corrosive, and compressible soils.
 2 However, all facility design and construction would be executed in conformance with the CBC, which
 3 specifies measures to mitigate effects of expansive soils, corrosive soils, and soils subject to
 4 compression and subsidence. The CBC requires measures such as soil replacement, lime treatment, and
 5 post-tensioned foundations to offset expansive soils, as well as such measures as using protective
 6 linings and coatings, dielectric isolation of dissimilar materials, and active cathodic protection systems
 7 to prevent corrosion of concrete and steel.

8 Potential adverse effects of compressible soils and soils subject to subsidence could be addressed by
 9 overexcavation and replacement with engineered fill or by installation of structural supports (e.g.,
 10 pilings) to a depth below the peat where the soils have adequate load bearing strength, as required by
 11 the CBC and by USACE design standards. For example, the CER indicates that a deep foundation (pile)
 12 length of 65 to 70 feet below the founding level of the in-river intake may be required for adequate
 13 support of intake structures without excessive settlement. Geotechnical studies would be conducted at
 14 all the facilities to determine what specific measures should be implemented at each facility to reduce
 15 these soil hazards to levels consistent with the CBC. Liquid limit and soil organic matter content testing
 16 would be performed on soil samples collected during the site-specific field investigations to determine
 17 site-specific geotechnical properties. Settlement monitoring points should be established along the
 18 route during tunnel construction and results reviewed regularly by a professional engineer.

19 The engineer would develop final engineering solutions to any hazardous condition, consistent with the
 20 code and standards requirements of federal, state, and local oversight agencies (e.g., California Building
 21 Code, DWR Interim Levee Design Criteria for Urban and Urbanizing Area State Federal Project Levees,
 22 and USACE Engineering and Design—Earthquake Design and Evaluation for Civil Works Projects).

23 By conforming with the CBC and other applicable design standards, potential effects associated with
 24 expansive and corrosive soils and soils subject to compression and subsidence would be offset. There
 25 would be no adverse effect.

26 **CEQA Conclusion:** Many of the Alternative 1B facilities would be constructed on surface soils that are
 27 moderately or highly subject to expansion, corrosive to concrete and uncoated steel, as well as soils
 28 that are moderately or highly subject to compression under load. Expansive soils could cause
 29 foundations, underground utilities, and pavements to crack and fail. Corrosive soils could damage in-
 30 ground facilities or shorten their service life. Compression/settlement of soils after a facility is
 31 constructed could result in damage to or failure of the facility. However, DWR would be required to
 32 design and construct the facilities in conformance with state and federal design standards, guidelines,
 33 and building codes (e.g., CBC and USACE design standards). Conforming with these codes and standards
 34 (Appendix 3B, *Environmental Commitments*) is an environmental commitment by DWR to ensure that
 35 potential adverse effects associated with expansive and corrosive soils and soils subject to compression
 36 and subsidence would be offset. Therefore, the impact would be less than significant. No mitigation is
 37 required.

38 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 39 **Operations**

40 Alternative 1B would use Operational Scenario A—the same scenario as Alternative 1A. Accordingly,
 41 the effects associated with river channel bank erosion/scour would be the same.

42 **NEPA Effects:** As under Alternative 1A, the operational components would cause changes in the tidal
 43 flows in some Delta channels, specifically those that lead into the major habitat restoration areas

1 (Suisun Marsh, Cache Slough, Yolo Bypass, and South Delta ROAs). However, detailed hydrodynamic
 2 (tidal) modeling would be conducted prior to any BDCP habitat restoration work in these ROA areas,
 3 and the changes in the tidal velocities in the major channels connecting to these restoration areas
 4 would be evaluated. If there is any indication that tidal velocities would be substantially increased, the
 5 restoration project design would be modified (such as by providing additional levee breaches or by
 6 requiring dredging in portions of the connecting channels) so that bed scour would not increase
 7 sufficiently to cause an erosion impact. Moreover, as presently occurs and as is typical with most
 8 naturally-functioning river channels, local erosion and deposition within the tidal habitats is expected
 9 as part of the restoration.

10 The effect would not be adverse because there would be no net increase in flow rates and therefore no
 11 net increase in channel bank scour.

12 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in channels
 13 and sloughs, potentially leading to increases in channel bank scour. However, where such changes are
 14 expected to occur (i.e., at the mouths of tidal marsh channels), the project would also entail expansion
 15 of the channel cross-section to increase the tidal prism at these locations. The net effect would be to
 16 reduce the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no
 17 appreciable increase in scour is anticipated. The impact would be less than significant. No mitigation is
 18 required.

19 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**
 20 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,**
 21 **CM18 and CM19**

22 Implementation of conservation measures under Alternative 1B would be the same as under
 23 Alternative 1A. These activities would include breaching, lowering, or removing levees; constructing
 24 setback levees and cross levees or berms; raising the land elevation by excavating relatively high areas
 25 to provide fill for subsided areas or by importing fill material; surface grading; deepening and/or
 26 widening tidal channels; excavating new channels; modifying channel banks; excavation and grading to
 27 construct facilities, access roads, and other facilities; and other activities. These activities could cause
 28 adverse effects on soil erosion rates and cause a loss of topsoil through both water and wind erosion.

29 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as
 30 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the
 31 BDCP proponents would be required to obtain coverage under the General Permit for Construction and
 32 Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan.

33 Proper implementation of the requisite SWPPP and compliance with the General Permit would ensure
 34 that accelerated water and wind erosion associated with implementation of conservation measures
 35 CM2–CM11 would not be an adverse effect.

36 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 37 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP
 38 proponents would seek coverage under the state General Permit for Construction and Land
 39 Disturbance Activities (as discussed in Appendix 3B, *Environmental Commitments*). Permit conditions
 40 would include erosion and sediment control BMPs (such as revegetation, runoff control, and sediment
 41 barriers) and compliance with water quality standards. As a result of the implementation of Permit
 42 conditions, the impact would be less than significant. No mitigation is required.

1 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
 2 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2–**
 3 **CM11**

4 Implementation of conservation measures CM2–CM11 would be the same under Alternative 1B as
 5 under Alternative 1A. Consequently, topsoil loss associated with excavation (e.g., levee foundations,
 6 water control structures), overcovering (e.g., levees, embankments, application of fill material in
 7 subsided areas), and water inundation (e.g., aquatic habitat areas) would also be the same as under
 8 Alternative 1A.

9 **NEPA Effects:** Implementation of habitat restoration activities at the ROAs would result in excavation,
 10 overcovering, or inundation of a minimum of 77,600 acres of topsoil. This effect would be adverse
 11 because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b
 12 would be available to reduce the severity of this effect.

13 **CEQA Conclusion:** Implementation of conservation measures CM2–CM11 would involve excavation,
 14 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby
 15 resulting in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would minimize
 16 and compensate for these impacts to a degree, but not to a less-than-significant level. Therefore, this
 17 impact is considered significant and unavoidable.

18 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

19 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

20 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 21 **Storage and Handling Plan**

22 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

23 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 24 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed**
 25 **Conservation Measures CM2–CM11**

26 Implementation of proposed conservation measures CM2–CM11 under Alternative 1B would be the
 27 same as under Alternative 1A. Similarly, the potential for injury or death to occur as a result of damage
 28 to or failure of the habitat levees where these are constructed in soils and sediments that are subject to
 29 subsidence and differential settlement would also be the same as under Alternative 1A. Levee damage
 30 or failure could cause surface flooding in the vicinity.

31 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
 32 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
 33 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
 34 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
 35 berms, and other features are constructed to withstand subsidence and settlement and to conform to
 36 applicable state and federal standards. Such standards include USACE's *Design and Construction of*
 37 *Levees* and DWR's *Interim Levee Design Criteria for Urban and Urbanizing Area State-Federal Project*
 38 *Levees*.

1 With construction of all levees, berms, and other conservation features designed and constructed to
2 withstand subsidence and settlement and through conformance with applicable state and federal
3 design standards, this effect would not be adverse.

4 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
5 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
6 of the facility. However, because the BDCP proponents would be required to design and construct the
7 facilities according to state and federal design standards and guidelines (which may involve, for
8 example, replacement of the organic soil), the impact would be less than significant. No mitigation is
9 required.

10 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,
11 and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2-
12 CM11**

13 Implementation of proposed conservation measures CM2–CM11 under Alternative 1B would be the
14 same as under Alternative 1A. Accordingly, construction of conservation measures in areas of
15 expansive, corrosive, or compressible soils would have the same effects as under Alternative 1A.

16 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control
17 structures or cause them to fail, resulting in a release of water from the structure and consequent
18 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs
19 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West
20 Delta ROA possess soils with high corrosivity to concrete. Highly compressible soils are in the Suisun
21 Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne, and South Delta ROAs.

22 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and compressible
23 soils. However, ROA-specific environmental effect evaluations and geotechnical studies and testing
24 would be completed prior to construction within the ROAs. The site-specific environmental evaluation
25 would identify specific areas where engineering soil properties, including soil compressibility, may
26 require special consideration during construction of specific features within ROAs. Conformity with
27 USACE, CBC, and other design standards for construction on expansive, corrosive and/or compressible
28 soils would prevent adverse effects.

29 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that are
30 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
31 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
32 could damage in-ground facilities or shorten their service life. Compression or settlement of soils after
33 a facility is constructed could result in damage to or failure of the facility. However, because the BDCP
34 proponents will be required to design and construct the facilities according to state and federal design
35 standards, guidelines, and building codes (which may involve, for example, soil lime stabilization,
36 cathodic protection of steel, and soil replacement), the impacts would be less than significant. No
37 mitigation is required.

10.3.3.4 Alternative 1C—Dual Conveyance with West Alignment and Intakes W1–W5 (15,000 cfs; Operational Scenario A)

Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities

The mechanisms of this impact are similar to those described for Alternative 1A; however, considerably more excavation would be necessary to construct the canal along the western alignment than would be necessary for tunnel boring under Alternative 1A. Construction of water conveyance facilities would involve vegetation removal; constructing building pads, levees, canals, and a tunnel; excavation; overexcavation for facility foundations; surface grading; trenching; road construction; spoil storage; soil stockpiling; and other activities over approximately 17,400 acres during the course of constructing the facilities. Vegetation would be removed (via grubbing and clearing) grading and other earthwork would be conducted at the intakes, pumping plants, the proposed Byron Tract Forebay, canal and gates between the Byron Tract Forebay tunnel shafts and the approach canal to the Banks Pumping Plant, borrow areas, RTM and spoil storage areas, setback and transition levees, sedimentation basins, solids handling facilities, transition structures, surge shafts and towers, substations, transmission line footings, access roads, concrete batch plants, fuel stations, bridge abutments, barge unloading facilities, and laydown areas. Some of the work would be conducted in areas that are fallow at the time. Excavation of a large volume of borrow material would be required to construct the canals. Some of the earthwork activities may also result in steepening of slopes and soil compaction, particularly for the embankments constructed for the intermediate forebay and the proposed Byron Tract Forebay. These conditions tend to result in increased runoff rates, degradation of soil structure, and reduced soil infiltration capacity, all of which could cause accelerated erosion, resulting in the loss of topsoil.

Water Erosion

The excavation, grading, and other soil disturbances described above that are conducted in gently sloping to level areas, such as the interiors of Delta islands, are expected to experience little or no accelerated water erosion because of the lack of runoff energy to entrain and transport soil particles. Any soil that is eroded within island interiors would tend to remain on the island, provided that existing or project levees are in place to serve as barriers to keep the eroded soil (i.e., sediment) from entering receiving waters.

In contrast, graded and otherwise disturbed tops and sideslopes of existing and project canals, levees and embankments are of greater concern for accelerated water erosion because of their steeper gradients. Although soil eroded from the land side of levees would be deposited on the island interiors, soil eroded from the disturbed top and water side of levees could reach adjoining waterways. Soil eroded from natural slopes in upland environments could also reach receiving waters.

Wind Erosion

In the primary work areas that would involve extensive surface soil disturbance (i.e., the proposed Byron Tract Forebay on the northwestern side of Clifton Court Forebay, the canals, staging areas, borrow/spoil areas, and intakes), the soils generally have a low susceptibility to wind erosion (Natural Resources Conservation Service 2010a) (Figure 10-6).

Excavation of soil from borrow areas and transport of soil material to spoil storage areas potentially would subject the soils to wind erosion. It is likely that approximately 50 million cubic yards of peat soil

1 material would be disposed of as spoils; this material would be especially susceptible to wind erosion
2 while being loaded onto trucks, transported, unloaded, and distributed.

3 **NEPA Effects:** These potential effects could be substantial because they could cause accelerated
4 erosion. However, as described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental*
5 *Commitments*, DWR would be required to obtain coverage under the General Permit for Construction
6 and Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan.
7 While the SWPPPs would not be prepared until just prior to construction and application to the State
8 Water Board for a General Permit, please see the discussion under Alternative 1A, Impact SOILS-1, for
9 more details on what SWPPPs would entail, and likely BMPs which would be included.

10 Accelerated water and wind erosion as a result of construction of the proposed water conveyance
11 facility could occur under Alternative 1C, but proper implementation of the requisite SWPPP and
12 compliance with the General Permit (as discussed in Appendix 3B, *Environmental Commitments*,
13 Commitment 3B.2) would ensure that there would not be substantial soil erosion resulting in daily site
14 runoff turbidity in excess of 250 NTUs, as a result of construction of the proposed water conveyance
15 facilities, and therefore, there would not be an adverse effect.

16 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
17 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR
18 would seek coverage under the state General Permit for Construction and Land Disturbance Activities
19 (as discussed in Appendix 3B, *Environmental Commitments*, Commitment 3B.2), necessitating the
20 preparation of a SWPPP and an erosion control plan. As a result of implementation of the SWPPP and
21 compliance with the General Permit, where applicable, there would not be substantial soil erosion
22 resulting in daily site runoff turbidity in excess of 250 NTUs, and therefore, the impact would be less
23 than significant. No mitigation is required.

24 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 25 **Constructing the Proposed Water Conveyance Facilities**

26 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation during
27 construction of the water conveyance facilities associated with Alternative 1C (e.g., canal alignment,
28 borrow areas, levee foundations, intake facilities, pumping plants); overcovering (e.g., levees and
29 embankments, spoil storage, pumping plants); and water inundation (e.g., forebay, sedimentation
30 basins, solids lagoons).

31 Table 10-7 presents an itemization of the effects on soils caused by excavation, overcovering, and
32 inundation, based on GIS analysis by facility type. Because of the nature of the earthwork to construct
33 many of the facilities, more than one mechanism of soil loss may be involved at a given facility. For
34 example, levee construction would require both excavation to prepare the subgrade and overcovering
35 to construct the levee. The table shows that the greatest extent of topsoil loss would be associated with
36 excavations such as for the canals, unless measures are undertaken to salvage the topsoil and reapply it
37 on top of the excavated borrow areas or on top of spoils once they have been placed.

Table 10-7. Topsoil Lost as a Result of Excavation, Overcovering, and Inundation Associated with the Proposed Water Conveyance Facility

Topsoil Loss Mechanism	Acreage Affected
Excavation (intakes, canals, shafts, borrow areas)	11,462
Overcovering (spoil storage, reusable tunnel material storage)	5,804
Inundation (forebay, sedimentation basins, solids lagoons)	773
Total	18,039

Note: Some mechanisms for topsoil loss entail more than one process of soil loss. For example, construction of setback levees would first require overexcavation for the levee foundation (i.e., excavation), then placement of fill material (i.e., overcovering).

DWR has made an Environmental Commitment for Disposal Site Preparation which would require that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will be set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas, thereby lessening the effect. However, this effect would be adverse because it would result in substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would also be available to reduce the severity of this effect.

CEQA Conclusion: Construction of the water conveyance facilities would involve irreversible removal, overcovering, and inundation of topsoil over large areas, thereby resulting in a substantial loss of topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these impacts, but not to a less-than-significant level. Therefore, this impact is considered significant and unavoidable.

Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance

Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil Storage and Handling Plan

Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed Water Conveyance Facilities

The part of the alignment that includes the northern canal, intakes, pipelines, pumping plants, sedimentation basins, and some of the siphons would be constructed where the near-surface soils have approximately 2% organic matter content. Compared to organic soils, these mineral soils would not be subject to appreciable subsidence caused by organic matter decomposition because there is relatively little organic matter available to decompose. The remainder (southern) part of the northern canal alignment is underlain by near-surface soils having 4–12.5% organic matter content (Figure 10-2). The thickness of the peat ranges between 0 and 20 feet. The amount of existing subsidence is 0–10 feet, with the deeper subsided areas existing where the intermediate pumping plant is proposed. This southern part would be subject to appreciable subsidence.

1 The proposed tunnel section extends through an area where the near-surface soils have 4% to more
2 than 22.5% organic matter content. The thickness of the peat ranges between approximately 5 and 25
3 feet. The amount of existing subsidence ranges between 5 and more than 20 feet. Because the tunnel
4 section would be constructed below the peat, it would not be affected by subsidence caused by organic
5 matter decomposition.

6 The proposed southern canal alignment generally would pass through an area where the soils have less
7 than approximately 2% organic matter content and where there apparently has been no evidence of
8 subsidence caused by organic matter decomposition. Compared to organic soils, these mineral soils
9 would not be subject to appreciable subsidence caused by organic matter decomposition because there
10 is relatively little organic matter available to decompose. Only the southern portion of the southern
11 canal alignment (including the part of the new Byron Tract Forebay) is underlain by peat soils up to 5
12 feet deep. Without adequate engineering, parts of the canals, pipelines, intermediate pumping plant,
13 some of the siphons, and other facilities could be subject to appreciable subsidence.

14 Damage to or collapse of the canal, tunnels, siphons, bridge abutments, and other facilities could occur,
15 where these facilities are constructed in soils and sediments that are subject to subsidence and
16 differential settlement. Subsidence- or differential sediment-induced damage or collapse of these
17 facilities could cause a rapid release of water to the surrounding soil, causing an interruption in water
18 supply and producing underground cavities, depressions at the ground surface, and surface flooding.
19 Facilities that have subsided would be subject to flooding.

20 Damage to other conveyance facilities, such as intakes, pumping plants, transition structures, and
21 control structures, caused by subsidence/settlement under the facilities and consequent damage or
22 failure to the facility could also occur. Facility damage or failure could cause a rapid release of water to
23 the surrounding area, resulting in flooding, thereby endangering people in the vicinity. However, the
24 amount of existing subsidence and soil organic matter content is generally low in the areas where these
25 facilities are proposed, so the likelihood of this occurring is low.

26 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on soils
27 that are subject to subsidence. However, as described in section 10.3.1, *Methods for Analysis*, and
28 Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all facilities to
29 identify the types of soil avoidance or soil stabilization measures that should be implemented to ensure
30 that the facilities are constructed to withstand subsidence and settlement and to conform to applicable
31 state and federal standards. These investigations would build upon the geotechnical data reports
32 (California Department of Water Resources 2001a, 2010b, 2011) and the CERs (California Department
33 of Water Resources 2009b, 2010d). Such standards include the American Society of Civil Engineers
34 Minimum Design Loads for Buildings and Other Structures, California Building Code, and USACE Design
35 and Construction of Levees. The results of the investigations, which would be conducted by a California
36 registered civil engineer or California certified engineering geologist, would be presented in
37 geotechnical reports. The reports would contain recommended measures to prevent subsidence. The
38 geotechnical report will prepared in accordance with state guidelines, in particular *Guidelines for*
39 *Evaluating and Mitigating Seismic Hazards in California* (California Geological Survey 2008).

40 Liquid limit and organic content testing should be performed on soil samples collected during the site-
41 specific field investigations to determine site-specific geotechnical properties. High organic matter
42 content soils that are unsuitable for support of structures, bridge abutments, roadways and other
43 facilities would be overexcavated and replaced with engineered fill, and the unsuitable soils disposed of

1 offsite as spoil, as described in more detail below. Geotechnical evaluations would be conducted to
2 identify soils materials that are suitable for engineering purposes.

3 Additional measures to address the potential adverse effects of organic soils could include construction
4 of structural supports that extend below the depth of organic soils into underlying materials with
5 suitable bearing strength. For example, the CER indicates that approximately 35 feet of soil would be
6 excavated and a pile foundation supporting a common concrete mat would be required for the intake
7 pumping plants. The piles would be 24-inches in diameter and concrete-filled, extending to 65 to 70
8 feet below the founding level of the plant. Piles extended to competent geologic beds, beyond the weak
9 soils would provide a solid foundation to support the pumping plants.

10 For the sedimentation basins, the CER indicates that most of the underlying soils would be excavated to
11 a depth of 30 feet below grade and removed from the site and suitable soil material imported to the site
12 to re-establish it to subgrade elevation. Removal of the weak soils and replacement with engineered fill
13 using suitable soil material would provide a solid foundation for the sedimentation basins.

14 Certain methods and practices may be utilized during tunnel construction to help reduce and manage
15 settlement risk. The CER indicates that the ground improvement techniques to control settlement at
16 the shafts and tunnels may involve jet-grouting, permeation grouting, compaction grouting, or other
17 methods that a contractor may propose. These measures would have the effect of better supporting the
18 soil above the borehole and would prevent unacceptable settlement between the borehole and the
19 tunnel segments. Additionally, settlement monitoring points, the number and location of which would
20 be identified during detailed design, would be established along the pipeline and tunnel routes during
21 construction and the results reviewed regularly by a professional engineer. The monitoring therefore
22 would provide early detection of excessive settlement such that corrective actions could be made
23 before the integrity of the tunnel is jeopardized. Conforming with state and federal design standards
24 would ensure that any subsidence that occurs under the conveyance facilities would not jeopardize
25 their integrity. As described in the section 10.3.1, *Methods for Analysis* and in Appendix 3B,
26 *Environmental Commitments*, such design codes and standards include the California Building Code and
27 resource agency and professional engineering specifications, such as the American Society of Civil
28 Engineers *Minimum Design Loads for Buildings and Other Structures*, ASCE-7-05, 2005. Conforming with
29 these codes and standards is an environmental commitment by DWR to ensure cut and fill slopes and
30 embankments will be stable as the water conveyance features are operated. Conforming with the
31 standards and guidelines may necessitate such measures as excavation and removal of weak soils and
32 replacement with engineered fill using suitable, imported soil, construction on pilings driven into
33 competent soil material, and construction of facilities on cast-in-place slabs. These measures would
34 reduce the potential hazard of subsidence or settlement to acceptable levels by avoiding construction
35 directly on or otherwise stabilizing the soil material that is prone to subsidence. There would be no
36 adverse effect.

37 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
38 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of
39 the facility. However, DWR would be required to design and construct the facilities according to state
40 and federal design standards and guidelines (e.g., California Building Code, American Society of Civil
41 Engineers *Minimum Design Loads for Buildings and Other Structures*, ASCE-7-05, 2005). Conforming
42 with these codes would reduce the potential hazard of subsidence or settlement to acceptable levels by
43 avoiding construction directly on or otherwise stabilizing the soil material that is prone to subsidence.
44 Because these measures would reduce the potential hazard of subsidence or settlement to meet design
45 standards, the impact would be less than significant. No mitigation is required.

1 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**
 2 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

3 The integrity of the water conveyance facilities, including the canal, intake facilities, pumping plants,
 4 access roads and utilities, and other features could be adversely affected by expansive, corrosive, and
 5 compressible soils.

6 ***Expansive Soils***

7 Soil expansion is a concern only at soil depths that are subject to seasonal changes in moisture content.
 8 The Alternative 1C alignment is underlain by soils with low to high shrink-swell potential (note areas of
 9 high linear extensibility in Figure 10-4), with the majority of the soils with high shrink-swell potential
 10 occurring where the intakes, pumping plants, pipelines, and sedimentation basin are proposed. Most of
 11 these areas are in Sacramento County (Dierssen and Egbert-Valpac association soils) and in Contra
 12 Costa County (Sacramento-Omni association soils). The remaining conveyance features generally
 13 would be located where the soils have low or moderate shrink-swell potential, although soil expansion-
 14 contraction is not expected to be a concern at these types of facilities.

15 Soils with a high shrink-swell potential (i.e., expansive soils) could damage facilities or cause the
 16 facilities to fail. For example, foundations and pavements could crack or shift and pipelines could
 17 rupture.

18 ***Soils Corrosive to Concrete***

19 The near-surface (i.e., upper 5 feet) soil corrosivity to concrete is low or moderate along the Alternative
 20 1C alignment in the parts of the alignment proposed for the intakes, pumping plants, siphons, bridges,
 21 and all other facilities except the tunnel, which will be below the depth of the near-surface soils. Data
 22 on soil corrosivity to concrete below approximately 5 feet (i.e., where pipelines, tunnels, and the deeper
 23 part of the tunnel shafts will be constructed) are not available. However, given the variability in the
 24 composition of the soils and geologic units on and within which the conveyance facilities would be
 25 constructed, corrosivity hazards are likely to range from low to high. Because soil corrosivity to
 26 concrete is high among the near-surface peat soils on the Delta, a high corrosivity is also expected to be
 27 present among the peat soils at depth at each element of the conveyance facility. Site-specific soil
 28 investigations will need to be conducted to determine this hazard. As described in 10.3.1, *Methods for*
 29 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
 30 facilities to identify site-specific soil corrosivity hazards. The resulting geotechnical report, prepared by
 31 a California registered civil engineer or a California certified engineering geologist, would describe
 32 these hazards and recommend the measures that should be implemented to ensure that the facilities
 33 are constructed to withstand corrosion and to conform with applicable state and federal standards,
 34 such as the CBC.

35 Soils that are moderately and highly corrosive to concrete may cause the concrete to degrade, thereby
 36 threatening the integrity of the facility. Degradation of concrete may cause pipelines to leak or rupture
 37 and cause foundations to weaken.

38 ***Soils Corrosive to Uncoated Steel***

39 Virtually all the near-surface soils along the Alternative 1C alignment have a high corrosivity to
 40 uncoated steel. The only the exception is an area of moderate corrosivity east of the Cache Slough ROA.
 41 Data on soil corrosivity to uncoated steel below approximately 5 feet (i.e., where pipelines, tunnels, and
 42 siphons would be constructed) are not available. However, given the variability in the composition of

1 the soils and geologic units on and within which the conveyance facilities would be constructed,
 2 corrosivity hazards are likely to range from low to high. Site-specific soil investigations will need to be
 3 conducted to determine the level of hazard.

4 Soils that are moderately and highly corrosive to uncoated steel (including steel rebar embedded in
 5 concrete) may cause the concrete to degrade, threatening the integrity of these facilities.

6 **Compressible Soils**

7 Soils that are weakly consolidated or that have high organic matter content (such as peat or muck soils)
 8 present a risk to structures and infrastructure due to high compressibility and poor bearing capacity.
 9 Soils with high organic matter content tend to compress under load and may decrease in volume as
 10 organic matter is oxidized. The non-tunnel sections of the alignment are underlain by soils that have an
 11 organic matter content of less than 2–4%. Although the intakes would generally be located on mineral
 12 soils, according to the CER some of these soils are soft and have poor bearing capacity. Some of the
 13 pumping plants and pipelines also would be located on such soils. Based on liquid limits reported in
 14 county soil surveys, near-surface soils within the Alternative 1C alignment vary from low to medium
 15 compressibility.

16 Part of the Byron Tract Forebay embankment would be subject to this hazard.

17 Damage to or collapse of the intakes, pumping plants, transition structures, and control structures,
 18 could occur where these facilities are constructed in soils and sediments that are subject to subsidence
 19 and differential settlement. Subsidence- or differential sediment-induced damage or collapse of these
 20 facilities could cause a rapid release of water to the surrounding soil, causing an interruption in water
 21 supply and producing underground cavities, depressions at the ground surface, and surface flooding.
 22 Facilities that have subsided would be subject to flooding and levees that have subsided would be
 23 subject to overtopping and consequent flooding on the land side of the levee.

24 The tunnel siphons or culvert siphons would be constructed at a depth below the peat (Figure 9-4);
 25 consequently, subsidence caused by organic matter decomposition below the tunnels/culverts is
 26 expected to be minimal. Surface and subsurface settlement may occur during tunnel construction;
 27 however, certain methods and practices may be utilized during tunnel/culvert construction to help
 28 reduce and manage settlement risk. Chapter 9, *Geology and Seismicity*, discusses the risks of settlement
 29 during tunnel construction and methods to reduce the amount of settlement (Impact GEO-2).

30 **NEPA Effects:** Various facilities would be located on expansive, corrosive, and compressible soils.
 31 However, all facility design and construction would be executed in conformance with the CBC, which
 32 specifies measures to mitigate effects of expansive soils, corrosive soils, and soils subject to
 33 compression and subsidence. The CBC requires measures such as soil replacement, lime treatment, and
 34 post-tensioned foundations to offset expansive soils, as well as such measures as using protective
 35 linings and coatings, dielectric isolation of dissimilar materials, and active cathodic protection systems
 36 to prevent corrosion of concrete and steel.

37 Potential adverse effects of compressible soils and soils subject to subsidence could be addressed by
 38 overexcavation and replacement with engineered fill or by installation of structural supports (e.g.,
 39 pilings) to a depth below the peat where the soils have adequate load bearing strength, as required by
 40 the CBC and by USACE design standards. For example, the CER indicates that a deep foundation (pile)
 41 length of 65–70 feet below the founding level of the in-river intake may be required for adequate
 42 support of intake structures without excessive settlement. Geotechnical studies would be conducted at
 43 all the facilities to determine what specific measures should be implemented at each facility to reduce

1 these soil hazards to levels consistent with the CBC. Liquid limit and soil organic matter content testing
2 would be performed on soil samples collected during the site-specific field investigations to determine
3 site-specific geotechnical properties. Settlement monitoring points should be established along the
4 route during tunnel construction and results reviewed regularly by a professional engineer.

5 The engineer would develop final engineering solutions to any hazardous condition, consistent with the
6 code and standards requirements of federal, state, and local oversight agencies. As described in section
7 10.3.1, *Methods for Analysis*, and in Appendix 3B, *Environmental Commitments*, such design codes,
8 guidelines, and standards include the California Building Code and resource agency and professional
9 engineering specifications, such as the DWR Interim Levee Design Criteria for Urban and Urbanizing
10 Area State Federal Project Levees, and USACE Engineering and Design—Earthquake Design and
11 Evaluation for Civil Works Projects.

12 By conforming with the CBC and other applicable design standards, potential effects associated with
13 expansive and corrosive soils and soils subject to compression and subsidence would be offset. There
14 would be no adverse effect.

15 **CEQA Conclusion:** Many of the Alternative 1C facilities would be constructed on soils that are subject to
16 expansion, corrosive to concrete and uncoated steel, as well as soils that are moderately or highly
17 subject to compression under load. Expansive soils could cause foundations, underground utilities, and
18 pavements to crack and fail. Corrosive soils could damage in-ground facilities or shorten their service
19 life. Compression or settlement of soils after a facility is constructed could result in damage to or failure
20 of the facility. However, because DWR would be required to design and construct the facilities in
21 conformance with state and federal design standards, guidelines, and building codes (e.g., CBC and
22 USACE design standards). Conforming with these codes and standards (Appendix 3B, *Environmental*
23 *Commitments*) is an environmental commitment by DWR to ensure that potential adverse effects
24 associated with expansive and corrosive soils and soils subject to compression and subsidence would
25 be offset. Therefore, the impact would be less than significant. No mitigation is required.

26 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 27 **Operations**

28 Alternative 1C would use Operational Scenario A—the same scenario as Alternative 1A. Accordingly,
29 the effects associated with river channel bank erosion/scour would be the same.

30 **NEPA Effects:** As under Alternative 1A, the operational components would cause changes in the tidal
31 flows in some Delta channels, specifically those that lead into the major habitat restoration areas
32 (Suisun Marsh, Cache Slough, Yolo Bypass, and South Delta ROAs); however, detailed hydrodynamic
33 (tidal) modeling would be conducted prior to any BDCP habitat restoration work in these ROA areas,
34 and the changes in the tidal velocities in the major channels connecting to these restoration areas
35 would be evaluated. If there is any indication that tidal velocities would be substantially increased, the
36 restoration project design would be modified (such as by providing additional levee breaches or by
37 requiring dredging in portions of the connecting channels) so that bed scour would not increase
38 sufficiently to cause an erosion impact. Moreover, as presently occurs and as is typical with most
39 naturally-functioning river channels, local erosion and deposition within the tidal habitats is expected
40 as part of the restoration.

41 The effect would not be adverse because there would be no net increase in flow rates and therefore no
42 net increase in channel bank scour.

1 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in channels
 2 and sloughs, potentially leading to increases in channel bank scour. However, where such changes are
 3 expected to occur (i.e., at the mouths of tidal marsh channels), the project would also entail expansion
 4 of the channel cross-section to increase the tidal prism at these locations. The net effect would be to
 5 reduce the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no
 6 appreciable increase in scour is anticipated. The impact would be less than significant. No mitigation is
 7 required.

8 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**
 9 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,**
 10 **CM18 and CM19**

11 Implementation of conservation measures under Alternative 1C would be the same as under
 12 Alternative 1A. These activities would include breaching, lowering, or removing levees; constructing
 13 setback levees and cross levees or berms; raising the land elevation by excavating relatively high areas
 14 to provide fill for subsided areas or by importing fill material; surface grading, deepening and/or
 15 widening tidal channels; excavating channels; excavation and grading to construct facilities, access
 16 roads, and other facilities; and other activities. These activities could cause adverse effects on soil
 17 erosion rates and cause a loss of topsoil through both water and wind erosion.

18 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as
 19 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the
 20 BDCP proponents would be required to obtain coverage under the General Permit for Construction and
 21 Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan.

22 Proper implementation of the requisite SWPPP and compliance with the General Permit would ensure
 23 that accelerated water and wind erosion associated with implementation of the conservation measures
 24 would not be an adverse effect.

25 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 26 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP
 27 proponents would seek coverage under the state General Permit for Construction and Land
 28 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such as
 29 revegetation, runoff control, and sediment barriers), and compliance with water quality standards. As a
 30 result of implementation of Permit conditions, the impact would be less than significant. No mitigation
 31 is required.

32 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
 33 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2–**
 34 **CM11**

35 Implementation of conservation measures would be the same under Alternative 1C as under
 36 Alternative 1A. Consequently, topsoil loss associated with excavation (e.g., levee foundations, water
 37 control structures), overcovering (e.g., levees, embankments, application of fill material in subsided
 38 areas), and water inundation (e.g., aquatic habitat areas) would also be the same as under Alternative
 39 1A.

40 **NEPA Effects:** Implementation of habitat restoration activities at the ROAs would result in excavation,
 41 overcovering, or inundation of a minimum of 77,600 acres of topsoil. This effect would be adverse

1 because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b
2 would be available to reduce the severity of this effect.

3 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,
4 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby
5 resulting in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would minimize
6 and compensate for these impacts to a degree, but not to a less-than-significant level. Therefore, this
7 impact is considered significant and unavoidable.

8 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

9 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

10 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil** 11 **Storage and Handling Plan**

12 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

13 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage** 14 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed** 15 **Conservation Measures CM2-CM11**

16 Implementation of the proposed conservation measures under Alternative 1C would be the same as
17 under Alternative 1A. Damage to or failure of the habitat levees could occur where these are
18 constructed in soils and sediments that are subject to subsidence and differential settlement would also
19 be the same as under Alternative 1A. Levee damage or failure could cause surface flooding in the
20 vicinity.

21 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
22 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
23 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
24 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
25 berms, and other features are constructed to withstand subsidence and settlement and to conform to
26 applicable state and federal standards. Such standards include the USACE Design and Construction of
27 Levee and DWR Interim Levee Design Criteria for Urban and Urbanizing Area State-Federal Project
28 Levees.

29 With construction of all levees, berms, and other conservation features designed and constructed to
30 withstand subsidence and settlement and through conformance with applicable state and federal
31 design standards, this effect would not be adverse.

32 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
33 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
34 of the facility. However, because the BDCP proponents would be required to design and construct the
35 facilities according to state and federal design standards and guidelines (which may involve, for
36 example, replacement of the organic soil), the impact would be less than significant. No mitigation is
37 required.

1 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**
 2 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2–**
 3 **CM11**

4 Implementation of the proposed conservation measures under Alternative 1C would be the same as
 5 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,
 6 corrosive, or compressible soils would have the same effects as under Alternative 1A. Seasonal
 7 shrinking and swelling of moderately or highly expansive soils could damage water control structures
 8 or cause them to fail, resulting in a release of water from the structure and consequent flooding, which
 9 would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs possess high potential
 10 for corrosion of uncoated steel, and the Suisun ROA and portions of the West Delta ROA possess soils
 11 with high corrosivity to concrete.

12 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne,
 13 and South Delta ROAs.

14 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and compressible
 15 soils. However, ROA-specific environmental effect evaluations and geotechnical studies and testing
 16 would be completed prior to construction within the ROAs. The site-specific environmental evaluation
 17 would identify specific areas where engineering soil properties, including soil compressibility, may
 18 require special consideration during construction of specific features within ROAs. Conformity with
 19 USACE, CBC, and other design standards for construction on expansive, corrosive and/or compressible
 20 soils would prevent adverse effects of such soils.

21 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that are
 22 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
 23 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
 24 could damage in-ground facilities or shorten their service life. Compression/settlement of soils after a
 25 facility is constructed could result in damage to or failure of the facility. However, because the BDCP
 26 proponents would be required to design and construct the facilities according to state and federal
 27 design standards, guidelines, and building codes (which may involve, for example, soil lime
 28 stabilization, cathodic protection of steel, and soil replacement), the impact would be less than
 29 significant. No mitigation is required.

30 **10.3.3.5 Alternative 2A—Dual Conveyance with Pipeline/Tunnel and 5**
 31 **Intakes (15,000 cfs; Operational Scenario B)**

32 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances**
 33 **as a Result of Constructing the Proposed Water Conveyance Facilities**

34 Alternative 2A would include the same physical/structural components as Alternative 1A, but could
 35 entail two different intake and intake pumping plant locations. These locations would be where soils
 36 have similar erosion hazards and would not substantially change the project effects on water soil
 37 erosion. The effects of Alternative 2A would, therefore, be the same as under Alternative 1A. See the
 38 discussion of Impact SOILS-1 under Alternative 1A.

39 **NEPA Effects:** Construction of the proposed water conveyance facility under Alternative 2A could cause
 40 substantial accelerated erosion. However, as described in section 10.3.1, *Methods for Analysis*, and
 41 Appendix 3B, *Environmental Commitments*, DWR would be required to obtain coverage under the
 42 General Permit for Construction and Land Disturbance Activities, necessitating the preparation of a

1 SWPPP and an erosion control plan. Proper implementation of the requisite SWPPP and compliance
 2 with the General Permit (as discussed in Appendix 3B, *Environmental Commitments*, Commitment 3B.2)
 3 would ensure that there would not be substantial soil erosion resulting in daily site runoff turbidity in
 4 excess of 250 NTUs as a result of construction of the proposed water conveyance facility, and therefore,
 5 there would not be an adverse effect.

6 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 7 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR
 8 would seek coverage under the state General Permit for Construction and Land Disturbance Activities,
 9 necessitating the preparation of a SWPPP and an erosion control plan. As a result of implementation of
 10 the requisite SWPPP, and compliance with the General Permit, there would not be substantial soil
 11 erosion resulting in daily site runoff turbidity in excess of 250 NTUs the effect would be less than
 12 significant. No mitigation is required.

13 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 14 **Constructing the Proposed Water Conveyance Facilities**

15 Alternative 2A would include the same physical/structural components as Alternative 1A, but could
 16 entail two different intake and intake pumping plant locations. Construction operations would be the
 17 same as under Alternative 1A, and therefore the effects on topsoil under Alternative 2A would be the
 18 same as Alternative 1A. See the discussion of Impact SOILS-2 under Alternative 1A.

19 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., forebays,
 20 borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants); overcovering (e.g.,
 21 levees and embankments, spoil storage, pumping plants); and water inundation (e.g., forebays,
 22 sedimentation basins, and solids lagoons). DWR has made an Environmental Commitment for Disposal
 23 Site Preparation which would require that a portion of the temporary sites selected for storage of
 24 spoils, RTM, and dredged material will be set aside for topsoil storage and the topsoil would be saved
 25 for reapplication to disturbed areas, thereby lessening the effect. However, this effect would be adverse
 26 because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b
 27 would be available to reduce the severity of this effect.

28 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,
 29 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss of
 30 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would
 31 be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these
 32 impacts, but not to a less-than-significant level. Therefore, this impact is considered significant and
 33 unavoidable.

34 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

35 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

36 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil** 37 **Storage and Handling Plan**

38 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

1 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 2 **from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed**
 3 **Water Conveyance Facilities**

4 Alternative 2A would include the same physical/structural components as Alternative 1A, but could
 5 entail two different intake and intake pumping plant locations. These locations would be where soils
 6 have similar subsidence hazards and, without adequate engineering, certain structures could be subject
 7 to appreciable subsidence resulting in potentially adverse effects. Damage to or collapse of the project
 8 facilities could occur if they are constructed in soils and sediments that are subject to subsidence or
 9 differential settlement.

10 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on soils
 11 that are subject to subsidence. However, as described in section 10.3.1, *Methods for Analysis*, and
 12 Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all facilities to
 13 identify the types of soil avoidance or soil stabilization measures that should be implemented to ensure
 14 that the facilities are constructed to withstand subsidence and settlement and to conform to applicable
 15 state and federal standards. These investigations would build upon the geotechnical data reports
 16 (California Department of Water Resources 2001a, 2010b, 2011) and the CERs (California Department
 17 of Water Resources 2010a, 2010b). As discussed under Alternative 1A, conforming with state and
 18 federal design standards, including conduct of site-specific geotechnical evaluations, would ensure that
 19 appropriate design measures are incorporated into the project and any subsidence that takes place
 20 under the project facilities would not jeopardize their integrity. There would be no adverse effect.

21 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
 22 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of
 23 the facility. However, DWR would be required to design and construct the facilities in conformance
 24 with state and federal design standards and guidelines (e.g., California Building Code, American Society
 25 of Civil Engineers *Minimum Design Loads for Buildings and Other Structures*, ASCE-7-05, 2005).
 26 Conforming with these codes would reduce the potential hazard of subsidence or settlement to
 27 acceptable levels by avoiding construction directly on or otherwise stabilizing the soil material that is
 28 prone to subsidence. Because these measures would reduce the potential hazard of subsidence or
 29 settlement to meet design standards, the impact would be less than significant. No mitigation is
 30 required.

31 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**
 32 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

33 Alternative 2A would include the same physical/structural components as Alternative 1A, but could
 34 entail two different intake and intake pumping plant locations. These different locations would be
 35 where the soils have similar properties of expansiveness, corrosivity, and compressibility. The effects
 36 under Alternative 2A would, however, be the same as 1A. See discussion of Impact SOILS-4 under
 37 Alternative 1A.

38 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake
 39 facilities, pumping plants, access roads and utilities, and other features could be adversely affected
 40 because they would be located on expansive, corrosive, and compressible soils. However, all facility
 41 design and construction would be executed in conformance with the CBC, which specifies measures to
 42 mitigate effects of expansive soils, corrosive soils, and soils subject to compression and subsidence. By
 43 conforming with the CBC and other applicable design standards, potential effects associated with

1 expansive and corrosive soils and soils subject to compression and subsidence would be offset. There
2 would be no adverse effect.

3 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to
4 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils
5 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils could
6 damage in-ground facilities or shorten their service life. Compression or settlement of soils after a
7 facility is constructed could result in damage to or failure of the facility. However, DWR would be
8 required to design and construct the facilities in conformance with state and federal design standards,
9 guidelines, and building codes (e.g., CBC and USACE design standards). Conforming with these codes
10 and standards is an environmental commitment by DWR to ensure that potential adverse effects
11 associated with expansive and corrosive soils and soils subject to compression and subsidence would
12 be offset. Therefore, this impact would be less than significant. No mitigation is required.

13 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 14 **Operations**

15 Alternative 2A would have different operations from those under Alternative 1A. However, operations
16 under Alternative 2A would have a potential effect on accelerated bank erosion similar to those under
17 Alternative 1A. The effects under Alternative 2A would, therefore, be similar to those under Alternative
18 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

19 **NEPA Effects:** Detailed hydrodynamic (tidal) modeling would be conducted prior to any BDCP habitat
20 restoration work in these ROA areas, and the changes in the tidal velocities in the major channels
21 connecting to these restoration areas would be evaluated. If there is any indication that tidal velocities
22 would be substantially increased, the restoration project design would be modified (such as by
23 providing additional levee breaches or by requiring dredging in portions of the connecting channels) so
24 that bed scour would not increase sufficiently to cause an erosion impact. Moreover, as presently
25 occurs and as is typical with most naturally-functioning river channels, local erosion and deposition
26 within the tidal habitats is expected as part of the restoration.

27 The effect would not be adverse because there would be no net increase in river flow rates and,
28 accordingly, no net increase in channel bank scour.

29 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in channels
30 and sloughs, potentially leading to increases in channel bank scour. However, where such changes are
31 expected to occur (i.e., at the mouths of tidal marsh channels), the project would also entail expansion
32 of the channel cross-section to increase the tidal prism at these locations. The net effect would be to
33 reduce the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no
34 appreciable increase in scour is anticipated. The impact would be less than significant. No mitigation is
35 required.

36 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other** 37 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,** 38 **CM18 and CM19**

39 Implementation of conservation measures under Alternative 2A would be the same as under
40 Alternative 1A. Implementation of the conservation measures would involve ground disturbance and
41 construction activities that could lead to accelerated soil erosion rates and consequent loss of topsoil.
42 See the discussion of Impact SOILS-6 under Alternative 1A.

1 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as
 2 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the
 3 BDCP proponents would be required to obtain coverage under the General Permit for Construction and
 4 Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan.
 5 Proper implementation of the requisite SWPPP, site-specific BMPs, and compliance with the General
 6 Permit would ensure that accelerated water and wind erosion as a result of implementing conservation
 7 measures would not be an adverse effect.

8 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 9 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP
 10 proponents would seek coverage under the state General Permit for Construction and Land
 11 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such as
 12 revegetation, runoff control, and sediment barriers), and compliance with water quality standards. As a
 13 result of implementation of Permit conditions, the impact would be less than significant. No mitigation
 14 is required.

15 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
 16 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2–**
 17 **CM11**

18 Conservation measures would be the same under Alternative 2A as under Alternative 1A. Topsoil
 19 effectively would be lost as a resource as a result of its excavation, overcovering, and water inundation
 20 over extensive areas of the Plan Area. See the discussion of Impact SOILS-7 under Alternative 1A.

21 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.
 22 Mitigation Measures SOILS-2a and SOILS-2b would be available to reduce the severity of this effect.

23 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,
 24 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby
 25 resulting in a substantial loss of topsoil. The impact would be significant. Mitigation Measures SOILS-2a
 26 and SOILS-2b would minimize and compensate for these impacts to a degree, but not to a less-than-
 27 significant level. Therefore, this impact is considered significant and unavoidable.

28 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

29 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

30 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 31 **Storage and Handling Plan**

32 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

33 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 34 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed**
 35 **Conservation Measures CM2–CM11**

36 Conservation measures would be the same under Alternative 2A as under Alternative 1A. Damage to or
 37 failure of the habitat levees could occur where these are constructed in soils and sediments that are
 38 subject to subsidence and differential settlement. These soil conditions have the potential to exist in the
 39 Suisun Marsh ROA. Levee damage or failure could cause surface flooding in the vicinity. See the
 40 discussion of Impact SOILS-8 under Alternative 1A.

1 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
 2 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
 3 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
 4 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
 5 berms, and other features are constructed to withstand subsidence and settlement and to conform to
 6 applicable state and federal standards.

7 With construction of all levees, berms, and other conservation features designed and constructed to
 8 withstand subsidence and settlement and through conformance with applicable state and federal
 9 design standards, this effect would not be adverse.

10 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
 11 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
 12 of the facility. However, because the BDCP proponents would be required to design and construct the
 13 facilities according to state and federal design standards and guidelines (which may involve, for
 14 example, replacement of the organic soil), the impact would be less than significant. No mitigation is
 15 required.

16 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**
 17 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2-**
 18 **CM11**

19 Implementation of the proposed conservation measures under Alternative 2A would be the same as
 20 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,
 21 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the
 22 discussion of Impact SOILS-9 under Alternative 1A.

23 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control
 24 structures or cause them to fail, resulting in a release of water from the structure and consequent
 25 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs
 26 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West
 27 Delta ROA possess soils with high corrosivity to concrete.

28 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne,
 29 and South Delta ROAs.

30 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and compressible
 31 soils. However, ROA-specific environmental effect evaluations and geotechnical studies and testing
 32 would be completed prior to construction within the ROAs. The site-specific environmental evaluation
 33 would identify specific areas where engineering soil properties, including soil compressibility, may
 34 require special consideration during construction of specific features within ROAs. Conformity with
 35 USACE, CBC, and other design standards for construction on expansive, corrosive and/or compressible
 36 soils would prevent adverse effects of such soils.

37 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that are
 38 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
 39 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
 40 could damage in-ground facilities or shorten their service life. Compression or settlement of soils after
 41 a facility is constructed could result in damage to or failure of the facility. However, because the BDCP
 42 proponents would be required to design and construct the facilities according to state and federal

1 design standards, guidelines, and building codes (which may involve, for example, soil lime
 2 stabilization, cathodic protection of steel, and soil replacement), this impact would be considered less
 3 than significant. No mitigation is required.

4 **10.3.3.6 Alternative 2B—Dual Conveyance with East Alignment and Five** 5 **Intakes (15,000 cfs; Operational Scenario B)**

6 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances** 7 **as a Result of Constructing the Proposed Water Conveyance Facilities**

8 Alternative 2B would include the same physical/structural components as Alternative 1B, but could
 9 entail two different intake and intake pumping plant locations. These locations would be where the
 10 soils have similar erosion hazards and would not substantially change the project effects on soil
 11 erosion. The effects under Alternative 2B would, therefore, be the same as under Alternative 1B. See
 12 the discussion of Impact SOILS-1 under Alternative 1A.

13 **NEPA Effects:** Construction of the proposed water conveyance facility under Alternative 2B could cause
 14 substantial accelerated erosion. However, as described in section 10.3.1, *Methods for Analysis*, and
 15 Appendix 3B, *Environmental Commitments*, DWR would be required to obtain coverage under the
 16 General Permit for Construction and Land Disturbance Activities, necessitating the preparation of a
 17 SWPPP and an erosion control plan. Proper implementation of the requisite SWPPP and compliance
 18 with the General Permit would ensure that there would not be substantial soil erosion resulting in daily
 19 site runoff turbidity in excess of 250 NTUs as a result of construction of the proposed water conveyance
 20 facility, and therefore, there would not be an adverse effect.

21 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 22 water conveyance facilities could cause accelerated water and wind erosion of soil. However, because
 23 DWR would seek coverage under the state General Permit for Construction and Land Disturbance
 24 Activities (as discussed in Appendix 3B, *Environmental Commitments*, Commitment 3B.2), necessitating
 25 the preparation of a SWPPP and an erosion control plan. As a result of implementation of the SWPPP
 26 and compliance with the General Permit, there would not be substantial soil erosion resulting in daily
 27 site runoff turbidity in excess of 250 NTUs, and therefore, the impact would be less than significant. No
 28 mitigation is required.

29 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 30 **Constructing the Proposed Water Conveyance Facilities**

31 Alternative 2B would include the same physical/structural components as Alternative 1B, but could
 32 entail two different intake and intake pumping plant locations. Construction operations would be the
 33 same as those under Alternative 1B, and therefore the effects on topsoil under Alternative 2B would be
 34 the same as those under Alternative 1B. See the discussion of Impact SOILS-2 under Alternative 1B.

35 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., canal
 36 alignment, borrow areas, levee foundations, intake facilities, pumping plants); overcovering (e.g., levees
 37 and embankments, spoil storage, pumping plants); and water inundation (e.g., forebay, sedimentation
 38 basins, and solids lagoons). DWR has made an Environmental Commitment for Disposal Site
 39 Preparation which would require that a portion of the temporary sites selected for storage of spoils,
 40 RTM, and dredged material will be set aside for topsoil storage and the topsoil would be saved for
 41 reapplication to disturbed areas, thereby lessening the effect. However, this effect would be adverse

1 because it would result in substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would
2 be available to reduce the severity of this effect.

3 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,
4 overcovering, and inundation of topsoil over large areas, thereby resulting in a substantial loss of
5 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would
6 be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these
7 impacts, but not to a less-than-significant level. Therefore, this impact is considered significant and
8 unavoidable.

9 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

10 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

11 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
12 **Storage and Handling Plan**

13 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

14 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
15 **from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed**
16 **Water Conveyance Facilities**

17 Alternative 2B would include the same physical/structural components as Alternative 1B, but could
18 entail two different intake and intake pumping plant locations. Soils in these locations would have
19 similar subsidence hazards and would not substantially change the project effects on subsidence. The
20 effects under Alternative 2B would, therefore, be the same as those under Alternative 1B. See the
21 discussion of Impact SOILS-3 under Alternative 1B.

22 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on soils
23 that are subject to subsidence. However, as described in section 10.3.1, *Methods for Analysis*, and
24 Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all facilities to
25 identify the types of soil avoidance or soil stabilization measures that should be implemented to ensure
26 that the facilities are constructed to withstand subsidence and settlement and to conform to applicable
27 state and federal standards. These investigations would build upon the geotechnical data reports
28 (California Department of Water Resources 2001a, 2010b, 2011) and the CERs (California Department
29 of Water Resources 2009a, 2010c). As discussed under Alternative 1B, conforming with state and
30 federal design standards, including conduct of site-specific geotechnical evaluations, would ensure that
31 appropriate design measures are incorporated into the project and any subsidence that takes place
32 under the project facilities would not jeopardize their integrity.

33 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
34 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of
35 the facility. However, because DWR would be required to design and construct the facilities in
36 conformance with state and federal design standards and guidelines (e.g., California Building Code,
37 American Society of Civil Engineers *Minimum Design Loads for Buildings and Other Structures*, ASCE-7-
38 05, 2005). Conforming with these codes would reduce the potential hazard of subsidence or settlement
39 to acceptable levels by avoiding construction directly on or otherwise stabilizing the soil material that
40 is prone to subsidence. Because these measures would reduce the potential hazard of subsidence or

1 settlement to meet design standards, this impact is considered less than significant. No mitigation is
2 required.

3 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**
4 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

5 Alternative 2B would include the same physical/structural components as Alternative 1B, but could
6 entail two different intake and intake pumping plant locations. These different locations would be
7 where the soils have similar properties of expansiveness, corrosivity, and compressibility. The effects
8 under Alternative 2B would, therefore, be the same as those under Alternative 1B. See the discussion of
9 Impact SOILS-4 under Alternative 1B.

10 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake
11 facilities, pumping plants, access roads and utilities, and other features could be adversely affected
12 because they would be located on expansive, corrosive, and compressible soils. However, all facility
13 design and construction would be executed in conformance with the CBC, which specifies measures to
14 mitigate effects of expansive soils, corrosive soils, and soils subject to compression and subsidence. By
15 conforming with the CBC and other applicable design standards, potential effects associated with
16 expansive and corrosive soils and soils subject to compression and subsidence would be offset. There
17 would be no adverse effect.

18 **CEQA Conclusion:** Many of the Alternative 2B facilities would be constructed on soils that are subject to
19 expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive soils could
20 cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils could damage
21 in-ground facilities or shorten their service life. Compression/settlement of soils after a facility is
22 constructed could result in damage to or failure of the facility. However, DWR would be required to
23 design and construct the facilities in conformance with state and federal design standards, guidelines,
24 and building codes (e.g., CBC and USACE design standards). Conforming with these codes and standards
25 is an environmental commitment by DWR to ensure that potential adverse effects associated with
26 expansive and corrosive soils and soils subject to compression and subsidence would be offset.
27 Therefore, the impact would be less than significant. No mitigation is required.

28 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**
29 **Operations**

30 Alternative 2B would have operations different from those under Alternative 1A. However, operations
31 under Alternative 2B would have a potential effect on accelerated bank erosion similar to those under
32 Alternative 1A. The effects under Alternative 2B would, therefore, be similar to those of Alternative 1A.
33 See the discussion of Impact SOILS-5 under Alternative 1A.

34 **NEPA Effects:** Detailed hydrodynamic (tidal) modeling would be conducted prior to any BDCP habitat
35 restoration work in these ROA areas, and the changes in the tidal velocities in the major channels
36 connecting to these restoration areas would be evaluated. If there is any indication that tidal velocities
37 would be substantially increased, the restoration project design would be modified (such as by
38 providing additional levee breaches or by requiring dredging in portions of the connecting channels) so
39 that bed scour would not increase sufficiently to cause an erosion impact. Moreover, as presently
40 occurs and as is typical with most naturally-functioning river channels, local erosion and deposition
41 within the tidal habitats is expected as part of the restoration. The effect would not be adverse because
42 there would be no net increase in river flow rates and therefore no net increase in channel bank scour.

1 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in channels
 2 and sloughs, potentially leading to increases in channel bank scour. However, where such changes are
 3 expected to occur (i.e., at the mouths of tidal marsh channels), the project would also entail expansion
 4 of the channel cross-section to increase the tidal prism at these locations. The net effect would be to
 5 reduce the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no
 6 appreciable increase in scour is anticipated. The impact would be less than significant. No mitigation is
 7 required.

8 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**
 9 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,**
 10 **CM18 and CM19**

11 Implementation of conservation measures under Alternative 2B would be the same as under
 12 Alternative 1A. Implementation of the conservation measures would involve ground disturbance and
 13 construction activities that could lead to accelerated soil erosion rates and consequent loss of topsoil.
 14 See the discussion of Impact SOILS-6 under Alternative 1A.

15 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as
 16 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the
 17 BDCP proponents would be required to obtain coverage under the General Permit for Construction and
 18 Land Disturbance Activities, necessitating preparation of a SWPPP and an erosion control plan. Proper
 19 implementation of the requisite SWPPP and compliance with the General Permit would ensure that
 20 accelerated water and wind erosion associated with implementation of the conservation measures
 21 would not be an adverse effect.

22 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 23 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP
 24 proponents would seek coverage under the state General Permit for Construction and Land
 25 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such as
 26 revegetation, runoff control, and sediment barriers), and compliance with water quality standards. As a
 27 result of implementation of Permit conditions, the impact would be less than significant. No mitigation
 28 is required.

29 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
 30 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2–**
 31 **CM11**

32 Implementation of conservation measures would be the same under Alternative 2B as under
 33 Alternative 1A. Consequently, topsoil loss associated with excavation, overcovering, and water
 34 inundation over extensive areas of the Plan Area would also be the same as under Alternative 1A. See
 35 the discussion of Impact SOILS-7 under Alternative 1A.

36 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.
 37 Mitigation Measures SOILS-2a and SOILS-2b would be available to reduce the severity of this effect.

38 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,
 39 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby
 40 resulting in a substantial loss of topsoil. The impact would be significant. Mitigation Measures SOILS-2a
 41 and SOILS-2b would minimize and compensate for these impacts, but not to a less-than-significant
 42 level. Therefore, this impact is considered significant and unavoidable.

1 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

2 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

3 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
4 **Storage and Handling Plan**

5 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

6 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
7 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed**
8 **Conservation Measures CM2–CM11**

9 Conservation measures would be the same under Alternative 2B as under Alternative 1A. Damage to or
10 failure of the habitat levees could occur where these are constructed in soils and sediments that are
11 subject to subsidence and differential settlement would also be the same as Alternative 1A. Levee
12 damage or failure could cause surface flooding in the vicinity. See the discussion of Impact SOILS-8
13 under Alternative 1A.

14 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
15 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
16 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
17 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
18 berms, and other features are constructed to withstand subsidence and settlement and to conform to
19 applicable state and federal standards.

20 With construction of all levees, berms, and other conservation features designed and constructed to
21 withstand subsidence and settlement and through conformance with applicable state and federal
22 design standards, this effect would not be adverse.

23 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
24 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
25 of the facility. However, because the BDCP proponents would be required to design and construct the
26 facilities according to state and federal design standards and guidelines (which may involve, for
27 example, replacement of the organic soil), the impact would be less than significant. No mitigation is
28 required.

29 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**
30 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2–**
31 **CM11**

32 Implementation of the proposed conservation measures under Alternative 2B would be the same as
33 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,
34 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the
35 discussion of Impact SOILS-9 under Alternative 1A.

36 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control
37 structures or cause them to fail, resulting in a release of water from the structure and consequent
38 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs
39 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West

1 Delta ROA possess soils with high corrosivity to concrete. Highly compressible soils are in the Suisun
2 Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne, and South Delta ROAs.

3 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and compressible
4 soils. However, ROA-specific environmental effect evaluations and geotechnical studies and testing
5 would be completed prior to construction within the ROAs. The site-specific environmental evaluation
6 would identify specific areas where engineering soil properties, including soil compressibility, may
7 require special consideration during construction of specific features within ROAs. Conformity with
8 USACE, CBC, and other design standards for construction on expansive, corrosive and/or compressible
9 soils would prevent adverse effects of such soils. See the discussion of Impact SOILS-9 under
10 Alternative 1A.

11 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that are
12 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
13 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
14 could damage in-ground facilities or shorten their service life. Compression or settlement of soils after
15 a facility is constructed could result in damage to or failure of the facility. However, because the BDCP
16 proponents would be required to design and construct the facilities according to state and federal
17 design standards, guidelines, and building codes (which may involve, for example, soil lime
18 stabilization, cathodic protection of steel, and soil replacement), the impacts would be considered less
19 than significant. No mitigation is required.

20 **10.3.3.7 Alternative 2C—Dual Conveyance with West Alignment and** 21 **Intakes W1–W5 (15,000 cfs; Operational Scenario B)**

22 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances** 23 **as a Result of Constructing the Proposed Water Conveyance Facilities**

24 Alternative 2C would include the same physical/structural components as Alternative 1C. The effects
25 under Alternative 2C would, therefore, be the same as under Alternative 1C. See the discussion of
26 Impact SOILS-1 under Alternative 1C.

27 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative 2C
28 could cause substantial accelerated erosion. However, as described in section 10.3.1, *Methods for*
29 *Analysis*, and Appendix 3B, *Environmental Commitments*, DWR would be required to obtain coverage
30 under the General Permit for Construction and Land Disturbance Activities, necessitating the
31 preparation of a SWPPP and an erosion control plan. Proper implementation of the requisite SWPPP
32 and compliance with the General Permit (as discussed in Appendix 3B, *Environmental Commitments*,
33 Commitment 3B.2) would ensure that there would not be substantial soil erosion resulting in daily site
34 runoff turbidity in excess of 250 NTUs as a result of construction of the proposed water conveyance
35 facility, and therefore, there would not be an adverse effect.

36 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
37 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR
38 would seek coverage under the state General Permit for Construction and Land Disturbance Activities
39 (as discussed in Appendix 3B, *Environmental Commitments*, Commitment 3B.2), necessitating the
40 preparation of a SWPPP and an erosion control plan. As a result of implementation of the requisite
41 SWPPP and compliance with the General Permit, there would not be substantial soil erosion resulting

1 in daily site runoff turbidity in excess of 250 NTUs, and therefore, the impact would be less than
2 significant. No mitigation is required.

3 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of**
4 **Constructing the Proposed Water Conveyance Facilities**

5 Alternative 2C would include the same physical/structural components as Alternative 1C. The effects
6 under Alternative 2C would, therefore, be the same as those under Alternative 1C. See the discussion of
7 Impact SOILS-2 under Alternative 1C.

8 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., canal
9 alignment, borrow areas, levee foundations, intake facilities, pumping plants); overcovering (e.g., levees
10 and embankments, spoil storage, pumping plants); and water inundation (e.g., forebay, sedimentation
11 basins, and solids lagoons). DWR has made an Environmental Commitment for Disposal Site
12 Preparation which would require that a portion of the temporary sites selected for storage of spoils,
13 RTM, and dredged material will be set aside for topsoil storage and the topsoil would be saved for
14 reapplication to disturbed areas, thereby lessening the effect. However, this effect would be adverse
15 because it would result in substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would
16 be available to reduce the severity of this effect.

17 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,
18 overcovering, and inundation of topsoil over large areas, thereby resulting in a substantial loss of
19 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would
20 be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these
21 impacts, but not to a less-than-significant level. Therefore, this impact is considered significant and
22 unavoidable.

23 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

24 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

25 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
26 **Storage and Handling Plan**

27 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

28 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
29 **from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed**
30 **Water Conveyance Facilities**

31 Alternative 2C would include the same physical/structural components as Alternative 1C. The effects of
32 Alternative 2C would, therefore, be the same as those under Alternative 1C. See the discussion of
33 Impact SOILS-3 under Alternative 1A.

34 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
35 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
36 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
37 facilities to identify the types of soil stabilization that should be implemented to ensure that the
38 facilities are constructed to withstand subsidence and settlement and to conform to applicable state
39 and federal standards. These investigations would build upon the geotechnical data reports (California
40 Department of Water Resources 2001a, 2010b, 2011) and the CERs (California Department of Water

1 Resources 2009b, 2010d). As discussed under Alternative 1C, conforming with state and federal design
2 standards, including conduct of site-specific geotechnical evaluations, would ensure that appropriate
3 design measures are incorporated into the project and any subsidence that takes place under the
4 project facilities would not jeopardize their integrity.

5 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
6 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of
7 the facility. However, because DWR would be required to design and construct the facilities in
8 conformance with state and federal design standards and guidelines (e.g., California Building Code,
9 American Society of Civil Engineers *Minimum Design Loads for Buildings and Other Structures*, ASCE-7-
10 05, 2005). Conforming with these codes would reduce the potential hazard of subsidence or settlement
11 to acceptable levels by avoiding construction directly on or otherwise stabilizing the soil material that
12 is prone to subsidence. Because these measures would reduce the potential hazard of subsidence or
13 settlement to meet design standards, the impact would be less than significant. No mitigation is
14 required.

15 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water** 16 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

17 Alternative 2C would include the same physical/structural components as Alternative 1C. The effects of
18 Alternative 2C would, therefore, be the same as those of Alternative 1C. See discussion of Impact SOILS-
19 4 under Alternative 1C.

20 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake
21 facilities, pumping plants, access roads and utilities, and other features could be adversely affected
22 because they would be located on expansive, corrosive, and compressible soils. However, all facility
23 design and construction would be executed in conformance with the CBC, which specifies measures to
24 mitigate effects of expansive soils, corrosive soils, and soils subject to compression and subsidence. By
25 conforming with the CBC and other applicable design standards, potential effects associated with
26 expansive and corrosive soils and soils subject to compression and subsidence would be offset. There
27 would be no adverse effect.

28 **CEQA Conclusion:** Many of the Alternative 2C facilities would be constructed on soils that are subject to
29 expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive soils could
30 cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils could damage
31 in-ground facilities or shorten their service life. Compression or settlement of soils after a facility is
32 constructed could result in damage to or failure of the facility. However, because DWR would be
33 required to design and construct the facilities in conformance with state and federal design standards,
34 guidelines, and building codes (e.g., CBC and USACE design standards). Conforming with these codes
35 and standards is an environmental commitment by DWR to ensure that potential adverse effects
36 associated with expansive and corrosive soils and soils subject to compression and subsidence would
37 be offset. Therefore, the impact would be less than significant. No mitigation is required.

38 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 39 **Operations**

40 Alternative 2C would have operations different from those of Alternative 1A. However, operations
41 under Alternative 2C would have a potential effect on accelerated bank erosion similar to those under
42 Alternative 1A. The effects of Alternative 2C would, therefore, be similar to those of Alternative 1A. See
43 the discussion of Impact SOILS-5 under Alternative 1A.

1 **NEPA Effects:** Detailed hydrodynamic (tidal) modeling would be conducted prior to any BDCP habitat
 2 restoration work in these ROA areas, and the changes in the tidal velocities in the major channels
 3 connecting to these restoration areas would be evaluated. If there is any indication that tidal velocities
 4 would be substantially increased, the restoration project design would be modified (such as by
 5 providing additional levee breaches or by requiring dredging in portions of the connecting channels) so
 6 that bed scour would not increase sufficiently to cause an erosion impact. Moreover, as presently
 7 occurs and as is typical with most naturally-functioning river channels, local erosion and deposition
 8 within the tidal habitats is expected as part of the restoration. The effect would not be adverse because
 9 there would be no net increase in river flow rates and therefore no net increase in channel bank scour.

10 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in channels
 11 and sloughs, potentially leading to increases in channel bank scour. However, where such changes are
 12 expected to occur (i.e., at the mouths of tidal marsh channels), the project would also entail expansion
 13 of the channel cross-section to increase the tidal prism at these locations. The net effect would be to
 14 reduce the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no
 15 appreciable increase in scour is anticipated. The impact would be less than significant. No mitigation is
 16 required.

17 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**
 18 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,**
 19 **CM18 and CM19**

20 Implementation of conservation measures under Alternative 2C would be the same as under
 21 Alternative 1A. Implementation of the conservation measures would involve ground disturbance and
 22 construction activities that could lead to accelerated soil erosion rates and consequent loss of topsoil.
 23 See the discussion of Impact SOILS-6 under Alternative 1A.

24 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as
 25 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the
 26 BDCP proponents would be required to obtain coverage under the General Permit for Construction and
 27 Land Disturbance Activities, necessitating preparation of a SWPPP and an erosion control plan. Proper
 28 implementation of the requisite SWPPP, site-specific BMPs, and compliance with the General Permit
 29 would ensure that accelerated water and wind erosion as a result of implementing conservation
 30 measures would not be an adverse effect.

31 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 32 conservation measures could cause accelerated water and wind erosion of soil. However, the BDCP
 33 proponents would seek coverage under the state General Permit for Construction and Land
 34 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such as
 35 revegetation, runoff control, and sediment barriers) and compliance with water quality standards. As a
 36 result of implementation of Permit conditions, the impact would be less than significant. No mitigation
 37 is required.

38 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
 39 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2–**
 40 **CM11**

41 Conservation measures would be the same under Alternative 2C as under Alternative 1A. Topsoil
 42 effectively would be lost as a resource as a result of its excavation, overcovering, and water inundation
 43 over extensive areas of the Plan Area. See the discussion of Impact SOILS-7 under Alternative 1A.

1 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.
 2 Mitigation Measures SOILS-2a and SOILS-2b would be available to reduce the severity of this effect.

3 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,
 4 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby
 5 resulting in a substantial loss of topsoil. The impact would be significant. Mitigation Measures SOILS-2a
 6 and SOILS-2b would minimize and compensate for these impacts to a degree, but not to a less-than-
 7 significant level. Therefore, this impact is considered significant and unavoidable.

8 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

9 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

10 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil** 11 **Storage and Handling Plan**

12 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

13 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage** 14 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed** 15 **Conservation Measures CM2–CM11**

16 Conservation measures would be the same under Alternative 2C as under Alternative 1A. Injury or
 17 death could result from damage to or failure of the habitat levees where these are constructed in soils
 18 and sediments that are subject to subsidence and differential settlement. These soil conditions have the
 19 potential to exist in the Suisun Marsh ROA. Levee damage or failure could cause surface flooding in the
 20 vicinity. See the discussion of Impact SOILS-8 under Alternative 1A.

21 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
 22 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
 23 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
 24 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
 25 berms, and other features are constructed to withstand subsidence and settlement and to conform to
 26 applicable state and federal standards.

27 With construction of all levees, berms, and other conservation features designed and constructed to
 28 withstand subsidence and settlement and through conformance with applicable state and federal
 29 design standards, this effect would not be adverse.

30 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
 31 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
 32 of the facility, potentially resulting in loss, injury, or death. However, because the BDCP proponents
 33 would be required to design and construct the facilities according to state and federal design standards
 34 and guidelines (which may involve, for example, replacement of the organic soil), the impact would be
 35 less than significant. No mitigation is required.

1 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**
 2 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2–**
 3 **CM11**

4 Construction of the proposed conservation measures under Alternative 2C would be the same as under
 5 Alternative 1A. Accordingly, construction of conservation measures in areas of expansive, corrosive, or
 6 compressible soils would have the same effects as under Alternative 1A. See the discussion of Impact
 7 SOILS-9 under Alternative 1A.

8 **NEPA Effects:** Seasonal shrinking and swelling of moderately or highly expansive soils could damage
 9 water control structures or cause them to fail, resulting in a release of water from the structure and
 10 consequent flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the
 11 ROAs possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the
 12 West Delta ROA possess soils with high corrosivity to concrete.

13 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne,
 14 and South Delta ROAs.

15 The conservation measures could be located on expansive, corrosive, and compressible soils. However,
 16 ROA-specific environmental effect evaluations and geotechnical studies and testing would be
 17 completed prior to construction within the ROAs. The site-specific environmental evaluation would
 18 identify specific areas where engineering soil properties, including soil compressibility, may require
 19 special consideration during construction of specific features within ROAs. Conformity with USACE,
 20 CBC, and other design standards for construction on expansive, corrosive and/or compressible soils
 21 would prevent adverse effects of such soils.

22 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that are
 23 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
 24 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
 25 could damage in-ground facilities or shorten their service life. Compression or settlement of soils after
 26 a facility is constructed could result in damage to or failure of the facility, potentially resulting in loss,
 27 injury, or death. However, because the BDCP proponents would be required to design and construct the
 28 facilities according to state and federal design standards, guidelines, and building codes (which may
 29 involve, for example, soil lime stabilization, cathodic protection of steel, and soil replacement), this
 30 impact would be considered less than significant. No mitigation is required.

31 **10.3.3.8 Alternative 3—Dual Conveyance with Pipeline/Tunnel and Intakes**
 32 **1 and 2 (6,000 cfs; Operational Scenario A)**

33 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances**
 34 **as a Result of Constructing the Proposed Water Conveyance Facilities**

35 Alternative 3 would include the same physical/structural components as Alternative 1A, except that it
 36 would entail three fewer intakes and three fewer pumping plants. These differences would result in
 37 slightly less accelerated erosion effects than Alternative 1A. The effects of Alternative 3 would,
 38 however, be similar to those of Alternative 1A. See the discussion of Impact SOILS-1 under Alternative
 39 1A.

40 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative 3
 41 could cause substantial accelerated erosion. However, as described in section 10.3.1, *Methods for*

1 *Analysis*, and Appendix 3B, *Environmental Commitments*, DWR would be required to obtain coverage
 2 under the General Permit for Construction and Land Disturbance Activities, necessitating the
 3 preparation of a SWPPP and an erosion control plan. Proper implementation of the requisite SWPPP
 4 and compliance with the General Permit would ensure that there would not be substantial soil erosion
 5 resulting in daily site runoff turbidity in excess of 250 NTUs as a result of construction of the proposed
 6 water conveyance facility, and therefore, would not be an adverse effect.

7 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 8 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR
 9 would seek coverage under the state General Permit for Construction and Land Disturbance Activities
 10 (as discussed in Appendix 3B, *Environmental Commitments*, Commitment 3B.2), necessitating
 11 preparation of a SWPPP and an erosion control plan. As a result of implementation of the requisite
 12 SWPPP and compliance with the General Permit, where applicable, there would not be substantial soil
 13 erosion resulting in daily site runoff turbidity in excess of 250 NTUs and the effect would be less than
 14 significant. No mitigation is required.

15 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of**
 16 **Constructing the Proposed Water Conveyance Facilities**

17 Alternative 3 would include the same physical/structural components as Alternative 1A, except that it
 18 would entail three fewer intakes and three fewer pumping plants. These differences would result in
 19 slightly less effects on topsoil loss than Alternative 1A. The effects of Alternative 3 would, however, be
 20 similar to those of Alternative 1A. See the discussion of Impact SOILS-2 under Alternative 1A.

21 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., forebays,
 22 borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants); overcovering (e.g.,
 23 levees and embankments, spoil storage, pumping plants); and water inundation (e.g., forebays,
 24 sedimentation basins, and solids lagoons). DWR has made an Environmental Commitment for Disposal
 25 Site Preparation which would require that a portion of the temporary sites selected for storage of
 26 spoils, RTM, and dredged material will be set aside for topsoil storage and the topsoil would be saved
 27 for reapplication to disturbed areas, thereby lessening the effect. However, this effect would be adverse
 28 because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b
 29 would be available to reduce the severity of this effect.

30 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,
 31 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss of
 32 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would
 33 be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these
 34 impacts, but not to a less than significant level. Therefore, this impact is considered significant and
 35 unavoidable.

36 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

37 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

38 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 39 **Storage and Handling Plan**

40 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

1 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
2 **from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed**
3 **Water Conveyance Facilities**

4 Alternative 3 would include the same physical/structural components as Alternative 1A, but would
5 entail three fewer intakes and three fewer pumping plants. These differences would result in slightly
6 less effects related to subsidence than Alternative 1A. The effects of Alternative 3 would, however, be
7 similar to those of Alternative 1A. See the discussion of Impact SOILS-3 under Alternative 1A.

8 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on soils
9 that are subject to subsidence. However, as described in Section 10.3.1, *Methods for Analysis*, and
10 Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all facilities to
11 identify the types of soil avoidance or soil stabilization that should be implemented to ensure that the
12 facilities are constructed to withstand subsidence and settlement and to conform to applicable state
13 and federal standards. These investigations would build upon the geotechnical data reports (California
14 Department of Water Resources 2001a, 2010b, 2011) and the CERs (California Department of Water
15 Resources 2010a, 2010b). As discussed under Alternative 1A, conforming with state and federal design
16 standards, including conduct of site-specific geotechnical evaluations, would ensure that appropriate
17 design measures are incorporated into the project and any subsidence that takes place under the
18 project facilities would not jeopardize their integrity.

19 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
20 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of
21 the facility, potentially resulting in loss, injury, or death. However, because DWR would be required to
22 design and construct the facilities according to state and federal design standards and guidelines (e.g.,
23 California Building Code, American Society of Civil Engineers Minimum Design Loads for Buildings and
24 Other Structures, ASCE-7-05, 2005). Conforming with these codes would reduce the potential hazard of
25 subsidence or settlement to acceptable levels by avoiding construction directly on or otherwise
26 stabilizing the soil material that is prone to subsidence. Because these measures would reduce the
27 potential hazard of subsidence or settlement to meet design standards, the impact would be less than
28 significant. No mitigation is required.

29 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**
30 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

31 Alternative 3 would include the same physical/structural components as Alternative 1A, except that it
32 would entail three fewer intakes and three fewer pumping plants. These differences would result in
33 slightly less effects related to expansive, corrosive, and compressible soils than Alternative 1A. The
34 effects of Alternative 3 would, however, be similar to those of Alternative 1A. See discussion of Impact
35 SOILS-4 under Alternative 1A.

36 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake
37 facilities, pumping plants, access roads and utilities, and other features could be adversely affected
38 because they would be located on expansive, corrosive, and compressible soils. However, all facility
39 design and construction would be executed in conformance with the CBC, which specifies measures to
40 mitigate effects of expansive soils, corrosive soils, and soils subject to compression and subsidence. By
41 conforming with the CBC and other applicable design standards, potential effects associated with
42 expansive and corrosive soils and soils subject to compression and subsidence would be offset. There
43 would be no adverse effect.

1 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to
2 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils
3 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils could
4 damage in-ground facilities or shorten their service life. Compression/settlement of soils after a facility
5 is constructed could result in damage to or failure of the facility, potentially resulting in loss, injury, or
6 death. However, DWR would be required to design and construct the facilities according to state and
7 federal design standards, guidelines, and building codes (e.g., CBC and USACE design standards).
8 Conforming with these codes and standards is an environmental commitment by DWR to ensure that
9 potential adverse effects associated with expansive and corrosive soils and soils subject to compression
10 and subsidence would be offset. Therefore, this impact would be less than significant. No mitigation is
11 required.

12 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 13 **Operations**

14 Alternative 3 would have operations similar to those of Alternative 1A, but of a lesser magnitude with
15 respect to potential effects on accelerated bank erosion because the flow from the north Delta would be
16 6,000 cfs rather than 15,000 cfs. The effects of Alternative 3 would, however, be similar to those of
17 Alternative 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

18 **NEPA Effects:** Detailed hydrodynamic (tidal) modeling would be conducted prior to any BDCP habitat
19 restoration work in these ROA areas, and the changes in the tidal velocities in the major channels
20 connecting to these restoration areas would be evaluated. If there is any indication that tidal velocities
21 would be substantially increased, the restoration project design would be modified (such as by
22 providing additional levee breaches or by requiring dredging in portions of the connecting channels) so
23 that bed scour would not increase sufficiently to cause an erosion impact. Moreover, as presently
24 occurs and as is typical with most naturally-functioning river channels, local erosion and deposition
25 within the tidal habitats is expected as part of the restoration. The effect would not be adverse because
26 there would be no net increase in river flow rates and, accordingly, no net increase in channel bank
27 scour.

28 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in channels
29 and sloughs, potentially leading to increases in channel bank scour. However, where such changes are
30 expected to occur (i.e., at the mouths of tidal marsh channels), the project would also entail expansion
31 of the channel cross-section to increase the tidal prism at these locations. The net effect would be to
32 reduce the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no
33 appreciable increase in scour is anticipated. The impact would be less than significant. No mitigation is
34 required.

35 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other** 36 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,** 37 **CM18 and CM19**

38 Implementation of conservation measures under Alternative 3 would be the same as under Alternative
39 1A. Implementation of the conservation measures would involve ground disturbance and construction
40 activities that could lead to accelerated soil erosion rates and consequent loss of topsoil. See the
41 discussion of Impact SOILS-6 under Alternative 1A.

42 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as
43 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the

1 BDCP proponents and their contractors would be required to obtain coverage under the General Permit
 2 for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP and an
 3 erosion control plan. Proper implementation of the requisite SWPPP, site-specific BMPs, and
 4 compliance with the General Permit would ensure that accelerated water and wind erosion as a result
 5 of implementing conservation measures would not be an adverse effect.

6 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 7 restoration areas could cause accelerated water and wind erosion of soil. the BDCP proponents and
 8 their contractors would seek coverage under the state General Permit for Construction and Land
 9 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such as
 10 revegetation, runoff control, and sediment barriers) and compliance with water quality standards. As a
 11 result of implementation of Permit conditions, the impact would be less than significant. No mitigation
 12 is required.

13 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
 14 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2-**
 15 **CM11**

16 Conservation measures would be the same under Alternative 3 as under Alternative 1A. Topsoil
 17 effectively would be lost as a resource as a result of its excavation, overcovering, and water inundation
 18 over extensive areas of the Plan Area. See the discussion of Impact SOILS-7 under Alternative 1A.

19 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.
 20 Mitigation Measures SOILS-2a and SOILS-2b would be available to reduce the severity of this effect.

21 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,
 22 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby
 23 resulting in a substantial loss of topsoil. The impact would be significant. Mitigation Measures SOILS-2a
 24 and SOILS-2b would minimize and compensate for these impacts to a degree, but not to a less-than-
 25 significant level. Therefore, this impact is considered significant and unavoidable.

26 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

27 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

28 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 29 **Storage and Handling Plan**

30 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

31 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 32 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed**
 33 **Conservation Measures CM2-CM11**

34 Conservation measures would be the same under Alternative 3 as under Alternative 1A. Injury or death
 35 could result from damage to or failure of the habitat levees where these are constructed in soils and
 36 sediments that are subject to subsidence and differential settlement. These soil conditions have the
 37 potential to exist in the Suisun Marsh ROA. Levee damage or failure could cause surface flooding in the
 38 vicinity. See the discussion of Impact SOILS-8 under Alternative 1A.

1 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
 2 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
 3 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
 4 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
 5 berms, and other features are constructed to withstand subsidence and settlement and to conform to
 6 applicable state and federal standards.

7 With construction of all levees, berms, and other conservation features designed and constructed to
 8 withstand subsidence and settlement and through conformance with applicable state and federal
 9 design standards, this effect would not be adverse.

10 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
 11 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
 12 of the facility, potentially resulting in loss, injury, or death. However, because the BDCP proponents
 13 would be required to design and construct the facilities according to state and federal design standards
 14 and guidelines (which may involve, for example, replacement of the organic soil), the impact would be
 15 less than significant. No mitigation is required.

16 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**
 17 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2-**
 18 **CM11**

19 Implementation of the proposed conservation measures under Alternative 3 would be the same as
 20 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,
 21 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the
 22 discussion of Impact SOILS-9 under Alternative 1A.

23 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control
 24 structures or cause them to fail, resulting in a release of water from the structure and consequent
 25 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs
 26 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West
 27 Delta ROA possess soils with high corrosivity to concrete.

28 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne,
 29 and South Delta ROAs.

30 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and compressible
 31 soils. However, ROA-specific environmental effect evaluations and geotechnical studies and testing
 32 would be completed prior to construction within the ROAs. The site-specific environmental evaluation
 33 would identify specific areas where engineering soil properties, including soil compressibility, may
 34 require special consideration during construction of specific features within ROAs. Conformity with
 35 USACE, CBC, and other design standards for construction on expansive, corrosive and/or compressible
 36 soils would prevent adverse effects of such soils.

37 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that are
 38 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
 39 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
 40 could damage in-ground facilities or shorten their service life. Compression or settlement of soils after
 41 a facility is constructed could result in damage to or failure of the facility, potentially resulting in loss,
 42 injury, or death. However, because the BDCP proponents would be required to design and construct the

1 facilities according to state and federal design standards, guidelines, and building codes (which may
 2 involve, for example, soil lime stabilization, cathodic protection of steel, and soil replacement), this
 3 impact would be considered less than significant. No mitigation is required.

4 **10.3.3.9 Alternative 4—Dual Conveyance with Modified Pipeline/Tunnel** 5 **and Intakes 2, 3, and 5 (9,000 cfs; Operational Scenario H)**

6 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances** 7 **as a Result of Constructing the Proposed Water Conveyance Facilities**

8 Construction of water conveyance facilities would involve vegetation removal, constructing building
 9 pads and levees, excavation, overexcavation for facility foundations, surface grading, trenching, road
 10 construction, spoil and RTM storage, soil stockpiling, and other activities over less than 7,500 acres
 11 during the course of constructing the facilities. Vegetation would be removed (via grubbing and
 12 clearing) and grading and other earthwork would be conducted at the three intakes, associated
 13 pumping plants, the intermediate forebay, the expanded Clifton Court Forebay, canal and gates
 14 between the expanded Clifton Court Forebay twin tunnel shafts and the approach canals to the Banks
 15 and Jones Pumping Plants, borrow areas, RTM and spoil storage areas, setback and transition levees,
 16 sedimentation basins, solids handling facilities, transition structures, surge shafts and towers,
 17 substations, transmission line footings, access roads, concrete batch plants, fuel stations, bridge
 18 abutments, barge unloading facilities, and laydown areas. Some of the work would be conducted in
 19 areas that are fallow at the time. Some of the earthwork activities may also result in steepening of
 20 slopes and soil compaction, particularly for the embankments constructed for the intermediate forebay
 21 and the expanded Clifton Court Forebay. These conditions tend to result in increased runoff rates,
 22 degradation of soil structure, and reduced soil infiltration capacity, all of which could cause accelerated
 23 erosion, resulting in loss of topsoil.

24 ***Water Erosion***

25 The excavation, grading, and other soil disturbances described above that are conducted in gently
 26 sloping to level areas, such as the interiors of Delta islands, are expected to experience little or no
 27 accelerated water erosion because of the lack of runoff energy to entrain and transport soil particles.
 28 Any soil that is eroded within island interiors would tend to remain on the island, provided that
 29 existing or project levees are in place to serve as barriers from keeping the eroded soil (i.e., sediment)
 30 from entering receiving waters.

31 In contrast, graded and otherwise disturbed tops and sideslopes of existing and project levees and
 32 embankments are of greater concern for accelerated water erosion because of their steep gradients.
 33 Although soil eroded from the landside of levees would be deposited on the island interiors, soil eroded
 34 from the disturbed top and water side of levees could reach adjoining waterways. Soil eroded from
 35 natural slopes in upland environments could also reach receiving waters.

36 ***Wind Erosion***

37 Most of the primary work areas that would involve extensive soil disturbance (i.e., staging areas,
 38 borrow areas, and intakes) within the Alternative 4 footprint are underlain by soils with a moderate or
 39 high susceptibility to wind erosion (Natural Resources Conservation Service 2010a) (Figure 10-6). Of
 40 the primary areas that would be disturbed, only a portion of the proposed borrow/spoil area west of
 41 Clifton Court Forebay generally has a low wind erosion hazard.

1 Construction activities (e.g., excavation, filling, grading, and vehicle traffic on unimproved roads) that
 2 could lead to accelerated wind erosion are generally the same as those for water erosion. These
 3 activities may result in vegetation removal and degradation of soil structure, both of which would make
 4 the soil much more subject to wind erosion. Removal of vegetation cover and grading increase
 5 exposure to wind at the surface and obliterate the binding effect of plant roots on soil aggregates. These
 6 effects make the soil particles much more subject to entrainment by wind. However, most of the areas
 7 that would be extensively disturbed by construction activities are already routinely disturbed by
 8 agricultural activities, such from disking and harrowing. These areas are the pumping plants, the
 9 intermediate forebay, most of the expanded Clifton Court Forebay, borrow areas, RTM and spoil
 10 storage areas, sedimentation basins, solids handling facilities, substations, access roads, concrete batch
 11 plants, and laydown areas. Consequently, with the exception of loading and transporting of soil
 12 material to storage areas, the disturbance that would result from constructing the conveyance facilities
 13 in many areas would not substantially depart from the existing condition, provided that the length of
 14 time that the soil is left exposed during the year does not change compared to that associated with
 15 agricultural operations. Because the SWPPPs prepared for the various components of the project will
 16 be required to prescribe ongoing best management practices to control wind erosion (such as
 17 temporary seeding), the amount of time that the soil would be exposed during construction should not
 18 significantly differ from the existing condition.

19 Unlike water erosion, the potential adverse effects of wind erosion are generally not dependent on
 20 slope gradient and location relative to levees or water. Without proper management, the wind-eroded
 21 soil particles can be transported great distances.

22 Excavation of soil from borrow areas and transport of soil material to spoil storage areas would
 23 potentially subject soils to wind erosion. It is likely that approximately 8 million cubic yards of peat soil
 24 material would be disposed of as spoils; this material would be especially susceptible to wind erosion
 25 while being loaded onto trucks, transported, unloaded, and distributed.

26 **NEPA Effects:** These potential effects could be substantial because they could cause accelerated
 27 erosion. However, as described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental*
 28 *Commitments*, DWR would be required to obtain coverage under the General Permit for Construction
 29 and Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan.
 30 Many SWPPPs and erosion control plans are expected to be prepared for the project, with a given
 31 SWPPP and erosion control plan prepared for an individual component (e.g., one intake) or groups of
 32 component (e.g., all the intakes), depending on the manner in which the work is contracted. DWR
 33 would be responsible for preparing and implementing a SWPPP and erosion control plan as portions of
 34 the construction are contracted out and applications are made to the State Water Board for coverage
 35 under a General Permit.

36 The General Permit requires that SWPPPs be prepared by a QSD and implemented under the
 37 supervision of a QSP. As part of the procedure to gain coverage under the General Permit, the QSD
 38 would determine the Risk Level (1, 2, or 3) of the project site, which involves an evaluation of the site's
 39 *Sediment Risk* and *Receiving Water Risk*. *Sediment Risk* is based on the tons per acre per year of
 40 sediment that the site could generate in the absence of erosion and sediment control BMPs. *Receiving*
 41 *Water Risk* is an assessment of whether the project site is in a sediment-sensitive watershed, such as
 42 those designated by the State Water Board as being impaired for sediment under Clean Water Act
 43 section 303(d). Much of the northern half of the Plan Area is in a sediment-sensitive watershed; such
 44 areas would likely be Risk Level 2. The remaining areas, generally southwest of the San Joaquin River,
 45 are not in a sediment-sensitive watershed and therefore may potentially be classified as Risk Level 1.

1 The results of the Risk Level determination partly drive the contents of the SWPPP. In accordance with
 2 the General Permit, the SWPPP would describe site topographic, soil, and hydrologic characteristics;
 3 construction activities and a project construction schedule; construction materials to be used and other
 4 potential sources of pollutants at the project site; potential non-stormwater discharges (e.g., trench
 5 dewatering); erosion and sediment control, non-stormwater, and “housekeeping” BMPs to be
 6 implemented; a BMP implementation schedule; a site and BMP inspection schedule; and ongoing
 7 personnel training requirements. The SWPPPs would also specify the forms and records that must be
 8 uploaded to the State Water Board’s online SMARTS, such as quarterly non-stormwater inspection and
 9 annual compliance reports. In those parts of the Plan Area that are determined to be Risk Level 2 or 3,
 10 water sampling for pH and turbidity would be required; the SWPPP would specify sampling locations
 11 and schedule, sample collection and analysis procedures, and recordkeeping and reporting protocols.

12 The QSD for the SWPPPs would prescribe BMPs that are tailored to site conditions and project
 13 component characteristics. Partly because the potential adverse effect on receiving waters depends on
 14 location of a work area relative to a waterway, the BMPs would be site-specific, such that those applied
 15 to level island-interior sites (e.g., RTM storage areas) would be different than those applied to water-
 16 side levee conditions (e.g., intakes).

17 All SWPPPs, irrespective of the site and project characteristics, are likely to contain the following BMPs.

- 18 ● Preservation of existing vegetation.
- 19 ● Perimeter control.
- 20 ● Fiber roll and/or silt fence sediment barriers.
- 21 ● Watering to control dust entrainment.
- 22 ● Tracking control and “housekeeping” measures for equipment refueling and maintenance.
- 23 ● Solid waste management.

24 Most sites would require temporary and permanent seeding and mulching. Sites that involve
 25 disturbance or construction of steep slopes may require installation of erosion control blankets or rock
 26 slope protection (e.g., setback levees at intakes). Turbidity curtains would be required for in-water
 27 work. Excavations that will require dewatering (such as for underground utilities and footings) will
 28 require proper disposal of the water, such as land application or filtration. Soil and material stockpiles
 29 (such as for borrow material) would require perimeter protection and covering or watering to control
 30 wind erosion. Concrete washout facilities would be established to prevent surface and ground water
 31 contamination. Such BMPs, if properly installed and maintained, would ensure compliance with the pH
 32 and turbidity level requirements defined by the General Permit.

33 The QSP would be responsible for day-to-day implementation of the SWPPP, including BMP
 34 inspections, maintenance, water quality sampling, and reporting to the State Water Board. In the event
 35 that the water quality sampling results indicate an exceedance of allowable pH and turbidity levels, the
 36 QSD would be required to modify the type and/or location of the BMPs by amending the SWPPP; such
 37 modifications would be uploaded by the QSD to SMARTS.

38 Accelerated water and wind erosion as a result of construction of the proposed water conveyance
 39 facility could occur under Alternative 4, but proper implementation of the requisite SWPPP and
 40 compliance with the General Permit (as discussed in Appendix 3B, *Environmental Commitments*,
 41 Commitment 3B.2) would ensure that there would not be substantial soil erosion resulting in daily site

1 runoff turbidity in excess of 250 NTUs as a result of construction of the proposed water conveyance
2 facility, and therefore, there would not be an adverse effect.

3 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
4 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR
5 would seek coverage under the state General Permit for Construction and Land Disturbance Activities
6 (as discussed in Appendix 3B, *Environmental Commitments*, Commitment 3B.2), necessitating
7 preparation of a SWPPP and an erosion control plan. As a result of implementation of the requisite
8 SWPPP and compliance with the General Permit, there would not be substantial soil erosion resulting
9 in daily site runoff turbidity in excess of 250 NTUs, and therefore, the impact would be less than
10 significant. No mitigation is required.

11 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 12 **Constructing the Proposed Water Conveyance Facilities**

13 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation during
14 construction of Alternative 4 (e.g., forebays, borrow areas, tunnel shafts, levee foundations, intake
15 facilities, pumping plants); overcovering (e.g., levees and embankments, spoil storage, pumping plants);
16 and water inundation (e.g., forebays, sedimentation basins, and solids lagoons). Table 10-8 presents an
17 itemization of the effects on soils caused by excavation, overcovering, and inundation, based on GIS
18 analysis by facility type. Because of the nature of the earthwork to construct many of the facilities, more
19 than one mechanism of topsoil loss may be involved at a given facility. For example, levee construction
20 would require both excavation to prepare the subgrade and overcovering to construct the levee. The
21 table shows that the greatest extent of topsoil loss would be associated with overcovering such as
22 spoil/RTM storage areas, unless measures are undertaken to salvage the topsoil and reapply it on top
23 of excavated borrow areas or on top of the spoils once they have been placed.

24 **Table 10-8. Topsoil Lost as a Result of Excavation, Overcovering, and Inundation Associated with the Proposed**
25 **Water Conveyance Facility**

Topsoil Loss Mechanism	Acreage Affected
Excavation (intakes, shafts, borrow/spoil areas)	623
Overcovering (spoil storage, reusable tunnel material storage)	3,499
Inundation (forebays, sedimentation basins, solids lagoons)	974
Total	5,096

Note: Some mechanisms for topsoil loss entail more than one process of soil loss. For example,
construction of setback levees would first require overexcavation for the levee foundation (i.e.,
excavation), then placement of fill material (i.e., overcovering).

26
27 DWR has made an Environmental Commitment for Disposal Site Preparation which would require that
28 a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will be set
29 aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas, thereby
30 lessening the effect. However, this effect would be adverse because it would result in a substantial loss
31 of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would also be available to reduce the severity of
32 this effect.

33 **CEQA Conclusion:** Construction of the water conveyance facilities would involve irreversible removal,
34 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss of
35 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would

1 be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these
 2 impacts, but not to a less-than-significant level. Therefore, this impact is considered significant and
 3 unavoidable.

4 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

5 A requirement of the General Permit is to minimize the extent of soil disturbance during
 6 construction. As described in Appendix 3B, *Environmental Commitments*, the SWPPPs prepared for
 7 BDCP construction activities will include a BMP that specifies the preservation of existing
 8 vegetation through installation of temporary construction barrier fencing to preclude unnecessary
 9 intrusion of heavy equipment into non-work areas. The BDCP proponents will ensure that the
 10 SWPPPs BMPs limiting ground disturbance are properly executed during construction by the
 11 contractors.

12 However, the BMP specifying preservation of existing vegetation may only limit the extent of
 13 surface area disturbed and not the area of excavated soils. Accordingly, soil-disturbing activities
 14 will be designed such that the area to be excavated, graded, or overcovered is the minimum
 15 necessary to achieve the purpose of the activity.

16 While minimizing the extent of soil disturbance will reduce the amount of topsoil lost, this will
 17 result in avoidance of this effect over only a small proportion of the total extent of the graded area
 18 that will be required to construct the habitat restoration areas, perhaps less than 5%.
 19 Consequently, a large extent of topsoil will be affected even after implementation of this mitigation
 20 measure.

21 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil 22 Storage and Handling Plan**

23 Depending on the thickness of the topsoil⁴ at a given construction or restoration site, up to 3 feet of
 24 the topsoil will be salvaged from construction work areas, stockpiled, and then applied over the
 25 surface of spoil and RTM storage sites and borrowed areas to the maximum extent practicable.
 26 Exceptions to this measure are areas smaller than 0.1 acre; areas of nonnative soil material, such as
 27 levees, where the near-surface soil does not consist of native topsoil; where the soil would be
 28 detrimental to plant growth; and any other areas identified by the soil scientist in evaluating
 29 topsoil characteristics (discussed below). This mitigation measure will complement and is related
 30 to activities recommended under Mitigation Measure AES-1c, in Chapter 17, *Aesthetics and Visual
 31 Resources* as well as to the environmental commitment for Disposal and Reuse of Spoils, RTM, and
 32 Dredged Material.

33 Topsoil excavated to install conveyance, natural gas, and sewer pipelines will be segregated from
 34 the subsoil excavated from open-cut trenches, stockpiled, and reapplied to the surface after the
 35 pipe has been installed.

36 The detailed design of the BDCP-related construction activities will incorporate an evaluation,
 37 based on review of soil survey maps supplemented by field investigations and prepared by a
 38 qualified soil scientist, that specifies the thickness of the topsoil that should be salvaged, and that

⁴ For the purposes of this mitigation measure, *topsoil* is defined as the O, Oi, Oe, Oa, A, Ap, A1, A2, A3, AB, and AC horizons. Three feet of topsoil was selected because it corresponds to the primary root zone depth of most crops grown in the Delta. With the exception of the Histosols (i.e., peat and muck soils), most of the topsoils in the Plan Area are less than 3 feet thick.

1 identifies areas in which no topsoil should be salvaged. The soil scientist will use the exceptions
2 listed above as the basis for identify areas in which no topsoil should be salvaged. The BDCP
3 proponents will ensure that the evaluation is prepared by a qualified individual, that it adequately
4 addresses all conveyance facilities, and that areas identified for topsoil salvage are incorporated
5 into the project design and that the contractors execute the salvage operations.

6 A qualified soil scientist will also prepare topsoil stockpiling and handling plans for the individual
7 conveyance and restoration components, establishing such guidelines as the maximum allowable
8 thickness of soil stockpiles, temporary stockpile stabilization/revegetation measures, and
9 procedures for topsoil handling during salvaging and reapplication. The maximum allowable
10 stockpile thickness will depend on the amount of time that the stockpile needs to be in place and is
11 expected to range from approximately three to 10 feet. The plans will also specify that, where
12 practicable, the topsoil be salvaged, transported, and applied to its destination area in one
13 operation (i.e., without stockpiling) to minimize degradation of soil structure and the increase in
14 bulk density as a result of excessive handling. The stockpiling and handling plans will also specify
15 maximum allowable stockpile sideslope gradients, seed mixes to control wind and water erosion,
16 cover crop seed mixes to maintain soil organic matter and nutrient levels, and all other measures to
17 avoid soil degradation and soil erosional losses caused by excavating, stockpiling, and transporting
18 topsoil. The BDCP proponents will ensure that each plan is prepared by a qualified individual, that
19 it adequately addresses all relevant activities and facilities, and that its specifications are properly
20 executed during construction by the contractors.

21 Adherence to this measure will ensure that topsoil is appropriately salvaged, stockpiled, and
22 reapplied. Nevertheless, adverse soil quality effects can also be associated with stockpiling. Such
23 effects commonly include loss of soil carbon, degraded aggregate stability, reduced growth of the
24 mycorrhizal fungi, and reduced nutrient cycling. Such effects may make the soil less productive
25 after it is applied to its destination site, compared to its pre-salvage condition. Depending on the
26 inherent soil characteristics, the manner in which it is handled and stockpiled, and the duration of
27 its storage, the reapplied topsoil may recover quickly to its original condition or require many
28 years to return to its pre-salvage physical, chemical, and biological condition (Strohmayer 1999;
29 Vogelsang and Bever 2010).

30 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage** 31 **from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed** 32 **Water Conveyance Facilities**

33 The three intakes, associated pumping plants, and pipelines would be constructed in areas in which the
34 near-surface soils have approximately 2–4% organic matter content. Compared to organic soils, these
35 mineral soils would not be subject to appreciable subsidence caused by organic matter decomposition
36 because there is relatively little organic matter available to decompose. The tunnels would be
37 constructed at a depth below that of the peat (Figure 10-2); consequently, subsidence caused by
38 organic matter decomposition at tunnel depth is expected to be minimal. Without adequate
39 engineering, the forebay levees and interior could be subject to appreciable subsidence.

40 Damage to or collapse of the pipelines and tunnels could occur where these facilities are constructed in
41 soils and sediments that are subject to subsidence and differential settlement. Subsidence- or
42 differential sediment-induced damage or collapse of these facilities could cause a rapid release of
43 water to the surrounding soil, causing an interruption in water supply, and producing underground

1 cavities, depressions at the ground surface, and surface flooding. Facilities that have subsided would be
2 subject to flooding, and levees that have subsided would be subject to overtopping.

3 Damage to other conveyance facilities, such as intakes, pumping plants, transition structures, and
4 control structures, caused by subsidence/settlement under the facilities and consequent damage to or
5 failure of the facility could also occur. Facility damage or failure could cause a rapid release of water to
6 the surrounding area, resulting in flooding, thereby endangering people in the vicinity.

7 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on soils
8 that are subject to subsidence. However, as described in section 10.3.1, *Methods for Analysis*, and
9 Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all facilities to
10 identify the types of soil avoidance or soil stabilization measures that should be implemented to ensure
11 that the facilities are constructed to withstand subsidence and settlement and to conform to applicable
12 state and federal standards. These investigations would build upon the geotechnical data reports
13 (California Department of Water Resources 2001a, 2010b, 2011) and the CERs (California Department
14 of Water Resources 2010a, 2010b). Such standards include the American Society of Civil Engineers
15 Minimum Design Loads for Buildings and Other Structures, CBC, and USACE Design and Construction of
16 Levees. The results of the investigations, which would be conducted by a California registered civil
17 engineer or California certified engineering geologist, would be presented in geotechnical reports. The
18 reports would contain recommended measures to prevent subsidence. The geotechnical report will
19 be prepared in accordance with state guidelines, in particular *Guidelines for Evaluating and Mitigating*
20 *Seismic Hazards in California* (California Geological Survey 2008).

21 Liquid limit (i.e., the moisture content at which a soil passes from a solid to a liquid state) and organic
22 material content testing should be performed on soil samples collected during the site-specific field
23 investigations to determine site-specific geotechnical properties. High organic matter content soils that
24 are unsuitable for support of structures, roadways, and other facilities would be overexcavated and
25 replaced with engineered fill, and the unsuitable soils disposed of offsite as spoil, as described in more
26 detail below. Geotechnical evaluations would be conducted to identify soils materials that are suitable
27 for engineering purposes.

28 Additional measures to address the potential adverse effects of organic soils could include construction
29 of structural supports that extend below the depth of organic soils into underlying materials with
30 suitable bearing strength. For example, the CER indicates that approximately 35 feet of soil would be
31 excavated and a pile foundation supporting a common concrete mat would be required for the intake
32 pumping plants. The piles would be 24-inches in diameter and concrete-filled, extending to 65 to 70
33 feet below the founding level of the plant. Piles extended to competent geologic beds beyond the weak
34 soils would provide a solid foundation to support the pumping plants.

35 For the sedimentation basins, the CER indicates that most of the underlying soils would be excavated to
36 a depth of 30 feet below grade and removed from the site and suitable soil material imported to the site
37 to reestablish it to subgrade elevation. Removal of the weak soils and replacement with engineered fill
38 using suitable soil material would provide a solid foundation for the sedimentation basins.

39 At the proposed expanded Clifton Court Forebay, the CER specifies that because most of the soils within
40 the footprints of the forebay and the forebay embankments have high organic matter content, they
41 would be excavated and removed from the site. Removal of the weak soils to reach competent soils
42 would provide a solid foundation upon which to construct the forebay and its embankment.

1 At the spillway and stilling basin for the intermediate spillway, the CER indicates that unsuitable soils
2 would be excavated to competent material and that the spillway would incorporate water-stopped
3 contraction joints at intervals to accommodate a degree of settlement and subsoil deformation.
4 Removal of the weak soils to reach competent soils and providing a joint system would provide a solid
5 foundation for the spillway and stilling basin and enable the spillway to withstand settlement and
6 deformation without jeopardizing its integrity.

7 Certain methods and practices may be utilized during tunnel construction to help reduce and manage
8 settlement risk. The CER indicates that the ground improvement techniques to control settlement at
9 the shafts and tunnels may involve jet-grouting, permeation grouting, compaction grouting, or other
10 methods that a contractor may propose. Jet-grouting involves use of high-pressure, high-velocity jets to
11 hydraulically erode, mix and partially replace the surrounding soil with a cementitious grout slurry,
12 thereby creating a cemented zone of high strength and low permeability around of tunnel bore.
13 Permeation grouting involves introduction of a low-viscosity grout (sodium silicate, microfine cement,
14 acrylate or polyurethane) into the pores of the soil around the tunnel bore, which increases the
15 strength and cohesion of granular soils. Compaction grouting involves injecting the soil surrounding
16 the tunnel bore with a stiff, low slump grout under pressure, forming a cemented mass that increases
17 soil bearing capacity. These measures would have the effect of better supporting the soil above the
18 borehole and would prevent unacceptable settlement between the borehole and the tunnel segments.
19 Additionally, settlement monitoring points, the number and location of which would be identified
20 during detailed design, would be established along the pipeline and tunnel routes during construction
21 and the results reviewed regularly by a professional engineer. The monitoring therefore would provide
22 early detection of excessive settlement such that corrective actions could be made before the integrity
23 of the tunnel is jeopardized.

24 This potential effect could be substantial because the facilities could be located on soils that are subject
25 to subsidence. However, as described in section 10.3.1, *Methods for Analysis*, and Appendix 3B,
26 *Environmental Commitments*, geotechnical studies would be conducted at all facilities to identify the
27 types of soil avoidance or soil stabilization that should be implemented to ensure that the facilities are
28 constructed to withstand subsidence and settlement and to conform to applicable state and federal
29 standards. These investigations would build upon the geotechnical data reports (California Department
30 of Water Resources 2001a, 2010b, 2011) and the CERs (California Department of Water Resources
31 2010a, 2010b). Additionally, conforming with state and federal design codes and standards, including
32 the California Building Code and resource agency and professional engineering specifications, such as
33 the American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures,
34 ASCE-7-05, 2005, would ensure that appropriate design measures are incorporated into the project and
35 any subsidence that takes place under the project facilities would not jeopardize their integrity.
36 Conforming with these codes and standards is an environmental commitment by DWR to ensure cut
37 and fill slopes and embankments will be stable as the water conveyance features are operated
38 (Appendix 3B, *Environmental Commitments*). Conforming with the standards and guidelines may
39 necessitate such measures as excavation and removal of weak soils and replacement with engineered
40 fill using suitable, imported soil, construction on pilings driven into competent soil material, and
41 construction of facilities on cast-in-place slabs. These measures would reduce the potential hazard of
42 subsidence or settlement to acceptable levels by avoiding construction directly on or otherwise
43 stabilizing the soil material that is prone to subsidence.

44 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
45 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of
46 the facility. However, because DWR would be required to design and construct the facilities according

1 to state and federal design standards and guidelines (e.g., California Building Code, American Society of
 2 Civil Engineers Minimum Design Loads for Buildings and Other Structures, ASCE-7-05, 2005).
 3 Conforming with these codes would reduce the potential hazard of subsidence or settlement to
 4 acceptable levels by avoiding construction directly on or otherwise stabilizing the soil material that is
 5 prone to subsidence. Because these measures would reduce the potential hazard of subsidence or
 6 settlement to meet design standards, this impact is considered less than significant. No mitigation is
 7 required.

8 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**
 9 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

10 The integrity of the water conveyance facilities, including tunnels, pipelines, intake facilities, pumping
 11 plants, access roads and utilities, and other features could be adversely affected because they would be
 12 located on expansive, corrosive, and compressible soils.

13 ***Expansive Soils***

14 The Alternative 4 alignment is underlain by soils with low to high shrink-swell potential (note areas of
 15 high linear extensibility in Figure 10-4). The majority of the soils with high shrink-swell potential are
 16 where the intakes, pumping plants, pipelines, sedimentation basin, one of the tunnels, and the northern
 17 third of the canal alignment are proposed. Most of these areas are in Sacramento County (Dierssen and
 18 Egbert-Valpac association soils). The remaining conveyance facilities would generally be located where
 19 the soils have low or moderate shrink-swell potential. Soil expansion-contraction is not expected to be
 20 a concern at these types of facilities.

21 Soils with a high shrink-swell potential (i.e., expansive soils) could damage facilities or cause the
 22 facilities to fail. For example, foundations and pavements could be cracked or shifted and pipelines
 23 could rupture.

24 Soil expansion is a concern only at soil depths that are subject to seasonal changes in moisture content.
 25 The Alternative 4 alignment is underlain by soils with low to high shrink-swell potential (note areas of
 26 high linear extensibility in Figure 10-4). The majority of the soils with high shrink-swell potential are
 27 where the intakes, pumping plants, pipelines, sedimentation basin, borrow/spoils sites, RTM areas, and
 28 the northern third of the canal alignment are proposed. Most of these areas are in Sacramento
 29 (Dierssen and Egbert-Valpac association soils). The remaining conveyance facilities are generally
 30 situated in areas of soils with low to moderate shrink-swell potential (see Figure 10-4). However, a
 31 borrow/spoils area, a temporary work area, three concrete batch plants and three fuel station locations
 32 along the Alternative 4 alignment, may contain soils with high to very high shrink-swell potential.

33 Soils with a high shrink-swell potential (i.e., expansive soils) could damage facilities or cause the
 34 facilities to fail. For example, foundations and pavements could be cracked or shifted and pipelines
 35 could rupture.

36 ***Soils Corrosive to Concrete***

37 The near-surface (i.e., upper 5 feet) soil corrosivity to concrete ranges from low to high along the
 38 Alternative 4 alignment, although approximately half of the alignment is in areas of low to moderate
 39 corrosivity. The near-surface soils at the three intake and pumping plant facilities generally have a
 40 moderate corrosivity to concrete. The near-surface soils at the tunnel shafts have a low to high
 41 corrosivity to concrete. Data on soil corrosivity to concrete below a depth of approximately 5 feet (i.e.,
 42 where pipelines, tunnels, and the deeper part of the tunnel shafts would be constructed) are not

1 available. However, given the variability in the composition of the soils and geologic units on and
2 within which the conveyance facilities would be constructed, corrosivity hazards are likely to range
3 from low to high. Because soil corrosivity to concrete is high among the near-surface peat soils in the
4 Delta, a high corrosivity is also expected to be present among the peat soils at depth. Site-specific soil
5 investigations would need to be conducted to determine the corrosivity hazard at depth at each
6 element of the conveyance facility. However, as described in 10.3.1, *Methods for Analysis*, and Appendix
7 3B, *Environmental Commitments*), geotechnical studies would be conducted at all facilities to identify
8 site-specific soil corrosivity hazards. The resulting geotechnical report, prepared by a California
9 registered civil engineer or a California certified engineering geologist, would describe these hazards
10 and recommend the measures that should be implemented to ensure that the facilities are constructed
11 to withstand corrosion and to conform with applicable state and federal standards, such as the CBC.

12 Soils that are moderately and highly corrosive to concrete may cause the concrete to degrade, thereby
13 threatening the integrity of the facility. Degradation of concrete may cause pipelines and tunnels to leak
14 or rupture and cause foundations to weaken.

15 ***Soils Corrosive to Uncoated Steel***

16 The near-surface soils along the Alternative 4 alignment generally are highly corrosive to uncoated
17 steel. Sections of the southern end of the alignment are moderately corrosive to uncoated steel. Data on
18 soil corrosivity to uncoated steel below a depth of approximately 5 feet (i.e., where pipelines, tunnels,
19 and the deeper part of the tunnel shafts would be constructed) are not available. However, given the
20 variability in the composition of the soils and geologic units on and within which the conveyance
21 facilities would be constructed, corrosivity hazards are likely to range from low to high. Site-specific
22 soil investigations would need to be conducted to determine the corrosivity hazard at depth at each
23 element of the conveyance facility.

24 Soils that are moderately and highly corrosive to uncoated steel (including steel rebar embedded in
25 concrete) may cause the concrete to degrade, threatening the integrity of these facilities.

26 ***Compressible Soils***

27 Soils that are weakly consolidated or that have high organic matter content (such as peat or muck soils)
28 present a risk to structures and infrastructure because of high compressibility and poor bearing
29 capacity. Soils with high organic matter content tend to compress under load and may decrease in
30 volume as organic matter is oxidized. Much of the Alternative 4 tunnel alignment is underlain by near-
31 surface soils that consist of peat. The soils in the area where the intakes and their associated structures
32 would be located have a relatively low organic matter content. Based on liquid limits reported in
33 county soil surveys, near-surface soils in the Alternative 4 alignment vary from low to medium
34 compressibility.

35 Damage to or collapse of the pipelines, intakes, pumping plants, transition structures, and control
36 structures could occur where these facilities are constructed in soils and sediments that are subject to
37 subsidence and differential settlement. Because of compressible soils, such effects could occur at the
38 five intakes, all the pumping plants, and the sedimentation basins, Subsidence- or differential
39 sediment-induced damage or collapse of these facilities could cause a rapid release of water to the
40 surrounding soil, causing an interruption in water supply and producing underground cavities,
41 depressions at the ground surface, and surface flooding.

1 The tunnels would be constructed at a depth below the peat (Figure 9-4); therefore, subsidence caused
 2 by organic matter decomposition below the tunnels is expected to be minimal. Surface and subsurface
 3 settlement may occur during tunnel construction; however, certain methods and practices may be used
 4 during tunnel construction to help reduce and manage settlement risk. Chapter 9, *Geology and*
 5 *Seismicity*, discusses the risks of settlement during tunnel construction and methods to reduce the
 6 amount of settlement (Impact GEO-2).

7 Embankments that have subsided would be subject to overtopping, leading to flooding on the landside
 8 of the embankments. The embankment that would be subject to this hazard is the expanded Clifton
 9 Court Forebay.

10 **NEPA Effects:** Various facilities would be located on expansive, corrosive, and compressible soils.
 11 However, all facility design and construction would be executed in conformance with the CBC, which
 12 specifies measures to mitigate effects of expansive soils, corrosive soils, and soils subject to
 13 compression and subsidence. The CBC requires measures such as soil replacement, lime treatment, and
 14 post-tensioned foundations to offset expansive soils. The CBC requires such measures as using
 15 protective linings and coatings, dielectric (i.e., use of an electrical insulator polarized by an
 16 applied electric field) isolation of dissimilar materials, and active cathodic protection systems to
 17 prevent corrosion of concrete and steel.

18 Potential adverse effects of compressible soils and soils subject to subsidence could be addressed by
 19 overexcavation and replacement with engineered fill or by installation of structural supports (e.g.,
 20 pilings) to a depth below the peat where the soils have adequate load bearing strength, as required by
 21 the CBC and by USACE design standards. Geotechnical studies would be conducted at all the facilities to
 22 determine the specific measures that should be implemented to reduce these soil hazards to levels
 23 consistent with the CBC. Liquid limit and soil organic matter content testing would be performed on
 24 collected soil samples during the site-specific field investigations to determine site-specific
 25 geotechnical properties. Settlement monitoring points should be established along the route during
 26 tunnel construction and results reviewed regularly by a professional engineer.

27 The engineer would develop final engineering solutions to any hazardous condition, consistent with the
 28 code and standards requirements of federal, state, and local oversight agencies. As described in section
 29 10.3.1, *Methods for Analysis*, and in Appendix 3B, *Environmental Commitments*, such design codes,
 30 guidelines, and standards include the California Building Code and resource agency and professional
 31 engineering specifications, such as the DWR Interim Levee Design Criteria for Urban and Urbanizing
 32 Area State Federal Project Levees, and USACE Engineering and Design—Earthquake Design and
 33 Evaluation for Civil Works Projects.

34 By conforming with the CBC and other applicable design standards, potential effects associated with
 35 expansive and corrosive soils and soils subject to compression and subsidence would be offset. There
 36 would be no adverse effect.

37 **CEQA Conclusion:** Many of the Alternative 4 facilities would be constructed on soils that are subject to
 38 expansion, moderately or highly corrosive to concrete and uncoated steel, as well as soils that are
 39 moderately or highly subject to compression under load. Corrosive soils could damage in-ground
 40 facilities or shorten their service life. Compression/settlement of soils after a facility is constructed
 41 could result in damage to or failure of the facility. Surface soils that are moderately to highly expansive
 42 exist throughout the Alternative 4 alignment except in the central part of the Delta between
 43 approximately Staten Island and Bacon Island. Expansive soils could cause foundations, underground
 44 utilities, and pavements to crack and fail. However, DWR would be required to design and construct the

1 facilities according to state and federal design standards, guidelines, and building codes. The CBC
2 requires measures such as soil replacement, lime treatment, and post-tensioned foundations to offset
3 expansive soils. The CBC requires such measures as using protective linings and coatings, dielectric
4 (i.e., use of an electrical insulator polarized by an applied electric field) isolation of dissimilar materials,
5 and active cathodic protection systems to prevent corrosion of concrete and steel in conformance with
6 CBC requirements. Potential adverse effects of compressible soils and soils subject to subsidence could
7 be addressed by overexcavation and replacement with engineered fill or by installation of structural
8 supports (e.g., pilings) to a depth below the peat where the soils have adequate load bearing strength,
9 as required by the CBC and by USACE design standards. Conforming with these codes and standards
10 (Appendix 3B, *Environmental Commitments*) is an environmental commitment by DWR to ensure that
11 potential adverse effects associated with expansive and corrosive soils and soils subject to compression
12 and subsidence would be offset. Therefore, this impact would be less than significant. No mitigation is
13 required.

14 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 15 **Operations**

16 River channel bank erosion/scour is a natural process. The rate of natural erosion can increase during
17 high flows and as a result of wave effect on banks during high wind conditions.

18 In general, changes in river flow rates associated with BDCP operations would remain within the range
19 that presently occurs. However, the operational components would cause changes in the tidal flows in
20 some Delta channels, specifically those that lead into the major habitat restoration areas (Suisun Marsh,
21 Cache Slough, Yolo Bypass, and South Delta ROAs). In major channels leading to the restoration areas,
22 tidal flow velocities may increase; this may cause some localized accelerated erosion/scour. Alternative
23 4 would have effects of a lesser magnitude with respect to potential accelerated bank erosion because
24 the flow from the north Delta would be 3,000 cfs rather than 15,000 cfs, as it is under some of the other
25 BDCP alternatives.

26 However, the increased flows would be offset as part of the conservation measures by the dredging of
27 these major channels, which would create a larger channel cross-section. The larger cross section
28 would allow river flow rates to be similar to that of other high tidal flows in the region. Moreover, as
29 presently occurs and as is typical with most naturally-functioning river channels, local erosion and
30 deposition within the tidal habitats is expected as part of the restoration.

31 For most of the existing channels that would not be subject to tidal flow restoration, there would be no
32 adverse effect to tidal flow volumes and velocities. The tidal prism would increase by 5–10%, but the
33 intertidal (i.e., MHHW to MLLW) cross-sectional area also would be increased such that tidal flow
34 velocities would be reduced by 10–20% compared to the existing condition. Consequently, no
35 appreciable increase in scour is anticipated.

36 **NEPA Effects:** The effect would not be adverse because there would be no net increase in river flow
37 rates and therefore no net increase in channel bank scour.

38 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in channels
39 and sloughs, potentially leading to increases in channel bank scour. However, where such changes are
40 expected to occur (i.e., at the mouths of tidal marsh channels), the project would also entail expansion
41 of the channel cross-section to increase the tidal prism at these locations. The net effect would be to
42 reduce the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no

1 appreciable increase in scour is anticipated. The impact would be less than significant. No mitigation is
2 required.

3 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**
4 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,**
5 **CM18 and CM19**

6 Conservation measures would include breaching, lowering, or removing levees; constructing setback
7 levees and cross levees or berms; raising the land elevation by excavating relatively high areas to
8 provide fill for subsided areas or by importing fill material; surface grading; deepening and/or
9 widening tidal channels; excavating new channels; modifying channel banks; and other activities.
10 Moreover, excavation and grading to construct facilities, access roads, and other features would be
11 necessary under the two conservation measures that are not associated with the ROAs (i.e., *CM18*
12 *Conservation Hatcheries* and *CM19 Urban Stormwater Treatment*). These activities could lead to
13 accelerated soil erosion rates and consequent loss of topsoil.

14 ***Water Erosion***

15 Activities associated with conservation measures that could lead to accelerated water erosion include
16 clearing, grubbing, demolition, grading, and other similar disturbances. Such activities steepen slopes
17 and compact soil. These activities tend to degrade soil structure, reduce soil infiltration capacity, and
18 increase runoff rates, all of which could cause accelerated erosion and consequent loss of topsoil.

19 Gently sloping to level areas, such as where most of the restoration actions would occur, are expected
20 to experience little or no accelerated water erosion because of the lack of runoff energy to entrain and
21 transport soil particles.

22 Graded and otherwise disturbed tops and sideslopes of existing and project levees and embankments
23 are of greater concern for accelerated water erosion because of their steep gradients. Soil eroded from
24 the disturbed top and water side of levees could reach adjoining waterways (if present), unless erosion
25 and sediment control measures are implemented.

26 ***Wind Erosion***

27 Wind erosion potential varies widely among and within the ROAs (Figure 10-6). Areas within ROAs
28 with high wind erodibility are largely correlated with the presence of organic soils. Wind erodibility in
29 the Suisun Marsh, Cache Slough, and South Delta ROAs ranges from high to low. The Yolo Bypass ROA
30 generally has a low wind erodibility hazard.

31 Conservation measures construction activities (e.g., excavation, filling, grading, and vehicle traffic on
32 unimproved roads) that could lead to accelerated wind erosion are the same as those for water erosion.
33 These activities may entail vegetation removal and degradation of soil structure, both of which would
34 make the soil more subject to wind erosion. Removal of vegetation cover and grading increase soil
35 exposure at the surface and obliterate the binding effect of plant roots on soil aggregates. These effects
36 make the soil particles more subject to entrainment by wind.

37 Unlike water erosion, the potential for wind erosion is generally not dependent on slope gradient and
38 location, nor is the potential affected by context relative to a receiving water. Without proper
39 management, the wind-eroded soil particles can be transported great distances.

1 The transport of soil material from the conveyance facilities for use as fill in subsided areas within the
 2 ROAs could subject the soils to wind erosion, particularly if the fill material consists of peat. The peat
 3 would be especially susceptible to wind erosion while being loaded onto trucks, transported, unloaded,
 4 and distributed onto the restoration areas.

5 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as
 6 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the
 7 BDCP proponents would be required to obtain coverage under the General Permit for Construction and
 8 Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan. The
 9 General Permit requires that SWPPPs be prepared by a QSD and requires SWPPPs be implemented
 10 under the supervision of a QSP. The QSD would select erosion and sediment control BMPs such as
 11 preservation of existing vegetation, seeding, mulching, fiber roll and silt fence barriers, erosion control
 12 blankets, watering to control dust entrainment, and other measures to comply with the practices and
 13 turbidity level requirements defined by the General Permit. Partly because the potential effect on
 14 receiving waters depends on location of a work area relative to a waterway, the BMPs would be site-
 15 specific. The QSP would be responsible for day-to-day implementation of the SWPPP, including BMP
 16 inspections, maintenance, water quality sampling, and reporting to the State Water Board. Proper
 17 implementation of the requisite SWPPP, site-specific BMPs, and compliance with the General Permit
 18 would ensure that accelerated water and wind erosion as a result of implementing conservation
 19 measures would not be an adverse effect.

20 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 21 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP
 22 proponents would seek coverage under the state General Permit for Construction and Land
 23 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such as
 24 revegetation, runoff control, and sediment barriers) and compliance with water quality standards. As a
 25 result of implementation of Permit conditions, the impact would be less than significant. No mitigation
 26 is required.

27 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
 28 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2-**
 29 **CM11**

30 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., levee
 31 foundations, water control structures); overcovering (e.g., levees, embankments, application of fill
 32 material in subsided areas); and water inundation (e.g., aquatic habitat areas) over extensive areas of
 33 the Plan Area. Implementation of habitat restoration activities at the ROAs would result in excavation,
 34 overcovering, or inundation of a minimum of 77,600 acres of topsoil. This effect would be adverse
 35 because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b
 36 would be available to reduce the severity of this effect.

37 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,
 38 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby
 39 resulting in a substantial loss of topsoil. The impact would be significant. Mitigation Measures SOILS-2a
 40 and SOILS-2b would minimize and compensate for these impacts to a degree, but not to a less than
 41 significant level. Therefore, this impact is considered significant and unavoidable.

42 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

43 Please see Mitigation Measure SOILS-2a under Impact SOILS-2.

1 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
2 **Storage and Handling Plan**

3 Please see Mitigation Measure SOILS-2b under Impact SOILS-2.

4 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
5 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed**
6 **Conservation Measures CM2–CM11**

7 With the exception of the Suisun Marsh ROA, the ROAs are not in areas of high subsidence nor where
8 the soils have a high organic matter content (Figures 10-2 and 10-9). Consequently, only the Suisun
9 Marsh ROA would be expected to be subject to substantial subsidence. Based on its current elevation,
10 the Suisun Marsh ROA has not experienced significant subsidence, despite the fact that the soils are
11 organic and of considerable thickness (Figure 10-3).

12 **NEPA Effects:** Damage to or failure of the habitat levees could occur where these are constructed in
13 soils and sediments that are subject to subsidence and differential settlement. These soil conditions
14 have the potential to exist in the Suisun Marsh ROA. Levee damage or failure could cause surface
15 flooding in the vicinity. This potential effect could be substantial because the facilities could be located
16 on unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
17 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
18 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
19 berms, and other features are constructed to withstand subsidence and settlement and to conform to
20 applicable state and federal standards. Such standards include the USACE Design and Construction of
21 Levee and DWR Interim Levee Design Criteria for Urban and Urbanizing Area State-Federal Project
22 Levees.

23 For example, high organic matter content soils and all soils otherwise subject to subsidence that are
24 unsuitable for supporting levees would be overexcavated and replaced with engineered fill, and the
25 unsuitable soils disposed of offsite as spoils. Geotechnical evaluations will be conducted to identify soils
26 materials that are suitable for engineering purposes. Liquid limit and organic content testing should be
27 performed on collected soil samples during the site-specific field investigations to determine site-
28 specific geotechnical properties.

29 With construction of all levees, berms, and other conservation features designed and constructed to
30 withstand subsidence and settlement and through conformance with applicable state and federal
31 design standards, this effect would not be adverse.

32 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
33 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
34 of the facility. However, because the BDCP proponents would be required to design and construct the
35 facilities according to state and federal design standards and guidelines (which may involve, for
36 example, replacement of the organic soil), the impact would be less than significant. No mitigation is
37 required.

1 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**
 2 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2-**
 3 **CM11**

4 ***Expansive Soils***

5 The ROAs generally have soils with moderate or high shrink-swell potential. The ROAs with a
 6 significant extent of highly expansive soils are the Yolo Bypass and Cache Slough ROAs (Figure 10-4).
 7 None appears to have appreciable areas of soils with very high expansiveness.

8 Potential adverse effects of expansive soils are a concern only to structural facilities within the ROAs,
 9 such as water control structures. Seasonal shrinking and swelling of moderately or highly expansive
 10 soils could damage water control structures or cause them to fail, resulting in a release of water from
 11 the structure and consequent flooding, which would cause unplanned inundation of aquatic habitat
 12 areas.

13 ***Corrosive Soils***

14 Soils in all the ROAs possess high potential for corrosion of uncoated steel, and the Suisun ROA and
 15 portions of the West Delta ROA possess soils with high corrosivity to concrete.

16 ***Compressible Soils***

17 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne,
 18 and South Delta ROAs. Areas of low to medium compressibility occur in the South Delta ROA. Silts and
 19 clays with a liquid limit less than 35% are considered to have low compressibility. Silts and clays with a
 20 liquid limit greater than 35% and less than 50% are considered to have medium compressibility and
 21 greater than 50% are considered highly compressible. Organic soils typically have high liquid limits
 22 (greater than 50%) and are therefore considered highly compressible.

23 ***NEPA Effects:*** The conservation measures could be located on expansive, corrosive, and compressible
 24 soils. However, ROA-specific environmental effect evaluations and geotechnical studies and testing
 25 would be completed prior to construction within the ROAs. The site-specific environmental evaluation
 26 would identify specific areas where engineering soil properties, including soil compressibility, may
 27 require special consideration during construction of specific features within ROAs. Conformity with
 28 USACE, CBC, and other design standards for construction on expansive, corrosive and/or compressible
 29 soils would prevent adverse effects of such soils.

30 ***CEQA Conclusion:*** Some of the restoration component facilities would be constructed on soils that are
 31 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
 32 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
 33 could damage in-ground facilities or shorten their service life. Compression or settlement of soils after
 34 a facility is constructed could result in damage to or failure of the facility. However, because the BDCP
 35 proponents would be required to design and construct the facilities according to state and federal
 36 design standards, guidelines, and building codes (which may involve, for example, soil lime
 37 stabilization, cathodic protection of steel, and soil replacement), this impact would be considered less
 38 than significant. No mitigation is required.

10.3.3.10 Alternative 5—Dual Conveyance with Pipeline/Tunnel and Intake 1 (3,000 cfs; Operational Scenario C)

Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities

Alternative 5 would include the same physical/structural components as Alternative 1A, except that it would entail four fewer intakes and four fewer pumping plants. These differences would result in slightly less accelerated erosion impacts than Alternative 1A. The impacts of Alternative 5 would, however, be similar to those of Alternative 1A. See the discussion of Impact SOILS-1 under Alternative 1A.

NEPA Effects: Construction of the proposed water conveyance facility could occur under Alternative 5 could cause substantial accelerated erosion. However, as described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, DWR would be required to obtain coverage under the General Permit for Construction and Land Disturbance Activities, necessitating the preparation of an erosion control plan. Proper implementation of the requisite SWPPP and compliance with the General Permit would ensure that there would not be substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs as a result of construction of the proposed water conveyance facility, and therefore, there would not be an adverse effect.

CEQA Conclusion: Vegetation removal and other soil disturbances associated with construction of water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR would seek coverage under the state General Permit for Construction and Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan. As a result of implementation of the requisite SWPPP and compliance with the General Permit, there would not be substantial soil erosion resulting in daily site runoff turbidity in excess of 250 NTUs, and the effect would be less than significant. No mitigation is required.

Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of Constructing the Proposed Water Conveyance Facilities

NEPA Effects: Alternative 5 would include the same physical/structural components as Alternative 1A, except that it would entail four fewer intakes and four fewer pumping plants. These differences would result in slightly less effects on topsoil loss than Alternative 1A. The impacts of Alternative 5 would, however, be similar to those of Alternative 1A. See the discussion of Impact SOILS-2 under Alternative 1A.

Topsoil effectively would be lost as a resource as a result of its excavation (e.g., forebays, borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants); overcovering (e.g., levees and embankments, spoil storage, pumping plants; and water inundation (e.g., forebays, sedimentation basins, and solids lagoons). DWR has made an Environmental Commitment for Disposal Site Preparation which would require that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material will be set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas, thereby lessening the effect. However, this effect would be adverse because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would be available to reduce the severity of this effect.

CEQA Conclusion: Construction of the water conveyance facilities would involve excavation, overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss of

1 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would
2 be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these
3 impacts, but not to a less-than-significant level. Therefore, this impact is considered significant and
4 unavoidable.

5 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

6 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

7 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
8 **Storage and Handling Plan**

9 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

10 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
11 **from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed**
12 **Water Conveyance Facilities**

13 Alternative 5 would include the same physical/structural components as Alternative 1A, except that it
14 would entail four fewer intakes and four fewer pumping plants. These differences would result in
15 slightly less effects related to subsidence than Alternative 1A. The impacts of Alternative 5 would,
16 however, be similar to those under Alternative 1A. See the discussion of Impact SOILS-3 under
17 Alternative 1A.

18 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
19 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
20 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
21 facilities to identify the types of soil avoidance or soil stabilization measures that should be
22 implemented to ensure that the facilities are constructed to withstand subsidence and settlement and
23 to conform to applicable state and federal standards. These investigations would build upon the
24 geotechnical data reports (California Department of Water Resources 2001a, 2010b, 2011) and the
25 CERs (California Department of Water Resources 2010a, 2010b). As discussed under Alternative 1A,
26 conforming with state and federal design standards, including conduct of site-specific geotechnical
27 evaluations, would ensure that appropriate design measures are incorporated into the project and any
28 subsidence that takes place under the project facilities would not jeopardize their integrity.

29 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
30 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of
31 the facility. However, because DWR would be required to design and construct the facilities according
32 to state and federal design standards and guidelines (e.g., California Building Code, American Society of
33 Civil Engineers Minimum Design Loads for Buildings and Other Structures, ASCE-7-05, 2005).
34 Conforming with these codes would reduce the potential hazard of subsidence or settlement to
35 acceptable levels by avoiding construction directly on or otherwise stabilizing the soil material that is
36 prone to subsidence. Because these measures would reduce the potential hazard of subsidence or
37 settlement to meet design standards, the impact would be less than significant. No mitigation is
38 required.

1 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**
 2 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

3 Alternative 5 would include the same physical/structural components as Alternative 1A, except it
 4 would entail four fewer intakes and four fewer pumping plants. These differences would result in
 5 slightly fewer effects related to expansive, corrosive, and compressible soils than under Alternative 1A.
 6 The effects under Alternative 5 would, however, be similar to those of Alternative 1A. See discussion of
 7 Impact SOILS-4 under Alternative 1A.

8 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake
 9 facilities, pumping plants, access roads and utilities, and other features could be adversely affected
 10 because they would be located on expansive, corrosive, and compressible soils. However, all facility
 11 design and construction would be executed in conformance with the CBC, which specifies measures to
 12 mitigate effects of expansive soils, corrosive soils, and soils subject to compression and subsidence. By
 13 conforming with the CBC and other applicable design standards, potential effects associated with
 14 expansive and corrosive soils and soils subject to compression and subsidence would be offset. There
 15 would be no adverse effect.

16 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to
 17 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils
 18 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils could
 19 damage in-ground facilities or shorten their service life. Compression/settlement of soils after a facility
 20 is constructed could result in damage to or failure of the facility. However, because DWR would be
 21 required to design and construct the facilities according to state and federal design standards,
 22 guidelines, and building codes (e.g., CBC and USACE design standards). Conforming with these codes
 23 and standards is an environmental commitment by DWR to ensure that potential adverse effects
 24 associated with expansive and corrosive soils and soils subject to compression and subsidence would
 25 be offset. Therefore, this impact would be less than significant. No mitigation is required.

26 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**
 27 **Operations**

28 Alternative 5 would have operations similar to those under Alternative 1A, but of a lesser magnitude
 29 with respect to potential effects on accelerated bank erosion because the flow from the north Delta
 30 would be 3,000 cfs rather than 15,000 cfs. The effects under Alternative 5 would, however, be similar to
 31 those under Alternative 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

32 **NEPA Effects:** The effect of increased channel flow rates on channel bank scour would not be adverse
 33 because, as part of the conservation measures, major channels would be dredged to create a larger
 34 cross-section that would offset increased tidal velocities. The effect would not be adverse because there
 35 would be no net increase in river flow rates and therefore no net increase in channel bank scour.

36 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in channels
 37 and sloughs, potentially leading to increases in channel bank scour. However, where such changes are
 38 expected to occur (i.e., at the mouths of tidal marsh channels), the project would also entail expansion
 39 of the channel cross-section to increase the tidal prism at these locations. The net effect would be to
 40 reduce the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no
 41 appreciable increase in scour is anticipated. The impact would be less than significant. No mitigation is
 42 required.

1 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**
 2 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,**
 3 **CM18 and CM19**

4 Implementation of conservation measures under Alternative 5 would be the same as under Alternative
 5 1A, except that only 25,000 acres of tidal habitat would be restored. The effects under Alternative 5 on
 6 accelerated erosion would, therefore, be similar to those under Alternative 1A, but of a lesser
 7 magnitude. Implementation of the conservation measures would involve ground disturbance and
 8 construction activities that could lead to accelerated soil erosion rates and consequent loss of topsoil.
 9 See the discussion of Impact SOILS-6 under Alternative 1A.

10 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as
 11 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the
 12 BDCP proponents would be required to obtain coverage under the General Permit for Construction and
 13 Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan.
 14 Proper implementation of the requisite SWPPP, site-specific BMPs, and compliance with the General
 15 Permit would ensure that accelerated water and wind erosion as a result of implementing conservation
 16 measures would not be an adverse effect.

17 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 18 restoration areas could cause accelerated water and wind erosion of soil. However, the project BDCP
 19 proponents would seek coverage under the state General Permit for Construction and Land
 20 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such as
 21 revegetation, runoff control, and sediment barriers) and compliance with water quality standards. As a
 22 result of implementation of Permit conditions, the impact would be less than significant. No mitigation
 23 is required.

24 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
 25 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2–**
 26 **CM11**

27 Conservation measures would be the same under Alternative 5 as under Alternative 1A. Topsoil would
 28 be lost as a resource as a result of its excavation, overcovering, and water inundation—except that only
 29 25,000 acres of tidal habitat would be restored. The impacts of Alternative 5 on the loss of topsoil
 30 would, therefore, be similar to those under Alternative 1A, but of a lesser magnitude. See the discussion
 31 of Impact SOILS-7 under Alternative 1A.

32 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.
 33 Mitigation Measures SOILS-2a and SOILS-2b would be available to reduce the severity of this effect.

34 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,
 35 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby
 36 resulting in a substantial loss of topsoil. The impact would be significant. Mitigation Measures SOILS-2a
 37 and SOILS-2b would minimize and compensate for these impacts to a degree, but not to a less-than-
 38 significant level. Therefore, this impact is considered significant and unavoidable.

39 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

40 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

1 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 2 **Storage and Handling Plan**

3 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

4 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 5 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed**
 6 **Conservation Measures CM2-CM11**

7 Conservation measures would be the same under Alternative 5 as under Alternative 1A, except that
 8 only 25,000 acres of tidal habitat would be restored. The impacts of Alternative 5 related to subsidence
 9 would, therefore, be similar to those under Alternative 1A, but of a lesser magnitude. Damage to or
 10 failure of the habitat levees could occur where these are constructed in soils and sediments that are
 11 subject to subsidence and differential settlement. These soil conditions have the potential to exist in the
 12 Suisun Marsh ROA. Levee damage or failure could cause surface flooding in the vicinity. See the
 13 discussion of Impact SOILS-8 under Alternative 1A.

14 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
 15 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
 16 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
 17 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
 18 berms, and other features are constructed to withstand subsidence and settlement and to conform to
 19 applicable state and federal standards.

20 With construction of all levees, berms, and other conservation features designed and constructed to
 21 withstand subsidence and settlement and through conformance with applicable state and federal
 22 design standards, this effect would not be adverse.

23 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
 24 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
 25 of the facility. However, because the BDCP proponents would be required to design and construct the
 26 facilities according to state and federal design standards and guidelines (which may involve, for
 27 example, replacement of the organic soil), the impact would be less than significant. No mitigation is
 28 required.

29 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**
 30 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2-**
 31 **CM11**

32 Implementation of the proposed conservation measures under Alternative 5 would be the same as
 33 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,
 34 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the
 35 discussion of Impact SOILS-9 under Alternative 1A.

36 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control
 37 structures or cause them to fail, resulting in a release of water from the structure and consequent
 38 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs
 39 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West
 40 Delta ROA possess soils with high corrosivity to concrete.

1 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne,
2 and South Delta ROAs.

3 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and compressible
4 soils. However, ROA-specific environmental effect evaluations and geotechnical studies and testing
5 would be completed prior to construction within the ROAs. The site-specific environmental evaluation
6 would identify specific areas where engineering soil properties, including soil compressibility, may
7 require special consideration during construction of specific features within ROAs. Conformity with
8 USACE, CBC, and other design standards for construction on expansive, corrosive and/or compressible
9 soils would prevent adverse effects of such soils.

10 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that are
11 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
12 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
13 could damage in-ground facilities or shorten their service life. Compression or settlement of soils after
14 a facility is constructed could result in damage to or failure of the facility. However, because the BDCP
15 proponents would be required to design and construct the facilities according to state and federal
16 design standards, guidelines, and building codes (which may involve, for example, soil lime
17 stabilization, cathodic protection of steel, and soil replacement), this impact would be considered less
18 than significant. No mitigation is required.

19 **10.3.3.11 Alternative 6A—Isolated Conveyance with Pipeline/Tunnel and** 20 **Intakes 1–5 (15,000 cfs; Operational Scenario D)**

21 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances** 22 **as a Result of Constructing the Proposed Water Conveyance Facilities**

23 Alternative 6A would involve physical/structural components similar to Alternative 1A, but existing
24 connections between the SWP and CVP south Delta export facilities would be severed. These
25 connections would be in soils similar to that in Alternative 1A and would not substantially change the
26 project effects related to accelerated erosion. The impacts of Alternative 6A would, therefore, be similar
27 to those of Alternative 1A. See the discussion of Impact SOILS-1 under Alternative 1A.

28 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative 6A
29 could cause substantial accelerated erosion. However, as described in section 10.3.1, *Methods for*
30 *Analysis*, and Appendix 3B, *Environmental Commitments*, DWR would be required to obtain coverage
31 under the General Permit for Construction and Land Disturbance Activities, necessitating the
32 preparation of a SWPPP and an erosion control plan. Proper implementation of the requisite SWPPP
33 and compliance with the General Permit would ensure that there would not be substantial soil erosion
34 resulting in daily site runoff turbidity in excess of 250 NTUs as a result of construction of the proposed
35 water conveyance facility, and therefore, there would not be an adverse effect.

36 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
37 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR
38 would seek coverage under the state General Permit for Construction and Land Disturbance Activities
39 (as discussed in Appendix 3B, *Environmental Commitments*, Commitment 3B.2), necessitating the
40 preparation of a SWPPP and an erosion control plan. As a result of implementation of the requisite
41 SWPPP and compliance with the General Permit, there would not be substantial soil erosion resulting

1 in daily site runoff turbidity in excess of 250 NTUs and the effect would be less than significant. No
2 mitigation is required.

3 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 4 **Constructing the Proposed Water Conveyance Facilities**

5 Alternative 6A would involve physical/structural components similar to Alternative 1A, but existing
6 connections between the SWP and CVP south Delta export facilities would be severed. These
7 connections would involve construction operations similar to those of Alternative 1A and would not
8 substantially change the project effects relating to the loss of topsoil. The impacts of Alternative 6A
9 would, therefore, be similar to those of Alternative 1A. See the discussion of Impact SOILS-2 under
10 Alternative 1A.

11 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., forebays,
12 borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants); overcovering (e.g.,
13 levees and embankments, spoil storage, pumping plants); and water inundation (e.g., forebays,
14 sedimentation basins, and solids lagoons). DWR has made an Environmental Commitment for Disposal
15 Site Preparation which would require that a portion of the temporary sites selected for storage of
16 spoils, RTM, and dredged material will be set aside for topsoil storage and the topsoil would be saved
17 for reapplication to disturbed areas, thereby lessening the effect. However, this effect would be adverse
18 because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b
19 would be available to reduce the severity of this effect.

20 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,
21 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss of
22 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would
23 be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these
24 impacts, but not to a less-than-significant level. Therefore, this impact is considered significant and
25 unavoidable.

26 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

27 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

28 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil** 29 **Storage and Handling Plan**

30 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

31 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage** 32 **from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed** 33 **Water Conveyance Facilities**

34 Alternative 6A would involve physical/structural components similar to Alternative 1A, but existing
35 connections between the SWP and CVP south Delta export facilities would be severed. These
36 connections would be in soils similar to those under Alternative 1A and would not substantially change
37 the project effects relating to subsidence. The impacts of Alternative 6A would, therefore, be similar to
38 those under Alternative 1A. See the discussion of Impact SOILS-3 under Alternative 1A.

39 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on soils
40 that are subject to subsidence. However, as described in section 10.3.1, *Methods for Analysis*, and

1 Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all facilities to
 2 identify the types of soil avoidance or soil stabilization measures that should be implemented to ensure
 3 that the facilities are constructed to withstand subsidence and settlement and to conform to applicable
 4 state and federal standards. These investigations would build upon the geotechnical data reports
 5 (California Department of Water Resources 2001a, 2010b, 2011) and the CERs (California Department
 6 of Water Resources 2010a, 2010b). As discussed under Alternative 1A, conforming with state and
 7 federal design standards, including conduct of site-specific geotechnical evaluations, would ensure that
 8 appropriate design measures are incorporated into the project and any subsidence that takes place
 9 under the project facilities would not jeopardize their integrity.

10 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
 11 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of
 12 the facility. However, because DWR would be required to design and construct the facilities according
 13 to state and federal design standards and guidelines (e.g., California Building Code, American Society of
 14 Civil Engineers Minimum Design Loads for Buildings and Other Structures, ASCE-7-05, 2005).
 15 Conforming with these codes would reduce the potential hazard of subsidence or settlement to
 16 acceptable levels by avoiding construction directly on or otherwise stabilizing the soil material that is
 17 prone to subsidence. Because these measures would reduce the potential hazard of subsidence or
 18 settlement to meet design standards, the impact would be less than significant. No mitigation is
 19 required.

20 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**
 21 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

22 Alternative 6A would involve physical/structural components similar to Alternative 1A, but existing
 23 connections between the SWP and CVP south Delta export facilities would be severed. These
 24 connections would be in soils similar to Alternative 1A and would not substantially change the project
 25 effects related to soil expansion, corrosivity, and compression. The effects of Alternative 6A would,
 26 therefore, be similar to those under Alternative 1A. See the discussion of Impact SOILS-4 under
 27 Alternative 1A.

28 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake
 29 facilities, pumping plants, access roads and utilities, and other features could be adversely affected
 30 because they would be located on expansive, corrosive, and compressible soils. However, all facility
 31 design and construction would be executed in conformance with the CBC, which specifies measures to
 32 mitigate effects of expansive soils, corrosive soils, and soils subject to compression and subsidence. By
 33 conforming with the CBC and other applicable design standards, potential effects associated with
 34 expansive and corrosive soils and soils subject to compression and subsidence would be offset. There
 35 would be no adverse effect.

36 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to
 37 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils
 38 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils could
 39 damage in-ground facilities or shorten their service life. Compression/settlement of soils after a facility
 40 is constructed could result in damage to or failure of the facility. However, because DWR would be
 41 required to design and construct the facilities in conformance with state and federal design standards,
 42 guidelines, and building codes (e.g., CBC and USACE design standards). Conforming with these codes
 43 and standards is an environmental commitment by DWR to ensure that potential adverse effects

1 associated with expansive and corrosive soils and soils subject to compression and subsidence would
2 be offset. Therefore, this impact would be less than significant. No mitigation is required.

3 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 4 **Operations**

5 Alternative 6A would have operations different than those under Alternative 1A. However, operations
6 under Alternative 6A would have a potential effect on accelerated bank erosion similar to that of
7 Alternative 1A. The effects under Alternative 6A would, therefore, be similar to those under Alternative
8 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

9 **NEPA Effects:** The effect of increased channel flow rates on channel bank scour would not be adverse
10 because, as part of the conservation measures, major channels would be dredged to create a larger
11 cross-section that would offset increased tidal velocities. The effect would not be adverse because there
12 would be no net increase in river flow rates and therefore no net increase in channel bank scour.

13 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in channels
14 and sloughs, potentially leading to increases in channel bank scour. However, where such changes are
15 expected to occur (i.e., at the mouths of tidal marsh channels), the project would also entail expansion
16 of the channel cross-section to increase the tidal prism at these locations. The net effect would be to
17 reduce the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no
18 appreciable increase in scour is anticipated. The impact would be less than significant. No mitigation is
19 required.

20 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other** 21 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,** 22 **CM18 and CM19**

23 Implementation of conservation measures under Alternative 6A would be the same as under
24 Alternative 1A. Implementation of the conservation measures would involve ground disturbance and
25 construction activities that could lead to accelerated soil erosion rates and consequent loss of topsoil.
26 See the discussion of Impact SOILS-6 under Alternative 1A.

27 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as
28 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the
29 BDCP proponents would be required to obtain coverage under the General Permit for Construction and
30 Land Disturbance Activities, necessitating preparation of a SWPPP and an erosion control plan. Proper
31 implementation of the requisite SWPPP, site-specific BMPs, and compliance with the General Permit
32 would ensure that accelerated water and wind erosion as a result of implementing conservation
33 measures would not be an adverse effect.

34 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
35 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP
36 proponents would seek coverage under the state General Permit for Construction and Land
37 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such as
38 revegetation, runoff control, and sediment barriers) and compliance with water quality standards. As a
39 result of implementation of Permit conditions, the impact would be less than significant. No mitigation
40 is required.

1 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
 2 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2–**
 3 **CM11**

4 Conservation measures would be the same under Alternative 6A as under Alternative 1A. Topsoil
 5 effectively would be lost as a resource as a result of its excavation, overcovering, and water inundation
 6 over extensive areas of the Plan Area. See the discussion of Impact SOILS-7 under Alternative 1A.

7 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.
 8 Mitigation Measures SOILS-2a and SOILS-2b would be available to reduce the severity of this effect.

9 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,
 10 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby
 11 resulting in a substantial loss of topsoil. The impact would be significant. Mitigation Measures SOILS-2a
 12 and SOILS-2b would minimize and compensate for these impacts to a degree, but not to a less-than-
 13 significant level. Therefore, this impact is considered significant and unavoidable.

14 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

15 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

16 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 17 **Storage and Handling Plan**

18 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

19 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 20 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed**
 21 **Conservation Measures CM2–CM11**

22 Conservation measures would be the same under Alternative 6A as under Alternative 1A. Damage to or
 23 failure of the habitat levees could occur where these are constructed in soils and sediments that are
 24 subject to subsidence and differential settlement. These soil conditions have the potential to exist in the
 25 Suisun Marsh ROA. Levee damage or failure could cause surface flooding in the vicinity. See the
 26 discussion of Impact SOILS-8 under Alternative 1A.

27 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
 28 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
 29 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
 30 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
 31 berms, and other features are constructed to withstand subsidence and settlement and to conform to
 32 applicable state and federal standards.

33 With construction of all levees, berms, and other conservation features designed and constructed to
 34 withstand subsidence and settlement and through conformance with applicable state and federal
 35 design standards, this effect would not be adverse.

36 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
 37 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
 38 of the facility. However, because the BDCP proponents would be required to design and construct the
 39 facilities according to state and federal design standards and guidelines (which may involve, for

1 example, replacement of the organic soil), the impact would be less than significant. No mitigation is
2 required.

3 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,
4 and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2-
5 CM11**

6 Implementation of the proposed conservation measures under Alternative 6A would be the same as
7 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,
8 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the
9 discussion of Impact SOILS-9 under Alternative 1A.

10 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control
11 structures or cause them to fail, resulting in a release of water from the structure and consequent
12 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs
13 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West
14 Delta ROA possess soils with high corrosivity to concrete.

15 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne,
16 and South Delta ROAs.

17 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and compressible
18 soils. However, ROA-specific environmental effect evaluations and geotechnical studies and testing
19 would be completed prior to construction within the ROAs. The site-specific environmental evaluation
20 would identify specific areas where engineering soil properties, including soil compressibility, may
21 require special consideration during construction of specific features within ROAs. Conformity with
22 USACE, CBC, and other design standards for construction on expansive, corrosive and/or compressible
23 soils would prevent adverse effects of such soils.

24 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that are
25 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
26 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
27 could damage in-ground facilities or shorten their service life. Compression or settlement of soils after
28 a facility is constructed could result in damage to or failure of the facility. However, because the BDCP
29 proponents would be required to design and construct the facilities according to state and federal
30 design standards, guidelines, and building codes (which may involve, for example, soil lime
31 stabilization, cathodic protection of steel, and soil replacement), this impact would be considered less
32 than significant. No mitigation is required.

33 **10.3.3.12 Alternative 6B—Isolated Conveyance with East Alignment and
34 Intakes 1–5 (15,000 cfs; Operational Scenario D)**

35 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances
36 as a Result of Constructing the Proposed Water Conveyance Facilities**

37 Alternative 6B would involve physical/structural components similar to Alternative 1B, but existing
38 connections between the SWP and CVP south Delta export facilities would be severed. These
39 connections would be in soils similar to those in Alternative 1B and would not substantially change the
40 project effects relating to accelerated erosion. The impacts of Alternative 6B would, therefore, be
41 similar to those of Alternative 1B. See the discussion of Impact SOILS-1 under Alternative 1B.

1 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative 6B
 2 could cause substantial accelerated erosion. However, as described in section 10.3.1, *Methods for*
 3 *Analysis*, and Appendix 3B, *Environmental Commitments*, DWR would be required to obtain coverage
 4 under the General Permit for Construction and Land Disturbance Activities, necessitating the
 5 preparation of a SWPPP and an erosion control plan. Proper implementation of the requisite SWPPP
 6 and compliance with the General Permit would ensure that there would not be substantial soil erosion
 7 resulting in daily site runoff turbidity in excess of 250 NTUs as a result of construction of the proposed
 8 water conveyance facility, and therefore, there would not be an adverse effect.

9 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 10 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR
 11 would seek coverage under the state General Permit for Construction and Land Disturbance Activities
 12 (as discussed in Appendix 3B, *Environmental Commitments*, Commitment 3B.2), necessitating the
 13 preparation of a SWPPP and an erosion control plan. As a result of implementation of the SWPPP and
 14 compliance with the General Permit, there would not be substantial soil erosion resulting in daily site
 15 runoff turbidity in excess of 250 NTUs and the impact would be a less than significant. No mitigation is
 16 required.

17 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 18 **Constructing the Proposed Water Conveyance Facilities**

19 Alternative 6B would involve physical/structural components similar to Alternative 1B, but existing
 20 connections between the SWP and CVP south Delta export facilities would be severed. These
 21 connections would involve construction operations similar to those under Alternative 1B and would
 22 not substantially change the project effects relating to the loss of topsoil. The impacts of Alternative 6B
 23 would, therefore, be similar to those under Alternative 1B. See the discussion of Impact SOILS-2 under
 24 Alternative 1B.

25 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., canal
 26 alignment, borrow areas, levee foundations, intake facilities, pumping plants); overcovering (e.g., levees
 27 and embankments, spoil storage, pumping plants); and water inundation (e.g., forebay, sedimentation
 28 basins, and solids lagoons). DWR has made an Environmental Commitment for Disposal Site
 29 Preparation which would require that a portion of the temporary sites selected for storage of spoils,
 30 RTM, and dredged material will be set aside for topsoil storage and the topsoil would be saved for
 31 reapplication to disturbed areas, thereby lessening the effect. However, this effect would be adverse
 32 because it would result in substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would
 33 be available to reduce the severity of this effect.

34 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,
 35 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss of
 36 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would
 37 be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these
 38 impacts, but not to a less-than-significant level. Therefore, this impact is considered significant and
 39 unavoidable.

40 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

41 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

1 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 2 **Storage and Handling Plan**

3 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

4 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 5 **from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed**
 6 **Water Conveyance Facilities**

7 Alternative 6B would involve physical/structural components similar to Alternative 1B, but existing
 8 connections between the SWP and CVP south Delta export facilities would be severed. These
 9 connections would be in soils similar to those under Alternative 1B and would not substantially change
 10 the project effects relating to subsidence. The impacts of Alternative 6B would, therefore, be similar to
 11 those under Alternative 1B. See the discussion of Impact SOILS-3 under Alternative 1B.

12 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
 13 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
 14 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
 15 facilities to identify the types of soil avoidance or soil stabilization measures that should be
 16 implemented to ensure that the facilities are constructed to withstand subsidence and settlement and
 17 to conform to applicable state and federal standards. These investigations would build upon the
 18 geotechnical data reports (California Department of Water Resources 2001a, 2010b, 2011) and the
 19 CERs (California Department of Water Resources 2009a, 2010c). As discussed under Alternative 1B,
 20 conforming with state and federal design standards, including conduct of site-specific geotechnical
 21 evaluations, would ensure that appropriate design measures are incorporated into the project and any
 22 subsidence that takes place under the project facilities would not jeopardize their integrity.

23 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
 24 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of
 25 the facility. However, because DWR would be required to design and construct the facilities according
 26 to state and federal design standards and guidelines (e.g., California Building Code, American Society of
 27 Civil Engineers Minimum Design Loads for Buildings and Other Structures, ASCE-7-05, 2005).
 28 Conforming with these codes would reduce the potential hazard of subsidence or settlement to
 29 acceptable levels by avoiding construction directly on or otherwise stabilizing the soil material that is
 30 prone to subsidence. Because these measures would reduce the potential hazard of subsidence or
 31 settlement to meet design standards, the impact would be less than significant. No mitigation is
 32 required.

33 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**
 34 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

35 Alternative 6B would involve physical/structural components similar to Alternative 1B, but existing
 36 connections between the SWP and CVP south Delta export facilities would be severed. These
 37 connections would be in soils similar to Alternative 1B and would not substantially change the project
 38 effects relating to soil expansion, corrosivity, and compression. The effects under Alternative 6B would,
 39 therefore, be similar to those under Alternative 1B. See discussion of Impact SOILS-4 under Alternative
 40 1B.

41 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake
 42 facilities, pumping plants, access roads and utilities, and other features could be adversely affected

1 because they would be located on expansive, corrosive, and compressible soils. However, all facility
2 design and construction would be executed in conformance with the CBC, which specifies measures to
3 mitigate effects of expansive soils, corrosive soils, and soils subject to compression and subsidence. By
4 conforming with the CBC and other applicable design standards, potential effects associated with
5 expansive and corrosive soils and soils subject to compression and subsidence would be offset. There
6 would be no adverse effect.

7 **CEQA Conclusion:** Many of the Alternative 6B facilities would be constructed on soils that are subject to
8 expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive soils could
9 cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils could damage
10 in-ground facilities or shorten their service life. Compression/settlement of soils after a facility is
11 constructed could result in damage to or failure of the facility. However, because DWR would be
12 required to design and construct the facilities in conformance with state and federal design standards,
13 guidelines, and building codes (e.g., CBC and USACE design standards). Conforming with these codes
14 and standards is an environmental commitment by DWR to ensure that potential adverse effects
15 associated with expansive and corrosive soils and soils subject to compression and subsidence would
16 be offset. Therefore, the impact would be less than significant. No mitigation is required.

17 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 18 **Operations**

19 Alternative 6B would have operations that are different than that of Alternative 1A. However,
20 operations under Alternative 6B would have a potential effect on accelerated bank erosion similar to
21 Alternative 1A. The effects of Alternative 6B would, therefore, be similar to those under Alternative 1A.
22 See the discussion of Impact SOILS-5 under Alternative 1A.

23 **NEPA Effects:** The effect of increased channel flow rates on channel bank scour would not be adverse
24 because as part of the conservation measures, major channels would be dredged to create a larger
25 cross-section that would offset increased tidal velocities. The effect would not be adverse because there
26 would be no net increase in river flow rates and accordingly, no net increase in channel bank scour.

27 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in channels
28 and sloughs, potentially leading to increases in channel bank scour. However, where such changes are
29 expected to occur (i.e., at the mouths of tidal marsh channels), the project would also entail expansion
30 of the channel cross-section to increase the tidal prism at these locations. The net effect would be to
31 reduce the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no
32 appreciable increase in scour is anticipated. The impact would be less than significant. No mitigation is
33 required.

34 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other** 35 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,** 36 **CM18 and CM19**

37 Implementation of conservation measures under Alternative 6B would be the same as under
38 Alternative 1A. Implementation of the conservation measures would involve ground disturbance and
39 construction activities that could lead to accelerated soil erosion rates and consequent loss of topsoil.
40 See the discussion of Impact SOILS-6 under Alternative 1A.

41 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as
42 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the

1 BDCP proponents would be required to obtain coverage under the General Permit for Construction and
 2 Land Disturbance Activities, necessitating preparation of a SWPPP and an erosion control plan. Proper
 3 implementation of the requisite SWPPP, site-specific BMPs, and compliance with the General Permit
 4 would ensure that accelerated water and wind erosion associated with construction of the
 5 conservation measures would not be an adverse effect.

6 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 7 restoration areas could cause accelerated water and wind erosion of soil. However, the BDCP
 8 proponents would seek coverage under the state General Permit for Construction and Land
 9 Disturbance Activities. Permit conditions would include erosion and sediment control BMPs (such as
 10 revegetation, runoff control, and sediment barriers) and compliance with water quality standards. As a
 11 result of implementation of Permit conditions, the impact would be less than significant. No mitigation
 12 is required.

13 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
 14 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2-**
 15 **CM11**

16 Implementation of the conservation measures would be the same under Alternative 6B as under
 17 Alternative 1A. Consequently, topsoil loss associated with excavation, overcovering, and water
 18 inundation over extensive areas of the Plan Area would also be the same as under Alternative 1A. See
 19 the discussion of Impact SOILS-7 under Alternative 1A.

20 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.
 21 Mitigation Measures SOILS-2a and SOILS-2b would be available to reduce the severity of this effect.

22 **CEQA Conclusion:** Construction of the restoration areas would involve excavation, overcovering, and
 23 inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby resulting in a
 24 substantial loss of topsoil. The impact would be significant. Mitigation Measures SOILS-2a and SOILS-2b
 25 would minimize and compensate for these impacts, but not to a less-than-significant level. Therefore,
 26 this impact is considered significant and unavoidable.

27 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

28 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

29 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 30 **Storage and Handling Plan**

31 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

32 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 33 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed**
 34 **Conservation Measures CM2-CM11**

35 Conservation measures would be the same under Alternative 6B as under Alternative 1A. See
 36 description and findings under Alternative 1A. Similarly, damage to or failure of the habitat levees
 37 could occur where these are constructed in soils and sediments that are subject to subsidence and
 38 differential settlement would also be the same as Alternative 1A. Levee damage or failure could cause
 39 surface flooding in the vicinity. See the discussion of Impact SOILS-8 under Alternative 1A.

1 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
2 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
3 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
4 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
5 berms, and other features are constructed to withstand subsidence and settlement and to conform to
6 applicable state and federal standards.

7 With construction of all levees, berms, and other conservation features designed and constructed to
8 withstand subsidence and settlement and through conformance with applicable state and federal
9 design standards, this effect would not be adverse.

10 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
11 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
12 of the facility. However, because the BDCP proponents would be required to design and construct the
13 facilities according to state and federal design standards and guidelines (which may involve, for
14 example, replacement of the organic soil), the impact would be less than significant. No mitigation is
15 required.

16 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**
17 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2-**
18 **CM11**

19 Implementation of the proposed conservation measures under Alternative 6B would be the same as
20 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,
21 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the
22 discussion of Impact SOILS-9 under Alternative 1A.

23 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control
24 structures or cause them to fail, resulting in a release of water from the structure and consequent
25 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs
26 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West
27 Delta ROA possess soils with high corrosivity to concrete.

28 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne,
29 and South Delta ROAs.

30 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and compressible
31 soils. However, ROA-specific environmental effect evaluations and geotechnical studies and testing
32 would be completed prior to construction within the ROAs. The site-specific environmental evaluation
33 would identify specific areas where engineering soil properties, including soil compressibility, may
34 require special consideration during construction of specific features within ROAs. Conformity with
35 USACE, CBC, and other design standards for construction on expansive, corrosive and/or compressible
36 soils would prevent adverse effects of such soils.

37 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that are
38 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
39 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
40 could damage in-ground facilities or shorten their service life. Compression or settlement of soils after
41 a facility is constructed could result in damage to or failure of the facility. However, because the BDCP
42 proponents would be required to design and construct the facilities according to state and federal

1 design standards, guidelines, and building codes (which may involve, for example, soil lime
 2 stabilization, cathodic protection of steel, and soil replacement), this impact would be considered less
 3 than significant. No mitigation is required.

4 **10.3.3.13 Alternative 6C—Isolated Conveyance with West Alignment and** 5 **Intakes W1–W5 (15,000 cfs; Operational Scenario D)**

6 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances** 7 **as a Result of Constructing the Proposed Water Conveyance Facilities**

8 Alternative 6C would involve physical/structural components similar to Alternative 1C, but existing
 9 connections between the SWP and CVP south Delta export facilities would be severed. These
 10 connections would be in soils similar to those in Alternative 1C and would not substantially change the
 11 project effects relating to accelerated erosion. The impacts of Alternative 6C would, therefore, be
 12 similar to those of Alternative 1C. See the discussion of Impact SOILS-1 under Alternative 1C.

13 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative 6C
 14 could cause substantial accelerated erosion. However, as described in section 10.3.1, *Methods for*
 15 *Analysis*, and Appendix 3B, *Environmental Commitments*, DWR would be required to obtain coverage
 16 under the General Permit for Construction and Land Disturbance Activities, necessitating the
 17 preparation of a SWPPP and an erosion control plan. Proper implementation of the requisite SWPPP
 18 and compliance with the General Permit would ensure that there would not be substantial soil erosion
 19 resulting in daily site runoff turbidity in excess of 250 NTUs as a result of construction of the proposed
 20 water conveyance facility, and therefore, there would not be an adverse effect.

21 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 22 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR
 23 would seek coverage under the state General Permit for Construction and Land Disturbance Activities
 24 (as discussed in Appendix 3B, *Environmental Commitments*, Commitment 3B.2), necessitating the
 25 preparation of a SWPPP and an erosion control plan. Because of implementation of the requisite
 26 SWPPP and compliance with the General Permit, there would not be substantial soil erosion resulting
 27 in daily site runoff turbidity in excess of 250 NTUs and the effect would be less than significant. No
 28 mitigation is required.

29 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 30 **Constructing the Proposed Water Conveyance Facilities**

31 Alternative 6C would involve physical/structural components similar to Alternative 1C, but existing
 32 connections between the SWP and CVP south Delta export facilities would be severed. These
 33 connections would involve construction operations similar to those under Alternative 1C and would
 34 not substantially change the project effects relating to the loss of topsoil. The impacts of Alternative 6C
 35 would, therefore, be similar to those under Alternative 1C. See the discussion of Impact SOILS-2 under
 36 Alternative 1C.

37 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., forebays,
 38 borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants); overcovering (e.g.,
 39 levees and embankments, spoil storage, pumping plants); and water inundation (e.g., forebays,
 40 sedimentation basins, and solids lagoons). DWR has made an Environmental Commitment for Disposal
 41 Site Preparation which would require that a portion of the temporary sites selected for storage of
 42 spoils, RTM, and dredged material will be set aside for topsoil storage and the topsoil would be saved

1 for reapplication to disturbed areas, thereby lessening the effect. However, this effect would be adverse
 2 because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b
 3 would be available to reduce the severity of this effect.

4 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,
 5 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss of
 6 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would
 7 be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these
 8 impacts, but not to a less than significant level. Therefore, this impact is considered significant and
 9 unavoidable.

10 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

11 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

12 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 13 **Storage and Handling Plan**

14 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

15 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 16 **from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed**
 17 **Water Conveyance Facilities**

18 Alternative 6C would involve physical/structural components similar to Alternative 1C, but existing
 19 connections between the SWP and CVP south Delta export facilities would be severed. These
 20 connections would be in soils similar to those under Alternative 1C and would not substantially change
 21 the project effects relating to subsidence. The impacts of Alternative 6C would, therefore, be similar to
 22 those under Alternative 1C. See the discussion of Impact SOILS-3 under Alternative 1C.

23 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
 24 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
 25 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
 26 facilities to identify the types of soil stabilization that should be implemented to ensure that the
 27 facilities are constructed to withstand subsidence and settlement and to conform to applicable state
 28 and federal standards. As discussed under Alternative 1C, conforming with state and federal design
 29 standards, including conduct of site-specific geotechnical evaluations, would ensure that appropriate
 30 design measures are incorporated into the project and any subsidence that takes place under the
 31 project facilities would not jeopardize their integrity.

32 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
 33 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of
 34 the facility. However, because DWR would be required to design and construct the facilities according
 35 to state and federal design standards and guidelines (e.g., California Building Code, American Society of
 36 Civil Engineers Minimum Design Loads for Buildings and Other Structures, ASCE-7-05, 2005).
 37 Conforming with these codes would reduce the potential hazard of subsidence or settlement to
 38 acceptable levels by avoiding construction directly on or otherwise stabilizing the soil material that is
 39 prone to subsidence. Because these measures would reduce the potential hazard of subsidence or
 40 settlement to meet design standards, the impact would be less than significant. No mitigation is
 41 required.

1 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**
2 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

3 Alternative 6C would involve physical/structural components similar to Alternative 1C, but existing
4 connections between the SWP and CVP south Delta export facilities would be severed. These
5 connections would be in soils similar to Alternative 1C and would not substantially change the project
6 effects related to soil expansion, corrosivity, and compression. The effects under Alternative 6C would,
7 therefore, be similar to those under Alternative 1C. See the discussion of Impact SOILS-4 under
8 Alternative 1C.

9 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake
10 facilities, pumping plants, access roads and utilities, and other features could be adversely affected
11 because they would be located on expansive, corrosive, and compressible soils. However, all facility
12 design and construction would be executed in conformance with the CBC, which specifies measures to
13 mitigate effects of expansive soils, corrosive soils, and soils subject to compression and subsidence. By
14 conforming with the CBC and other applicable design standards, potential effects associated with
15 expansive and corrosive soils and soils subject to compression and subsidence would be offset. There
16 would be no adverse effect.

17 **CEQA Conclusion:** Many of the Alternative 6C facilities would be constructed on soils that are subject to
18 expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive soils could
19 cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils could damage
20 in-ground facilities or shorten their service life. Compression or settlement of soils after a facility is
21 constructed could result in damage to or failure of the facility. However, because DWR would be
22 required to design and construct the facilities in conformance with state and federal design standards,
23 guidelines, and building codes (e.g., CBC and USACE design standards). Conforming with these codes
24 and standards is an environmental commitment by DWR to ensure that potential adverse effects
25 associated with expansive and corrosive soils and soils subject to compression and subsidence would
26 be offset. Therefore, the impact would be less than significant. No mitigation is required.

27 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**
28 **Operations**

29 Alternative 6C would have operations that are different from those under Alternative 1A. However,
30 operations under Alternative 6C would have a potential effect on accelerated bank erosion similar to
31 Alternative 1A. The effects of Alternative 6C would, therefore, be similar to those under Alternative 1A.
32 See the discussion of Impact SOILS-5 under Alternative 1A.

33 **NEPA Effects:** The effect of increased channel flow rates on channel bank scour would not be adverse
34 because, as part of the conservation measures, major channels would be dredged to create a larger
35 cross-section that would offset increased tidal velocities. The effect would not be adverse because there
36 would be no net increase in river flow rates and therefore no net increase in channel bank scour.

37 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in channels
38 and sloughs, potentially leading to increases in channel bank scour. However, where such changes are
39 expected to occur (i.e., at the mouths of tidal marsh channels), the project would also entail expansion
40 of the channel cross-section to increase the tidal prism at these locations. The net effect would be to
41 reduce the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no
42 appreciable increase in scour is anticipated. The impact would be less than significant. No mitigation is
43 required.

1 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**
 2 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,**
 3 **CM18 and CM19**

4 Implementation of conservation measures under Alternative 6C would be the same as under
 5 Alternative 1A. Implementation of the conservation activities would involve ground disturbance and
 6 construction activities that could lead to accelerated soil erosion rates and consequent loss of topsoil.
 7 See the discussion of Impact SOILS-6 under Alternative 1A.

8 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as
 9 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the
 10 BDCP proponents would be required to obtain coverage under the General Permit for Construction and
 11 Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan.
 12 Proper implementation of the requisite SWPPP, site-specific BMPs, and compliance with the General
 13 Permit would ensure that accelerated water and wind erosion as a result of implementing conservation
 14 measures would not be an adverse effect.

15 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 16 conservation measures could cause accelerated water and wind erosion of soil. However, because the
 17 BDCP proponents would seek coverage under the state General Permit for Construction and Land
 18 Disturbance Activities, which will require implementation of erosion and sediment control BMPs (such
 19 as revegetation, runoff control, and sediment barriers) and compliance with water quality standards,
 20 the impact would be less than significant. No mitigation is required.

21 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
 22 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2–**
 23 **CM11**

24 Conservation measures would be the same under Alternative 6C as under Alternative 1A. Topsoil
 25 effectively would be lost as a resource as a result of its excavation, overcovering, and water inundation
 26 over extensive areas of the Plan Area. See the discussion of Impact SOILS-7 under Alternative 1A.

27 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.
 28 Mitigation Measures SOILS-2a and SOILS-2b would be available to reduce the severity of this effect.

29 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,
 30 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby
 31 resulting in a substantial loss of topsoil. The impact would be significant. Mitigation Measures SOILS-2a
 32 and SOILS-2b would minimize and compensate for these impacts to a degree, but not to a less-than-
 33 significant level. Therefore, this impact is considered significant and unavoidable.

34 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

35 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

36 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 37 **Storage and Handling Plan**

38 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

1 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 2 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed**
 3 **Conservation Measures CM2-CM11**

4 Conservation measures would be the same under Alternative 6C as under Alternative 1A. Damage to or
 5 failure of the habitat levees could occur where these are constructed in soils and sediments that are
 6 subject to subsidence and differential settlement. These soil conditions have the potential to exist in the
 7 Suisun Marsh ROA. Levee damage or failure could cause surface flooding in the vicinity. See the
 8 discussion of Impact SOILS-8 under Alternative 1A.

9 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
 10 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
 11 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
 12 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
 13 berms, and other features are constructed to withstand subsidence and settlement and to conform to
 14 applicable state and federal standards.

15 With construction of all levees, berms, and other conservation features designed and constructed to
 16 withstand subsidence and settlement and through conformance with applicable state and federal
 17 design standards, this effect would not be adverse.

18 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
 19 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
 20 of the facility. However, because the BDCP proponents would be required to design and construct the
 21 facilities according to state and federal design standards and guidelines (which may involve, for
 22 example, replacement of the organic soil), the impact would be less than significant. No mitigation is
 23 required.

24 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**
 25 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2-**
 26 **CM11**

27 Implementation of the proposed conservation measures under Alternative 6C would be the same as
 28 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,
 29 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the
 30 discussion of Impact SOILS-9 under Alternative 1A.

31 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control
 32 structures or cause them to fail, resulting in a release of water from the structure and consequent
 33 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs
 34 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West
 35 Delta ROA possess soils with high corrosivity to concrete.

36 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne,
 37 and South Delta ROAs.

38 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and compressible
 39 soils. However, ROA-specific environmental effect evaluations and geotechnical studies and testing
 40 would be completed prior to construction within the ROAs. The site-specific environmental evaluation
 41 would identify specific areas where engineering soil properties, including soil compressibility, may
 42 require special consideration during construction of specific features within ROAs. Conformity with

1 USACE, CBC, and other design standards for construction on expansive, corrosive and/or compressible
2 soils would prevent adverse effects of such soils.

3 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that are
4 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
5 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
6 could damage in-ground facilities or shorten their service life. Compression or settlement of soils after
7 a facility is constructed could result in damage to or failure of the facility. However, because the BDCP
8 proponents would be required to design and construct the facilities according to state and federal
9 design standards, guidelines, and building codes (which may involve, for example, soil lime
10 stabilization, cathodic protection of steel, and soil replacement), this impact would be considered less
11 than significant. No mitigation is required.

12 **10.3.3.14 Alternative 7—Dual Conveyance with Pipeline/Tunnel, Intakes 2, 3, 13 and 5, and Enhanced Aquatic Conservation (9,000 cfs; Operational 14 Scenario E)**

15 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances 16 as a Result of Constructing the Proposed Water Conveyance Facilities**

17 Alternative 7 would include the same physical/structural components as Alternative 1A, except that it
18 would entail two fewer intakes and two fewer pumping plants. These differences would result in
19 slightly less accelerated erosion effects on soils than under Alternative 1A. The effects of Alternative 7
20 would, however, be similar to those of Alternative 1A. See the discussion of Impact SOILS-1 under
21 Alternative 1A.

22 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative 7
23 could cause substantial accelerated erosion. However, as described in section 10.3.1, *Methods for*
24 *Analysis*, and Appendix 3B, *Environmental Commitments*, DWR would be required to obtain coverage
25 under the General Permit for Construction and Land Disturbance Activities, necessitating the
26 preparation of a SWPPP and an erosion control plan. Proper implementation of the requisite SWPPP
27 and compliance with the General Permit would ensure that there would not be substantial soil erosion
28 resulting in daily site runoff turbidity in excess of 250 NTUs as a result of construction of the proposed
29 water conveyance facility, and therefore, there would not be an adverse effect.

30 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
31 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR
32 would seek coverage under the state General Permit for Construction and Land Disturbance Activities
33 (as discussed in Appendix 3B, *Environmental Commitments*, Commitment 3B.2), necessitating
34 preparation of a SWPPP and an erosion control plan. Because of implementation of the requisite
35 SWPPP and compliance with the General Permit, there would not be substantial soil erosion resulting
36 in daily site runoff turbidity in excess of 250 NTUs, the effect would be less than significant. No
37 mitigation is required.

38 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of 39 Constructing the Proposed Water Conveyance Facilities**

40 Alternative 7 would include the same physical/structural components as Alternative 1A, except that it
41 would entail two fewer intakes and two fewer pumping plants. These differences would result in

1 slightly less effects on topsoil loss than Alternative 1A. The impacts of Alternative 7 would, however, be
2 similar to those of Alternative 1A. See the discussion of Impact SOILS-2 under Alternative 1A.

3 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., forebays,
4 borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants); overcovering (e.g.,
5 levees and embankments, spoil storage, pumping plants); and water inundation (e.g., forebays,
6 sedimentation basins, and solids lagoons). DWR has made an Environmental Commitment for Disposal
7 Site Preparation which would require that a portion of the temporary sites selected for storage of
8 spoils, RTM, and dredged material will be set aside for topsoil storage and the topsoil would be saved
9 for reapplication to disturbed areas, thereby lessening the effect. However, this effect would be adverse
10 because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b
11 would be available to reduce the severity of this effect.

12 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,
13 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss of
14 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would
15 be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these
16 impacts, but not to a less-than-significant level. Therefore, this impact is considered significant and
17 unavoidable.

18 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

19 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

20 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil 21 Storage and Handling Plan**

22 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

23 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage 24 from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed 25 Water Conveyance Facilities**

26 Alternative 7 would include the same physical/structural components as Alternative 1A, except that it
27 would entail two fewer intakes and two fewer pumping plants. These differences would result in
28 slightly less effects related to subsidence than under Alternative 1A. The impacts of Alternative 7
29 would, however, be similar to those under Alternative 1A. See the discussion of Impact SOILS-3 under
30 Alternative 1A.

31 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
32 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
33 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
34 facilities to identify the types of soil avoidance or soil stabilization measures that should be
35 implemented to ensure that the facilities are constructed to withstand subsidence and settlement and
36 to conform to applicable state and federal standards. These investigations would build upon the
37 geotechnical data reports (California Department of Water Resources 2001a, 2010b, 2011) and the
38 CERs (California Department of Water Resources 2010a, 2010b). As discussed under Alternative 1A,
39 conforming with state and federal design standards, including conduct of site-specific geotechnical
40 evaluations, would ensure that appropriate design measures are incorporated into the project and any
41 subsidence that takes place under the project facilities would not jeopardize their integrity.

1 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
 2 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of
 3 the facility. However, DWR would be required to design and construct the facilities according to state
 4 and federal design standards and guidelines (e.g., California Building Code, American Society of Civil
 5 Engineers Minimum Design Loads for Buildings and Other Structures, ASCE-7-05, 2005). Conforming
 6 with these codes would reduce the potential hazard of subsidence or settlement to acceptable levels by
 7 avoiding construction directly on or otherwise stabilizing the soil material that is prone to subsidence.
 8 Because these measures would reduce the potential hazard of subsidence or settlement to meet design
 9 standards, the impact would be less than significant. No mitigation is required.

10 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**
 11 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

12 Alternative 7 would include the same physical/structural components as Alternative 1A, except that it
 13 would entail two fewer intakes and two fewer pumping plants. These differences would result in
 14 slightly less effects related to expansive, corrosive, and compressible soils than under Alternative 1A.
 15 The effects of Alternative 7 would, however, be similar to those under Alternative 1A. See the
 16 discussion of SOILS-4 under Alternative 1A.

17 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake
 18 facilities, pumping plants, access roads and utilities, and other features could be adversely affected
 19 because they would be located on expansive, corrosive, and compressible soils. However, all facility
 20 design and construction would be executed in conformance with the CBC, which specifies measures to
 21 mitigate effects of expansive soils, corrosive soils, and soils subject to compression and subsidence. By
 22 conforming with the CBC and other applicable design standards, potential effects associated with
 23 expansive and corrosive soils and soils subject to compression and subsidence would be offset. There
 24 would be no adverse effect.

25 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to
 26 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils
 27 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils could
 28 damage in-ground facilities or shorten their service life. Compression/settlement of soils after a facility
 29 is constructed could result in damage to or failure of the facility. However, because DWR would be
 30 required to design and construct the facilities in conformance with state and federal design standards,
 31 guidelines, and building codes (e.g., CBC and USACE design standards). Conforming with these codes
 32 and standards is an environmental commitment by DWR to ensure that potential adverse effects
 33 associated with expansive and corrosive soils and soils subject to compression and subsidence would
 34 be offset. Therefore, this impact would be less than significant. No mitigation is required.

35 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of**
 36 **Operations**

37 Alternative 7 would have operations similar to those under Alternative 1A, but of a lesser magnitude
 38 with respect to potential effects on accelerated bank erosion because the flow from the north Delta
 39 would be 9,000 cfs rather than 15,000 cfs. The effects of Alternative 7 would, however, be similar to
 40 those under Alternative 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

41 **NEPA Effects:** The effect of increased channel flow rates on channel bank scour would not be adverse
 42 because, as part of the conservation measures, major channels would be dredged to create a larger

1 cross-section that would offset increased tidal velocities. The effect would not be adverse because there
2 would be no net increase in river flow rates and therefore no net increase in channel bank scour.

3 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in channels
4 and sloughs, potentially leading to increases in channel bank scour. However, where such changes are
5 expected to occur (i.e., at the mouths of tidal marsh channels), the project would also entail expansion
6 of the channel cross-section to increase the tidal prism at these locations. The net effect would be to
7 reduce the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no
8 appreciable increase in scour is anticipated. The impact would be less than significant. No mitigation is
9 required.

10 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**
11 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,**
12 **CM18 and CM19**

13 Implementation of conservation measures under Alternative 7 would be the same as those under
14 Alternative 1A, with the additional restoration of 20 linear miles of channel margin habitat and 10,000
15 acres of seasonally inundated floodplain habitat. The effects under Alternative 7 would, therefore, be
16 similar to those under Alternative 1A but of a greater magnitude. See discussion of Impact SOILS-6
17 under Alternative 1A.

18 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as
19 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the
20 BDCP proponents would be required to obtain coverage under the General Permit for Construction and
21 Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan.
22 These requirements would apply to the additional 20 linear miles of channel margin habitat and
23 additional 10,000 acres of seasonally inundated floodplain habitat under Alternative 7. Proper
24 implementation of the requisite SWPPP, site-specific BMPs, and compliance with the General Permit
25 would ensure that accelerated water and wind erosion as a result of implementing conservation
26 measures would not be an adverse effect.

27 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
28 restoration areas could cause accelerated water and wind erosion of soil. However, because the BDCP
29 proponents would seek coverage under the state General Permit for Construction and Land
30 Disturbance Activities, which will require implementation of erosion and sediment control BMPs (such
31 as revegetation, runoff control, and sediment barriers) and compliance with water quality standards,
32 the impact would be less than significant. No mitigation is required.

33 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
34 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2–**
35 **CM11**

36 Conservation measures under Alternative 7 would be the same as those under Alternative 1A, with the
37 additional restoration of 20 linear miles of channel margin habitat and 10,000 acres of seasonally
38 inundated floodplain habitat. The effects under Alternative 7 would, therefore, be similar to those
39 under Alternative 1A but of a greater magnitude. See discussion of Impact SOILS-7 under Alternative
40 1A.

41 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.
42 Mitigation Measures SOILS-2a and SOILS-2b would be available to reduce the severity of this effect.

1 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,
 2 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby
 3 resulting in a substantial loss of topsoil. The impact would be significant. Mitigation Measures SOILS-2a
 4 and SOILS-2b would minimize and compensate for these impacts to a degree, but not to a less-than-
 5 significant level. Therefore, this impact is considered significant and unavoidable.

6 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

7 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

8 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 9 **Storage and Handling Plan**

10 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

11 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 12 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed**
 13 **Conservation Measures CM2–CM11**

14 Conservation measures under Alternative 7 would be the same as those under Alternative 1A, except
 15 that an additional 20 linear miles of channel margin habitat and an additional 10,000 acres of
 16 seasonally inundated floodplain habitat would be restored. Under Alternative 7, the additional 10,000
 17 acres of seasonally inundated floodplain habitat could lessen the rate of subsidence in the restored
 18 areas, assuming that the restoration areas are subject to subsidence. Therefore, there could be a
 19 beneficial effect on soils in these areas. Otherwise, Alternative 7 would be similar to those under
 20 Alternative 1A. Damage to or failure of the habitat levees could occur where these are constructed in
 21 soils and sediments that are subject to subsidence and differential settlement. These soil conditions
 22 have the potential to exist in the Suisun Marsh ROA. Levee damage or failure could cause surface
 23 flooding in the vicinity. See the discussion of Impact SOILS-8 under Alternative 1A.

24 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
 25 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
 26 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
 27 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
 28 berms, and other features are constructed to withstand subsidence and settlement and to conform to
 29 applicable state and federal standards.

30 With construction of all levees, berms, and other conservation features designed and constructed to
 31 withstand subsidence and settlement and through conformance with applicable state and federal
 32 design standards, this effect would not be adverse.

33 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
 34 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
 35 of the facility. However, because the BDCP proponents would be required to design and construct the
 36 facilities according to state and federal design standards and guidelines (which may involve, for
 37 example, replacement of the organic soil), the impact would be less than significant. Under this
 38 alternative, the additional 10,000 acres of seasonally inundated floodplain habitat could lessen the rate
 39 of subsidence in the restored areas, assuming that the restoration areas are subject to subsidence. This
 40 could be a beneficial impact on soils in these areas. No mitigation is required.

1 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**
 2 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2–**
 3 **CM11**

4 Implementation of the proposed conservation measures under Alternative 7 would be the same as
 5 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,
 6 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the
 7 discussion of Impact SOILS-9 under Alternative 1A.

8 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control
 9 structures or cause them to fail, resulting in a release of water from the structure and consequent
 10 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs
 11 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West
 12 Delta ROA possess soils with high corrosivity to concrete.

13 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne,
 14 and South Delta ROAs.

15 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and compressible
 16 soils. However, ROA-specific environmental effect evaluations and geotechnical studies and testing
 17 would be completed prior to construction within the ROAs. The site-specific environmental evaluation
 18 would identify specific areas where engineering soil properties, including soil compressibility, may
 19 require special consideration during construction of specific features within ROAs. Conformity with
 20 USACE, CBC, and other design standards for construction on expansive, corrosive and/or compressible
 21 soils would prevent adverse effects of such soils.

22 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that are
 23 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
 24 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
 25 could damage in-ground facilities or shorten their service life. Compression or settlement of soils after
 26 a facility is constructed could result in damage to or failure of the facility. However, because the BDCP
 27 proponents would be required to design and construct the facilities according to state and federal
 28 design standards, guidelines, and building codes (which may involve, for example, soil lime
 29 stabilization, cathodic protection of steel, and soil replacement), this impact would be considered less
 30 than significant. No mitigation is required.

31 **10.3.3.15 Alternative 8—Dual Conveyance with Pipeline/Tunnel, Intakes 2, 3,**
 32 **and 5 and Increased Delta Outflow (9,000 cfs; Operational Scenario**
 33 **F)**

34 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances**
 35 **as a Result of Constructing the Proposed Water Conveyance Facilities**

36 Alternative 8 would include the same physical/structural components as Alternative 1A, except that it
 37 would entail two fewer intakes and two fewer pumping plants. These differences would result in
 38 slightly less accelerated erosion effects than under Alternative 1A. The effects of Alternative 8 would,
 39 however, be similar to those of Alternative 1A. See the discussion of Impact SOILS-1 under Alternative
 40 1A.

1 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative 8
 2 could cause substantial accelerated erosion. However, as described in section 10.3.1, *Methods for*
 3 *Analysis*, and Appendix 3B, *Environmental Commitments*, DWR would be required to obtain coverage
 4 under the General Permit for Construction and Land Disturbance Activities, necessitating the
 5 preparation of a SWPPP and an erosion control plan. Proper implementation of the requisite SWPPP
 6 and compliance with the General Permit would ensure that there would not be substantial soil erosion
 7 resulting in daily site runoff turbidity in excess of 250 NTUs as a result of construction of the proposed
 8 water conveyance facility, therefore, there would not be an adverse effect.

9 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 10 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR
 11 would seek coverage under the state General Permit for Construction and Land Disturbance Activities
 12 (as discussed in Appendix 3B, *Environmental Commitments*, Commitment 3B.2), necessitating
 13 preparation of a SWPPP and an erosion control plan. Because of implementation of the requisite
 14 SWPPP and compliance with the General Permit, there would not be substantial soil erosion resulting
 15 in daily site runoff turbidity in excess of 250 NTUs and the effect would be less than significant. No
 16 mitigation is required.

17 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of** 18 **Constructing the Proposed Water Conveyance Facilities**

19 Alternative 8 would include the same physical/structural components as Alternative 1A, except that it
 20 would entail two fewer intakes and two fewer pumping plants. These differences would result in
 21 slightly less effects on topsoil loss than Alternative 1A. The effects of Alternative 8 would, however, be
 22 similar to those of Alternative 1A. See the discussion of Impact SOILS-2 under Alternative 1A.

23 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., forebays,
 24 borrow areas, tunnel shafts, levee foundations, intake facilities, pumping plants); overcovering (e.g.,
 25 levees and embankments, spoil storage, pumping plants); and water inundation (e.g., forebays,
 26 sedimentation basins, and solids lagoons). DWR has made an Environmental Commitment for Disposal
 27 Site Preparation which would require that a portion of the temporary sites selected for storage of
 28 spoils, RTM, and dredged material will be set aside for topsoil storage and the topsoil would be saved
 29 for reapplication to disturbed areas, thereby lessening the effect. However, this effect would be adverse
 30 because it would result in a substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b
 31 would be available to reduce the severity of this effect.

32 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,
 33 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss of
 34 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would
 35 be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these
 36 impacts, but not to a less-than-significant level. Therefore, this impact is considered significant and
 37 unavoidable.

38 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

39 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

1 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 2 **Storage and Handling Plan**

3 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

4 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 5 **from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed**
 6 **Water Conveyance Facilities**

7 Alternative 8 would include the same physical/structural components as Alternative 1A, except that it
 8 would entail two fewer intakes and two fewer pumping plants. These differences would result in
 9 slightly less effects related to subsidence than Alternative 1A. The effects of Alternative 8 would,
 10 however, be similar to those under Alternative 1A. See the discussion of Impact SOILS-3 under
 11 Alternative 1A.

12 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on soils
 13 that are subject to subsidence. However, as described in section 10.3.1, *Methods for Analysis*, and
 14 Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all facilities to
 15 identify the types of soil avoidance or soil stabilization measures that should be implemented to ensure
 16 that the facilities are constructed to withstand subsidence and settlement and to conform to applicable
 17 state and federal standards. These investigations would build upon the geotechnical data reports
 18 (California Department of Water Resources 2001a, 2010b, 2011) and the CERs (California Department
 19 of Water Resources 2010a, 2010b). As discussed under Alternative 1A, conforming with state and
 20 federal design standards, including conduct of site-specific geotechnical evaluations, would ensure that
 21 appropriate design measures are incorporated into the project and any subsidence that takes place
 22 under the project facilities would not jeopardize their integrity.

23 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
 24 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of
 25 the facility. However, because DWR would be required to design and construct the facilities according
 26 to state and federal design standards and guidelines (e.g., California Building Code, American Society of
 27 Civil Engineers Minimum Design Loads for Buildings and Other Structures, ASCE-7-05, 2005).
 28 Conforming with these codes would reduce the potential hazard of subsidence or settlement to
 29 acceptable levels by avoiding construction directly on or otherwise stabilizing the soil material that is
 30 prone to subsidence. Because these measures would reduce the potential hazard of subsidence or
 31 settlement to meet design standards, the impact would be less than significant. No mitigation is
 32 required.

33 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water**
 34 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

35 Alternative 8 would include the same physical/structural components as Alternative 1A, except that it
 36 would entail two fewer intakes and two fewer pumping plants. These differences would result in
 37 slightly less effects related to expansive, corrosive, and compressible soils than Alternative 1A. The
 38 impacts of Alternative 8 would, however, be similar to those under Alternative 1A. See the discussion of
 39 Impact SOILS-4 under Alternative 1A.

40 **NEPA Effects:** The integrity of the water conveyance facilities, including tunnels, pipelines, intake
 41 facilities, pumping plants, access roads and utilities, and other features could be adversely affected
 42 because they would be located on expansive, corrosive, and compressible soils. However, all facility

1 design and construction would be executed in conformance with the CBC, which specifies measures to
 2 mitigate effects of expansive soils, corrosive soils, and soils subject to compression and subsidence. By
 3 conforming with the CBC and other applicable design standards, potential effects associated with
 4 expansive and corrosive soils and soils subject to compression and subsidence would be offset. There
 5 would be no adverse effect.

6 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to
 7 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils
 8 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils could
 9 damage in-ground facilities or shorten their service life. Compression/settlement of soils after a facility
 10 is constructed could result in damage to or failure of the facility. However, because DWR would be
 11 required to design and construct the facilities according to state and federal design standards,
 12 guidelines, and building codes (e.g., CBC and USACE design standards). Conforming with these codes
 13 and standards is an environmental commitment by DWR to ensure that potential adverse effects
 14 associated with expansive and corrosive soils and soils subject to compression and subsidence would
 15 be offset. Therefore, this impact would be less than significant. No mitigation is required.

16 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 17 **Operations**

18 Alternative 8 would have operations similar to those under Alternative 1A, but of a lesser magnitude
 19 with respect to potential effects on accelerated bank erosion because the flow from the north Delta
 20 would be 9,000 cfs rather than 15,000 cfs. The effects of Alternative 8 would, however, be similar to
 21 those under Alternative 1A. See the discussion of Impact SOILS-5 under Alternative 1A.

22 **NEPA Effects:** The effect of increased channel flow rates on channel bank scour would not be adverse
 23 because, as part of the conservation measures, major channels would be dredged to create a larger
 24 cross-section that would offset increased tidal velocities. The effect would not be adverse because there
 25 would be no net increase in river flow rates and therefore no net increase in channel bank scour.

26 **CEQA Conclusion:** Changes in operational flow regimes could cause increases in flow rates in channels
 27 and sloughs, potentially leading to increases in channel bank scour. However, where such changes are
 28 expected to occur (i.e., at the mouths of tidal marsh channels), the project would also entail expansion
 29 of the channel cross-section to increase the tidal prism at these locations. The net effect would be to
 30 reduce the channel flow rates by 10–20% compared to Existing Conditions. Consequently, no
 31 appreciable increase in scour is anticipated. The impact would be less than significant. No mitigation is
 32 required.

33 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other** 34 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,** 35 **CM18 and CM19**

36 Implementation of conservation measures under Alternative 8 would be similar to those under
 37 Alternative 1A. Implementation of the conservation measures would involve ground disturbance and
 38 construction activities that could lead to accelerated soil erosion rates and consequent loss of topsoil.
 39 See the discussion of Impact SOILS-6 under Alternative 1A.

40 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as
 41 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the
 42 BDCP proponents would be required to obtain coverage under the General Permit for Construction and

1 Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan.
 2 Proper implementation of the requisite SWPPP, site-specific BMPs, and compliance with the General
 3 Permit would ensure that accelerated water and wind erosion as a result of implementing conservation
 4 measures would not be an adverse effect.

5 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 6 restoration areas could cause accelerated water and wind erosion of soil. However, because the BDCP
 7 proponents would seek coverage under the state General Permit for Construction and Land
 8 Disturbance Activities, which will require implementation of erosion and sediment control BMPs (such
 9 as revegetation, runoff control, and sediment barriers) and compliance with water quality standards,
 10 the impact would be less than significant. No mitigation is required.

11 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
 12 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2–**
 13 **CM11**

14 Conservation measures under Alternative 8 would be similar to those under Alternative 1A. Topsoil
 15 effectively would be lost as a resource as a result of its excavation, overcovering, and water inundation
 16 over extensive areas of the Plan Area. See the discussion of Impact SOILS-7 under Alternative 1A.

17 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.
 18 Mitigation Measures SOILS-2a and SOILS-2b would be available to reduce the severity of this effect.

19 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,
 20 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby
 21 resulting in a substantial loss of topsoil. The impact would be significant. Mitigation Measures SOILS-2a
 22 and SOILS-2b would minimize and compensate for these impacts to a degree, but not to a less-than-
 23 significant level. Therefore, this impact is considered significant and unavoidable.

24 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

25 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

26 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
 27 **Storage and Handling Plan**

28 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

29 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
 30 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed**
 31 **Conservation Measures CM2–CM11**

32 Conservation measures under Alternative 8 would be similar to those under Alternative 1A. Damage to
 33 or failure of the habitat levees could occur where these are constructed in soils and sediments that are
 34 subject to subsidence and differential settlement. These soil conditions have the potential to exist in the
 35 Suisun Marsh ROA. Levee damage or failure could cause surface flooding in the vicinity. See the
 36 discussion of Impact SOILS-8 under Alternative 1A.

37 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
 38 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
 39 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all

1 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
 2 berms, and other features are constructed to withstand subsidence and settlement and to conform to
 3 applicable state and federal standards.

4 With construction of all levees, berms, and other conservation features designed and constructed to
 5 withstand subsidence and settlement and through conformance with applicable state and federal
 6 design standards, this effect would not be adverse.

7 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
 8 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
 9 of the facility. However, because the BDCP proponents would be required to design and construct the
 10 facilities according to state and federal design standards and guidelines (which may involve, for
 11 example, replacement of the organic soil), the impact would be less than significant. No mitigation is
 12 required.

13 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,
 14 and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2-
 15 CM11**

16 Implementation of the proposed conservation measures under Alternative 8 would be the same as
 17 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,
 18 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the
 19 discussion of Impact SOILS-9 under Alternative 1A.

20 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control
 21 structures or cause them to fail, resulting in a release of water from the structure and consequent
 22 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs
 23 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West
 24 Delta ROA possess soils with high corrosivity to concrete.

25 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne,
 26 and South Delta ROAs.

27 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and compressible
 28 soils. However, ROA-specific environmental effect evaluations and geotechnical studies and testing
 29 would be completed prior to construction within the ROAs. The site-specific environmental evaluation
 30 would identify specific areas where engineering soil properties, including soil compressibility, may
 31 require special consideration during construction of specific features within ROAs. Conformity with
 32 USACE, CBC, and other design standards for construction on expansive, corrosive and/or compressible
 33 soils would prevent adverse effects of such soils.

34 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that are
 35 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
 36 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
 37 could damage in-ground facilities or shorten their service life. Compression or settlement of soils after
 38 a facility is constructed could result in damage to or failure of the facility. However, because the BDCP
 39 proponents would be required to design and construct the facilities according to state and federal
 40 design standards, guidelines, and building codes (which may involve, for example, soil lime
 41 stabilization, cathodic protection of steel, and soil replacement), this impact would be considered less
 42 than significant. No mitigation is required.

1 **10.3.3.16 Alternative 9—Through Delta/Separate Corridors (15,000 cfs;**
 2 **Operational Scenario G)**

3 **Impact SOILS-1: Accelerated Erosion Caused by Vegetation Removal and Other Soil Disturbances**
 4 **as a Result of Constructing the Proposed Water Conveyance Facilities**

5 Construction of water conveyance facilities under Alternative 9 would involve an array of intakes,
 6 pumping plants, pipelines, culvert siphons, canals, borrow areas, enlargement of a channel, and other
 7 facilities. Some of the facilities would primarily involve in-water work and would have no bearing on
 8 soils. The locations of some of the Alternative 9 facilities would be different than those of the other
 9 alternatives. At the primary two such locations, operable barriers would be constructed; these would
 10 involve grading for the work/staging areas, which would result in accelerated erosion. However, the
 11 soil disturbance work would be subject to the same regulatory compliance requirements to control
 12 erosion as under Alternative 1A. The impacts of Alternative 9 would, therefore, be similar to but of
 13 much lesser extent than under Alternative 1A. See the discussion of Impact SOILS-1 under Alternative
 14 1A.

15 **NEPA Effects:** Construction of the proposed water conveyance facility could occur under Alternative 9
 16 could cause substantial accelerated erosion. However, as described in section 10.3.1, *Methods for*
 17 *Analysis*, and Appendix 3B, *Environmental Commitments*, DWR would be required to obtain coverage
 18 under the General Permit for Construction and Land Disturbance Activities, necessitating the
 19 preparation of a SWPPP and an erosion control plan. Proper implementation of the requisite SWPPP
 20 and compliance with the General Permit would ensure that there would not be substantial soil erosion
 21 resulting in daily site runoff turbidity in excess of 250 NTUs as a result of construction of the proposed
 22 water conveyance facility, and therefore, there would not be an adverse effect.

23 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
 24 water conveyance facilities could cause accelerated water and wind erosion of soil. However, DWR
 25 would seek coverage under the state General Permit for Construction and Land Disturbance Activities
 26 (as discussed in Appendix 3B, *Environmental Commitments*, Commitment 3B.2), necessitating the
 27 preparation of a SWPPP and an erosion control plan. Because of implementation of the requisite
 28 SWPPP and compliance with the General Permit, there would not be substantial soil erosion resulting
 29 in daily site runoff turbidity in excess of 250 NTUs and the effect would be less than significant. No
 30 mitigation is required.

31 **Impact SOILS-2: Loss of Topsoil from Excavation, Overcovering, and Inundation as a Result of**
 32 **Constructing the Proposed Water Conveyance Facilities**

33 Construction of water conveyance facilities under Alternative 9 would involve an array of intakes,
 34 pumping plants, pipelines, culvert siphons, canals, borrow areas, enlargement of a channel, and other
 35 facilities. (Some of the facilities would primarily involve in-water work and would have no bearing on
 36 soils.) The locations of some of the Alternative 9 facilities would be different from those of the other
 37 alternatives. At the primary two such locations, operable barriers would be constructed; these would
 38 involve construction operations similar to those under Alternative 1A. The effects of Alternative 9
 39 would, therefore, be similar but of much lesser extent than under Alternative 1A. See the discussion of
 40 Impact SOILS-2 under Alternative 1A.

41 **NEPA Effects:** Topsoil effectively would be lost as a resource as a result of its excavation (e.g., borrow
 42 areas, intake facilities, pumping plants); overcovering (e.g., spoil storage, pumping plants); and water

1 inundation. DWR has made an Environmental Commitment for Disposal Site Preparation which would
 2 require that a portion of the temporary sites selected for storage of spoils, RTM, and dredged material
 3 will be set aside for topsoil storage and the topsoil would be saved for reapplication to disturbed areas,
 4 thereby lessening the effect. However, this effect would be adverse because it would result in a
 5 substantial loss of topsoil. Mitigation Measures SOILS-2a and SOILS-2b would be available to reduce the
 6 severity of this effect.

7 **CEQA Conclusion:** Construction of the water conveyance facilities would involve excavation,
 8 overcovering, and inundation of topsoil over extensive areas, thereby resulting in a substantial loss of
 9 topsoil despite a commitment for Disposal Site Preparation. The impact on soils in the Plan Area would
 10 be significant. Mitigation Measures SOILS-2a and SOILS-2b would minimize and compensate for these
 11 impacts, but not to a less-than-significant level. Therefore, this impact is considered significant and
 12 unavoidable.

13 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

14 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

15 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil** 16 **Storage and Handling Plan**

17 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

18 **Impact SOILS-3: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage** 19 **from Construction on or in Soils Subject to Subsidence as a Result of Constructing the Proposed** 20 **Water Conveyance Facilities**

21 Construction of water conveyance facilities under Alternative 9 would involve an array of intakes,
 22 pumping plants, pipelines, culvert siphons, canals, borrow areas, enlargement of a channel, and other
 23 facilities. (Some of the facilities would primarily involve in-water work and would have no bearing on
 24 soils.) The locations of some of the Alternative 9 facilities would be different from those of any of the
 25 other alternatives. At the primary two such locations, operable barriers would be constructed; this area
 26 would be subject to the same engineering design standards as under Alternative 1A. The impacts of
 27 Alternative 9 would, therefore, be similar but of much lesser extent than those under Alternative 1A.
 28 See the discussion of Impact SOILS-3 under Alternative 1A.

29 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on soils
 30 that are subject to subsidence. However, as described in section 10.3.1, *Methods for Analysis*, and
 31 Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all facilities to
 32 identify the types of soil avoidance or soil stabilization measures that should be implemented to ensure
 33 that the facilities are constructed to withstand subsidence and settlement and to conform to applicable
 34 state and federal standards. These investigations would build upon the geotechnical data reports
 35 (California Department of Water Resources 2001a, 2010b, 2011) and the CERs (California Department
 36 of Water Resources 2010e). As discussed under Alternative 1A, conforming with state and federal
 37 design standards, including conduct of site-specific geotechnical evaluations, would ensure that
 38 appropriate design measures are incorporated into the project and any subsidence that takes place
 39 under the project facilities would not jeopardize their integrity.

40 **CEQA Conclusion:** Some of the conveyance facilities would be constructed on soils that are subject to
 41 subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure of

1 the facility. However, DWR would be required to design and construct the facilities according to state
2 and federal design standards and guidelines (e.g., California Building Code, American Society of Civil
3 Engineers Minimum Design Loads for Buildings and Other Structures, ASCE-7-05, 2005). Conforming
4 with these codes would reduce the potential hazard of subsidence or settlement to acceptable levels by
5 avoiding construction directly on or otherwise stabilizing the soil material that is prone to subsidence.
6 Because these measures would reduce the potential hazard of subsidence or settlement to meet design
7 standards, the impact would be less than significant. No mitigation is required.

8 **Impact SOILS-4: Risk to Life and Property as a Result of Constructing the Proposed Water** 9 **Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils**

10 Construction of water conveyance facilities under Alternative 9 would involve an array of intakes,
11 pumping plants, pipelines, culvert siphons, canals, borrow areas, enlargement of a channel, and other
12 facilities. (Some of the facilities would primarily involve in-water work and would have no bearing on
13 soils.) The locations of some of the Alternative 9 facilities would be different than under the other
14 alternatives. At the primary two such locations, operable barriers would be constructed; this area
15 would be subject to the same engineering design standards for expansive, corrosive, and compressible
16 soils as under Alternative 1A. The impacts of Alternative 9 would, therefore, be similar to but of much
17 lesser extent than under Alternative 1A. See the discussion of Impact SOILS-4 under Alternative 1A.

18 **NEPA Effects:** The integrity of the water conveyance facilities, including intake facilities, pumping
19 plants, access roads and utilities, and other features could be adversely affected because they would be
20 located on expansive, corrosive, and compressible soils. However, all facility design and construction
21 would be executed in conformance with the CBC, which specifies measures to mitigate effects of
22 expansive soils, corrosive soils, and soils subject to compression and subsidence. By conforming with
23 the CBC and other applicable design standards, potential effects associated with expansive and
24 corrosive soils and soils subject to compression and subsidence would be offset. There would be no
25 adverse effect.

26 **CEQA Conclusion:** Some of the project facilities would be constructed on soils that are subject to
27 expansion, corrosion to concrete and uncoated steel, and compression under load. Expansive soils
28 could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils could
29 damage in-ground facilities or shorten their service life. Compression/settlement of soils after a facility
30 is constructed could result in damage to or failure of the facility. However, DWR would be required to
31 design and construct the facilities in conformance with state and federal design standards, guidelines,
32 and building codes (e.g., CBC and USACE design standards). Conforming with these codes and standards
33 is an environmental commitment by DWR to ensure that potential adverse effects associated with
34 expansive and corrosive soils and soils subject to compression and subsidence would be offset.
35 Therefore, this impact would be less than significant. No mitigation is required.

36 **Impact SOILS-5: Accelerated Bank Erosion from Increased Channel Flow Rates as a Result of** 37 **Operations**

38 **NEPA Effects:** Operations under Alternative 9 would be different than those under the other
39 alternatives. All flows would be moved through existing, new, and expanded channels and canals by
40 operating the south Delta pumps. The cross-sectional area of those existing channels that could be
41 subject to increased scour (i.e., three reaches of Old River and Victoria Canal) would be expanded to
42 increase their flow capacity; the banks of other channels and canals may be armored with riprap to
43 protect them from scour. Therefore, changes in channel flow rates are expected to be within the range

1 that presently occurs. The effects under Alternative 9 would, therefore, be the similar to the No Action
2 Alternative.

3 **CEQA Conclusion:** Changes in flows through existing, new, and expanded channels and canals and other
4 changes in operational flow regimes could lead to increases in channel bank scour. However, where
5 such changes are expected to occur (e.g., three reaches of Old River and Victoria Canal), the project
6 would also entail expansion of the channel cross-section to increase the tidal prism at these locations.
7 The net effect would be to reduce the channel flow rates by 10–20% compared to Existing
8 Conditions. Consequently, no appreciable increase in scour is anticipated. The impact would be less
9 than significant. No mitigation is required.

10 **Impact SOILS-6: Accelerated Erosion Caused by Clearing, Grubbing, Grading, and Other**
11 **Disturbances Associated with Implementation of Proposed Conservation Measures CM2–CM11,**
12 **CM18 and CM19**

13 Implementation of conservation measures under Alternative 9 would be similar to those under
14 Alternative 1A. Implementation of the conservation measures would involve ground disturbance and
15 construction activities that could lead to accelerated soil erosion rates and consequent loss of topsoil.
16 See the discussion of Impact SOILS-6 under Alternative 1A.

17 **NEPA Effects:** These effects could potentially cause substantial accelerated erosion. However, as
18 described in section 10.3.1, *Methods for Analysis*, and Appendix 3B, *Environmental Commitments*, the
19 BDCP proponents would be required to obtain coverage under the General Permit for Construction and
20 Land Disturbance Activities, necessitating the preparation of a SWPPP and an erosion control plan.
21 Proper implementation of the requisite SWPPP, site-specific BMPs, and compliance with the General
22 Permit would ensure that accelerated water and wind erosion as a result of implementing conservation
23 measures would not be an adverse effect.

24 **CEQA Conclusion:** Vegetation removal and other soil disturbances associated with construction of
25 restoration areas could cause accelerated water and wind erosion of soil. However, because the BDCP
26 proponents would seek coverage under the state General Permit for Construction and Land
27 Disturbance Activities, which will require implementation of erosion and sediment control BMPs (such
28 as revegetation, runoff control, and sediment barriers) and compliance with water quality standards,
29 the impact would be less than significant. No mitigation is required.

30 **Impact SOILS-7: Loss of Topsoil from Excavation, Overcovering, and Inundation Associated with**
31 **Restoration Activities as a Result of Implementing the Proposed Conservation Measures CM2–**
32 **CM11**

33 Conservation measures under Alternative 9 would be similar to those under Alternative 1A. See
34 description and findings under Alternative 1A. Topsoil effectively would be lost as a resource as a result
35 of its excavation, overcovering, and water inundation over extensive areas of the Plan Area. See the
36 discussion of Impact SOILS-7 under Alternative 1A.

37 **NEPA Effects:** This effect would be adverse because it would result in a substantial loss of topsoil.
38 Mitigation Measures SOILS-2a and SOILS-2b would be available to reduce the severity of this effect.

39 **CEQA Conclusion:** Implementation of the conservation measures would involve excavation,
40 overcovering, and inundation (to create aquatic habitat areas) of topsoil over extensive areas, thereby
41 resulting in a substantial loss of topsoil. The impact would be significant. Mitigation Measures SOILS-2a

1 and SOILS-2b would minimize and compensate for these impacts to a degree, but not to a less-than-
2 significant level. Therefore, this impact is considered significant and unavoidable.

3 **Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance**

4 Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

5 **Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil**
6 **Storage and Handling Plan**

7 Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternative 1A.

8 **Impact SOILS-8: Property Loss, Personal Injury, or Death from Instability, Failure, and Damage**
9 **from Construction on Soils Subject to Subsidence as a Result of Implementing the Proposed**
10 **Conservation Measures CM2–CM11**

11 Conservation measures under Alternative 9 would be similar to those under Alternative 1A. Damage to
12 or failure of the habitat levees could occur where these are constructed in soils and sediments that are
13 subject to subsidence and differential settlement. These soil conditions have the potential to exist in the
14 Suisun Marsh ROA. Levee damage or failure could cause surface flooding in the vicinity. See the
15 discussion of Impact SOILS-8 under Alternative 1A.

16 **NEPA Effects:** This potential effect could be substantial because the facilities could be located on
17 unstable soils that are subject to subsidence. However, as described in section 10.3.1, *Methods for*
18 *Analysis*, and Appendix 3B, *Environmental Commitments*, geotechnical studies would be conducted at all
19 the ROAs to identify the types of soil stabilization that should be implemented to ensure that levees,
20 berms, and other features are constructed to withstand subsidence and settlement and to conform to
21 applicable state and federal standards.

22 With construction of all levees, berms, and other conservation features designed and constructed to
23 withstand subsidence and settlement and through conformance with applicable state and federal
24 design standards, this effect would not be adverse.

25 **CEQA Conclusion:** Some of the restoration area facilities would be constructed on soils that are subject
26 to subsidence. Subsidence occurring after the facility is constructed could result in damage to or failure
27 of the facility. However, because the BDCP proponents would be required to design and construct the
28 facilities according to state and federal design standards and guidelines (which may involve, for
29 example, replacement of the organic soil), the impact would be less than significant. No mitigation is
30 required.

31 **Impact SOILS-9: Risk to Life and Property from Construction in Areas of Expansive, Corrosive,**
32 **and Compressible Soils as a Result of Implementing the Proposed Conservation Measures CM2–**
33 **CM11**

34 Implementation of the proposed conservation measures under Alternative 9 would be the same as
35 under Alternative 1A. Accordingly, construction of conservation measures in areas of expansive,
36 corrosive, or compressible soils would have the same effects as under Alternative 1A. See the
37 discussion of Impact SOILS-9 under Alternative 1A.

38 Seasonal shrinking and swelling of moderately or highly expansive soils could damage water control
39 structures or cause them to fail, resulting in a release of water from the structure and consequent

1 flooding, which would cause unplanned inundation of aquatic habitat areas. Soils in all the ROAs
 2 possess high potential for corrosion of uncoated steel, and the Suisun ROA and portions of the West
 3 Delta ROA possess soils with high corrosivity to concrete.

4 Highly compressible soils are in the Suisun Marsh, Cache Slough, Yolo Bypass, Cosumnes/Mokelumne,
 5 and South Delta ROAs.

6 **NEPA Effects:** The conservation measures could be located on expansive, corrosive, and compressible
 7 soils. However, ROA-specific environmental effect evaluations and geotechnical studies and testing
 8 would be completed prior to construction within the ROAs. The site-specific environmental evaluation
 9 would identify specific areas where engineering soil properties, including soil compressibility, may
 10 require special consideration during construction of specific features within ROAs. Conformity with
 11 USACE, CBC, and other design standards for construction on expansive, corrosive and/or compressible
 12 soils would prevent adverse effects of such soils.

13 **CEQA Conclusion:** Some of the restoration component facilities would be constructed on soils that are
 14 subject to expansion, corrosive to concrete and uncoated steel, and compress under load. Expansive
 15 soils could cause foundations, underground utilities, and pavements to crack and fail. Corrosive soils
 16 could damage in-ground facilities or shorten their service life. Compression or settlement of soils after
 17 a facility is constructed could result in damage to or failure of the facility. However, because the BDCP
 18 proponents would be required to design and construct the facilities according to state and federal
 19 design standards, guidelines, and building codes (which may involve, for example, soil lime
 20 stabilization, cathodic protection of steel, and soil replacement), this impact would be considered less
 21 than significant. No mitigation is required.

22 10.3.4 Cumulative Analysis

23 The cumulative effects analysis for soils considers the effects of implementation of the alternatives in
 24 combination with the potential effects of other past, present, and reasonably foreseeable future
 25 projects and programs. Implementation of the alternatives and other local and regional projects as
 26 presented in Table 10-9, could contribute to regional impacts and hazards associated with soils.

27 **Table 10-9. Programs and Projects Considered in the Soils Cumulative Analysis**

Agency	Program/Project	Status	Description of Program/Project	Effects on Soils
California Department of Water Resources	Mayberry Farms Subsidence Reversal and Carbon Sequestration Project	Completed October 2010	Permanently flooded a 308-acre parcel of DWR owned land (Hunting Club leased) and restored 274 acres of palustrine emergent wetlands within Sherman Island to create permanent wetlands and to monitor waterfowl, water quality, and greenhouse gases.	Inundation of topsoil over approximately 274 acres.
DWR	Dutch Slough Tidal Marsh Restoration Project	Planning phase	Wetland and upland habitat restoration in area used for agriculture.	Inundation and overcovering (by dredge spoils) of topsoil over much of 1,166-acre site.

Agency	Program/Project	Status	Description of Program/Project	Effects on Soils
Freeport Regional Water Authority and Bureau of Reclamation	Freeport Regional Water Project	Completed late 2010	Project included an intake/pumping plant near Freeport on the Sacramento River and a conveyance structure to transport water through Sacramento County to the Folsom South Canal.	Loss of approximately 50–70 acres of topsoil from excavation and overcovering.
Reclamation District 2093	Liberty Island Conservation Bank	Completed 2011	This project included restoration of inaccessible, flood prone land to wildlife habitat.	Inundation of approximately 186 acres of topsoil.
City of Stockton	Delta Water Supply Project (Phase 1)	Currently under construction	This project consists of a new intake structure and pumping station adjacent to the San Joaquin River; a water treatment plant along Lower Sacramento Road; and water pipelines along Eight Mile, Davis, and Lower Sacramento Roads.	Loss of 106 acres of topsoil from excavation and overcovering.
DWR	Delta Levees Flood Protection Program	Ongoing	Levee rehabilitation projects in the Delta.	Unknown but probably small acreage of overcovering of topsoil.
USACE	Suisun Channel (Slough) Operations and Maintenance Project	Ongoing	Maintenance dredging of an entrance channel in Suisun Bay, with turning basin.	Unknown acreage of overcovering of topsoil from dredge material disposal.
DWR	Central Valley Flood Management Planning Program	Planning phase	Among other management actions, involves levee raising and construction of new levees for flood control purposes.	Unknown acreage of overcovering of topsoil from levee earthwork.
Bureau of Reclamation	Delta-Mendota Canal/California Aqueduct Intertie	Completed in 2012.	The purpose of the intertie is to better coordinate water delivery operations between the California Aqueduct (state) and the Delta-Mendota Canal (federal) and to provide better pumping capacity for the Jones Pumping Plant. New project facilities include a pipeline and pumping plant.	Loss of approximately 2 acres of topsoil from excavation and overcovering.
California Department of Water Resources	North Delta Flood Control and Ecosystem Restoration Project	Final EIR certified and Notice of Determination filed in 2010.	Project is intended to improve flood management and provide ecosystem benefits in the North Delta area through actions such as construction of setback levees and configuration of flood bypass areas to create quality habitat for species of concern. These actions are focused on McCormack-Williamson Tract and Staten Island. The purpose of the Project is to implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes.	Unknown but probably significant acreage of overcovering of topsoil from tidal inundation, excavation and overcovering.

1 The analysis focuses on projects and programs within the Plan Area that involve substantial grading,
2 excavation, overcovering, or inundation. The principal programs and projects considered in the
3 analysis are listed in Table 10-9. These programs and projects have been drawn from a more
4 substantial compilation of past, present, and reasonably foreseeable programs and projects included in
5 Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative*
6 *Impact Conditions*. This analysis considers projects that could affect soils and, where relevant, in the
7 same timeframe as the project, resulting in a cumulative impact.

8 When the effects of the BDCP on soils are considered in connection with the potential effects of projects
9 listed in Appendix 3D, the potential cumulative effects on soils could range from beneficial to
10 potentially adverse. The specific programs, projects and policies with the potential to combine with
11 effects of the alternatives to create a cumulatively considerable impact are identified below for each
12 impact category. The potential for cumulative impacts on soils is described for construction of the
13 conveyance facilities and CM2–CM22 within the Plan Area.

14 **No Action Alternative**

15 The No Action Alternative in a cumulative condition would result in accelerated water and wind
16 erosion as a result of implementation of numerous levee stabilization, dredge spoil disposal, and
17 habitat restoration projects. However, federal, state, and local regulations, codes, and permitting
18 programs would continue to require implementation of measures to prevent nonagricultural
19 accelerated erosion and sediment transport associated with construction. The loss of topsoil as a result
20 of excavation, overcovering, and inundation would continue in the Delta and statewide as a result of
21 numerous land development and habitat restoration projects. Such losses of topsoil are effectively
22 irreversible. In contrast, the loss of topsoil associated with habitat restoration projects typically results
23 from overcovering, such as placement of dredge spoils in subsided areas, and inundation, such as the
24 introduction of seasonal or perennial water into nonwetland environments to establish seasonal
25 wetlands or freshwater or tidal marshes. Land subsidence in the Delta and the Suisun Marsh would
26 continue. However, the rate of subsidence in the future may be slower than the current rate as the
27 organic soils become more consolidated over time. Several projects are now underway that would have
28 a beneficial effect on subsidence, some with the explicit goal of controlling or reversing subsidence.
29 These entail inundating areas underlain by peat soils to restore or create tidal marsh habitat. The
30 inundation would tend to reduce biological oxidation rates of the soil organic matter. Depending on the
31 vegetation type, soil organic matter would accumulate over time in the restored marsh habitats,
32 thereby raising the elevation of the area. Although these projects would tend to control or reverse
33 subsidence only on the islands at which they are implemented, they would benefit the Delta as a whole
34 by promoting the “blocking” effect of Delta islands on sea water intrusion in the Delta. The subsidence
35 control/reversal projects would therefore help to maintain water quality and water supply in the Delta
36 in the event of widespread levee failure. Ongoing and reasonably foreseeable future projects in the Plan
37 Area are likely to encounter expansive, corrosive, and compressible soils. However, federal and state
38 design guidelines and building codes would continue to require that the facilities constructed as part of
39 these projects incorporate design measures to avoid the adverse effects of such soils.

40 In total, the plans and programs would result in the loss of at least 3,618 acres of topsoil from
41 overcovering or inundation. The cumulative effect of these plans, policies, and programs along with the
42 No Action Alternative would be deemed to have direct and adverse effects on topsoil loss in the Delta.
43 Subsidence would be controlled or reversed on approximately 308 acres, resulting in a beneficial effect.

1 The Delta and vicinity are within a highly active seismic area, with a generally high potential for major
 2 future earthquake events along nearby and/or regional faults, and with the probability for such events
 3 increasing over time. Based on the location, extent and non-engineered nature of many existing levee
 4 structures in the Delta area, the potential for significant damage to, or failure of, these structures during
 5 a major local seismic event is generally moderate to high. In the instance of a large seismic event, levees
 6 constructed on liquefiable foundations are expected to experience large deformations (in excess of 10
 7 feet) under a moderate to large earthquake in the region. There would potentially be loss of topsoil
 8 from inundation. (See Appendix 3E, *Potential Seismic and Climate Change Risks to SWP/CVP Water*
 9 *Supplies* for more detailed discussion). While similar risks would occur under implementation of the
 10 action alternatives, these risks may be reduced by BDCP-related levee improvements along with those
 11 projects identified in Table 10-9.

12 **Impact SOILS-1: Cumulative Impact on Accelerated Erosion Caused by Vegetation Removal and**
 13 **Other Soil Disturbances as a Result of Constructing the Proposed Water Conveyance Facilities**

14 Construction activities associated with Alternatives 1A through 9 could result in accelerated erosion
 15 due to vegetation removal and other activities which cause soil disturbance. Accelerated water and
 16 wind erosion are expected to affect soils as a result of past, present, and reasonably foreseeable future
 17 projects.

18 **NEPA Effects:** Although the BDCP alternatives are not expected to result in adverse effects on soil
 19 erosion, when combined with projects listed above that may generate a cumulative effect on soil
 20 erosion. However, the projects listed above would be required to comply with state water quality
 21 regulations (i.e., the storm water General Permit for Construction and Land Disturbance Activities) to
 22 control accelerated erosion and movement of sediment to receiving waters. Though past, current, and
 23 future projects may result in accelerated soil erosion, the various regulatory frameworks that govern
 24 within the Plan Area are expected to mitigate any potential adverse effects on soil erosion. BDCP is also
 25 subject to the same regulations as the projects listed in Table 10-9 and would have no adverse effect on
 26 soil erosion. Consequently, there would not be a significant cumulative impact and the incremental
 27 contribution of the BDCP would not be cumulatively considerable.

28 **CEQA Conclusion:** The soil erosion that could occur in association with construction of all project
 29 alternatives would be mitigated through compliance with state water quality regulations. Other past,
 30 present and probable future projects and programs in the Plan Area that are identified in Appendix 3D
 31 might also result in accelerated erosion, but would also have to comply with state water quality
 32 regulations. Therefore, the impact of accelerated soil erosion associated with the project alternatives
 33 would not combine with the soil erosion risks from other projects or programs to create a substantial
 34 cumulative effect. This cumulative impact is considered less than significant. No mitigation is required.

35 **Impact SOILS-2: Cumulative Impact on Topsoil from Construction Activities Occurring Within**
 36 **the Plan Area**

37 For Alternatives 1A–9, the construction of conveyance facilities under CM1 could result in adverse
 38 effects on soils involving the substantial loss of topsoil. These effects result from the following actions.

- 39 ● Excavation, such as for construction of canal foundations, pumping plant subgrades, and water
 40 control structures.
- 41 ● Overcovering, such as from paving and from application of dredge spoils onto native topsoil.

- Inundation, such as from introducing seasonal or perennial water to a non-wetland area for the purpose of marsh restoration.

For Alternatives 1A–9, the construction of restored habitats associated with CM2–CM22 could also result in similar construction-related effects.

Other projects that may involve construction and habitat restoration activities with similar effects on the loss of topsoil are provided in Table 10-9.

NEPA Effects: Implementing the projects and programs listed in Table 10-9 in combination with any of Alternatives 1A–9 would result in a substantial loss of topsoil. It is assumed that environmental commitments and mitigation measures to reduce topsoil loss similar to those identified for the alternatives analyzed in this document would also be implemented for at least some of these projects. However, it is assumed that a net loss of topsoil would occur despite the use of mitigation measures by the BDCP or other projects. Consequently, these effects, in combination with the BDCP, could result in a cumulatively adverse effect on the loss of topsoil. Due to the magnitude of the project footprint of Alternatives 1A-9, the amount of topsoil lost from construction would be substantial in comparison to the other projects considered in this cumulative analysis. Therefore, the incremental contribution of any one of the BDCP alternatives would be cumulatively considerable.

CEQA Conclusion. Alternatives 1A–9, would result in adverse impacts on soils involving a significant loss of topsoil. Construction of the past, present, and reasonably foreseeable future projects listed in Table 10-9, taken in conjunction with BDCP Alternatives 1A-9 would result in a cumulative impact on topsoil loss. This cumulative impact is considered significant. Due to the magnitude of the project footprint for Alternatives 1A–9, the contribution from any of these BDCP alternatives would be cumulatively considerable. The following mitigation measures could reduce this effect, but not to a less than significant level. Therefore this cumulative impact is considered significant and unavoidable.

Mitigation Measure SOILS-2a: Minimize Extent of Excavation and Soil Disturbance

Please see Mitigation Measure SOILS-2a under Impact SOILS-2 in the discussion of Alternative 1A.

Mitigation Measure SOILS-2b: Salvage, Stockpile, and Replace Topsoil and Prepare a Topsoil Storage and Handling Plan

Please see Mitigation Measure SOILS-2b under Impact SOILS-2 in the discussion of Alternatives 1A–8.

Impact SOILS-4: Cumulative Impact on Risk to Life and Property as a Result of Constructing the Proposed Water Conveyance Facilities in Areas of Expansive, Corrosive, and Compressible Soils

It is expected that past, present, and reasonably foreseeable future projects would be required to comply with design requirements (i.e., CBC) to offset potential adverse effects of subsidence and compressible, expansive, and corrosive soils. Moreover, these soil hazards existing at other project sites would be local to those sites and would not act in combination with those of the BDCP project. While the incremental contribution of the BDCP could be cumulatively considerable due to the scale of the alternatives, conforming with CBC and other BMPs would reduce the effects of the BDCP to acceptable levels and they would not be adverse. Accordingly, there would not be a significant cumulative impact.

NEPA Effects: Construction activities associated with Alternatives 1A through 9 could result in an adverse effect on life and property as a result of construction of project facilities on expansive,

1 corrosive and/or compressible soils. However, the BDCP alternatives are not expected to result in
 2 adverse effects on life and property as a result of constructing project facilities on expansive, corrosive
 3 and/or compressible soils because the BDCP proponents would conform with design requirements (i.e.,
 4 CBC) to offset potential adverse effects of subsidence and compressible, expansive, and corrosive soils.

5 Given the extent of expansive, corrosive and/or compressible soils in the Project Area, past, present,
 6 and reasonably foreseeable future projects will likely have some project features located on these types
 7 of soils. However, these projects would not increase the risks to structures and people at the specific
 8 locations affected by BDCP alternatives. Additionally, the projects listed in Table 10-9 would also be
 9 required to conform with the same design requirements BDCP would be building under.

10 Therefore, the risks of loss, injury, or death associated with the alternatives would not combine with
 11 the risks from other projects or programs to create a cumulatively adverse effect at any one locality in
 12 the Plan Area. There would be no cumulative adverse effect.

13 **CEQA Conclusion:** The hazard from expansive, corrosive and/or compressible soils that would exist
 14 and the potential adverse effects that could occur in association with construction of all project
 15 alternatives would be restricted to the locations of the construction activities of these alternatives.
 16 Other past, present and probable future projects and programs in the Plan Area that are identified in
 17 Appendix 3D would not increase the risks of loss, injury or death at the specific locations affected by
 18 project alternatives. Therefore, the risks of loss, injury or death associated with the project alternatives
 19 would not combine with the soil risks from other projects or programs to create a substantial
 20 cumulative effect at any one locality in the Plan Area. This cumulative impact is considered less than
 21 significant. No mitigation is required.

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